Anticipatory versus Reactive Spatial Attentional Bias to Threat

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Abstract

Dot-Probe or Visual Probe Tasks (VPTs) are used extensively to measure attentional biases. A novel variant termed the cued VPT (cVPT) was developed to focus on the anticipatory component of attentional bias. The current study aimed to establish an anticipatory attentional bias to threat using the cVPT and compare its split-half reliability with a typical Dot-Probe task. 120 students performed the cVPT task and Dot-Probe tasks. Essentially, the cVPT uses cues that predict the location of pictorial threatening stimuli, but on trials on which probe stimuli are presented the pictures do not appear. Hence, actual presentation of emotional stimuli did not affect responses. The reliability of the cVPT was higher at most Cue-Stimulus Intervals, and was .56 overall. A clear anticipatory attentional bias was found. In conclusion, the cVPT may be of methodological and theoretical interest. Using visually neutral predictive cues may remove sources of noise that negatively impact reliability. Predictive cues are able to bias response selection, suggesting a role of predicted outcomes in automatic processes.

Keywords: Threat; attentional bias; anticipatory; cued visual probe; predictive cue

Survival and mental health depend on the ability to efficiently and appropriately respond to threatening stimuli. Spatial selective attention contributes to this ability via attentional biases to threat, broadly defined as the preferential processing of information perceived as threatening (Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & van IJzendoorn, 2007; Cisler & Koster, 2010; Mogg & Bradley, 2016). One of the most frequently used paradigms to assess biases in spatial attention is the Dot-Probe or Visual Probe Task (Cisler & Koster, 2010; MacLeod, Mathews, & Tata, 1986; Mogg & Bradley, 2016; Notebaert, Crombez, Van Damme, De Houwer, & Theeuwes, 2011). In this task, two stimuli are presented simultaneously, usually one hypothetically salient and one neutral, with specific stimulus categories depending on the research question. After a short interval, a probe stimulus appears at one of the two stimuli's location, and participants have to respond to the probe. To infer an attentional bias, reaction times are compared between trials in which the probe appears at the location of the negative versus neutral stimulus. Attentional biases involving threat are of interest both as a general feature of human cognition and as a potential contributor to disorders such as aggression, anxiety, and post-traumatic stress disorder and depression (Aupperle, Melrose, Stein, & Paulus, 2012; Gladwin, 2017a; Kimonis, Frick, Fazekas, & Loney, 2006; Mogg & Bradley, 2016; Yang, Ding, Dai, Peng, & Zhang, 2015).

However, measurement procedures involving spatial attentional biases evoked by emotional stimuli will involve a variety of processes, possibly contributing to a number of findings indicating low reliability (Brown et al., 2014; Dear, Sharpe, Nicholas, & Refshauge, 2011; Schmukle, 2005; Waechter, Nelson, Wright, Hyatt, & Oakman, 2014). The cues must be perceived, the emotional content must be detected, and this will evoke a subsequent mixture of responses. For example, participants may automatically shift attention towards the threat as expected, but as threatening stimuli are likely to also be aversive participants may tend to avoid them, or be distracted by the stimulus after focusing attention on it. Indeed, complex patterns of attentional shifting appear to occur in the emotional spatial attention tasks, involving time-dependent shifting, selective attention to the probe versus emotional cue after spatial attentional selection, and engagement versus disengagement with the emotional stimuli (Gladwin, Ter Mors-Schulte, Ridderinkhof, & Wiers, 2013; Koster, Crombez, Verschuere, Van Damme, & Wiersema, 2006; Mogg, Bradley, Miles, & Dixon, 2004; Mogg, Holmes, Garner, & Bradley, 2008; Noël et al., 2006; Townshend & Duka, 2007; Vollstädt-Klein, Loeber, von der Goltz, Mann, & Kiefer, 2009).

Moreover, there is a potentially important element of attention that is not included in this mixture of processes, namely the predictive aspect of threat-related biases. One function of spatial selective attention seems likely to be to focus attention on locations where a threatening stimulus may appear, but has not appeared yet. As an illustration, consider the experience of the person hiding in a closet in a horror film, focused on the door about to be opened by the killer. The psychological processes in that state are intuitively very different from those that occur when the killer actually opens the door, and indeed clear psychophysiological changes occur preceding threatening events (Bolstad et al., 2013; Gladwin, Hashemi, van Ast, & Roelofs, 2016; Kerr, McLaren, Mathy, & Nitschke, 2012; Sussman, Szekely, Hajcak, & Mohanty, 2016). This kind of anticipatory state is of theoretical interest from the perspective of models of motivated cognition emphasizing the understanding of cognitive processes as reinforcement-based response selection processes (Alexander, DeLong, & Strick, 1986; de Wit & Dickinson, 2009; Ernst et al., 2004;

Gladwin & Figner, 2014; Gladwin, Figner, Crone, & Wiers, 2011; Seger, 2008). If even automatic processes involve at least some degree of outcome prediction to select cognitive actions, even if simple and heuristics-based, then attentional biases should also be found before a predicted emotional stimulus, and not only after the actual presentation of one.

Thus, Visual Probe Tasks (VPTs) designed to focus on this anticipatory attentional state could be of both methodological and theoretical interest. The cued VPT (cVPT), as distinguished from the reactive kind of VPT described above (rVPT), was previously developed to this aim in the context of alcohol-related biases (Gladwin, 2016; Gladwin & Vink, 2017). The cVPT in a sense combines the Dot-Probe task and Posner cueing tasks (Posner, 1980). In the cVPT trials are divided into Picture trials and Probe trials. On Picture trials, a pair of initially neutral cues (i.e., simple symbols) are replaced, after a variable Cue-Stimulus Interval, by an emotional and a neutral stimulus (i.e., pictures or words). One cue is always replaced by the emotional stimulus, and the other cue is always replaced by the neutral stimulus. These trials establish the predictive value of the cues during a training period, and subsequently maintain the predictive value of cues. On Probe trials, the cues are followed by a probe stimulus instead of the emotional and neutral pictures, to which participants are required to react pressing a button on the keyboard following task instructions. Cue-related effects on performance on Probe trials are thus caused by the contingency between cues and predicted emotional stimuli (Le Pelley, Vadillo, & Luque, 2013; Luque et al., 2016; Notebaert et al., 2011; Van Damme, Crombez, Hermans, Koster, & Eccleston, 2006), with no emotional stimulus actually being presented at all on that trial. The cVPT has been used to provide novel information on relationships between anticipatory attentional biases for alcohol stimuli, automatic associations and conflict between them, craving, and motives to drink or refrain from drinking (Gladwin & Vink, 2017). It has, however, not been established whether such anticipatory attentional biases exist for threatening stimuli. Further, the visually neutral cues may improve psychometric properties, as effects are due to only two easily distinguishable cues, with presumably no or relatively weak inherent associations that would affect attention, relative to the salience of emotional cues. Thus, the aims of the current study were, first, to determine whether there exists an overall threat-related anticipatory attentional bias; and second, to provide information on the reliability of the cVPT in comparison with an rVPT.

Methods

Subjects

120 healthy adult participants (92 female, 28 male, mean age 20, *SD* = 2.1) successfully completed the online experiment and were included in the analyses. An additional participants 11 were not included, as they either did not finish the full experiment or produced extremely low-quality data, quantified as below chance level (0.5) overall accuracy. Participants provided informed consent and the study was approved by the institutional ethics committee.

Materials

The tasks were programmed in JavaScript, PHP, CSS and HTML; the code is available on request.

Cued Visual Probe Task (cVPT)

The structure of the cVPT was very similar to the alcohol-cVPT as described previously (Gladwin & Vink, 2017). There was a training phase (4 blocks of 24 trials each) and an assessment phase (24 blocks of 24 trials each, split into two halves to allow the ABBA procedure described below). The phases were identical except from the number of blocks. There were two trial types, randomly selected per trial: Picture and Probe trials. Picture trials started with a fixation cross presented for 100, 200, or 300 ms (all such varying durations in the task were selected randomly with equal probability). This was followed by the presentation of two cues, located on the top-left and bottom-right of the screen, or on the bottom-left and top-right of the screen. These diagonals on which the cues were located alternated per trial. The cues were colored blue and yellow, and consisted of the symbols O O O O O and | | | | |. The color-symbol mapping was randomized per participant. Cues were presented for 200, 400, 600, 800 or 1000 ms. The cues were then replaced by pictures representing angry and neutral faces. One of the cues was always replaced by an angry face centered on the cue location. The other cue was always replaced by a neutral face. The pictures remained onscreen for 1000 ms, followed by 200 ms of empty screen. Participants did not have to give any response on Picture trials. The stimulus set consisted of 44 faces selected from the Bochum Emotional Stimulus Set, BESST (Thoma, Soria Bauser, & Suchan, 2013). The mapping of cues to stimulus category was randomized over subjects.

On Probe trials, the fixation and cue parts of the trial were identical. Instead of pictures appearing at the cued locations, however, a probe stimulus, >><<, was presented at one of the locations, and a distractor stimulus, /\/\ or \/\/, at the other location. The probe stimulus was presented for 1000 ms, or until a response was given. The task was to quickly and accurately press a key corresponding to the probe location whenever it appeared. The keys were F I J R, pressed with the index and middle finger of the left and right hands, mapped to the corresponding position; e.g., the R-key was mapped to top-left, and was pressed with the middle finger of the left hand. On catch trials (5% probability), no probe was presented and subjects had to refrain from pressing. This was done in order to encourage searching for the probe stimulus rather than possibly attempting to infer the probe location based on viewing a distractor stimulus at the other location. Responses were followed by 200 ms feedback depending on accuracy: a green +1 for correct responses, a red -1 for incorrect responses, and a red “Too late!” if no response was given within the 1000 ms probe presentation duration.

The use of the two alternating diagonals to present stimuli was done to remove at least some sources of noise due to trial-to-trial carryover effects (Gladwin, 2017a), which were not of interest in the current study; for instance, effects due to giving the same or different response, or responding to the same of different location, on subsequent trials. The varying Cue-Stimulus Interval was included because of the possible time-dependence of attentional biases; for instance, the bias could shift or be stronger or weaker at different time periods following cue presentation.

Reactive Visual Probe Task (rVPT)

The rVPT consisted of a brief introductory phase (two blocks of 24 trials each) and an assessment phase (12 blocks of 24 trials each, split into two parts). The trials of the rVPT were identical to the half of the trials of the Probe trials of the cVPT, except for the use of pairs of an emotional and a neutral stimulus as cues, instead of the predictive cues. The stimuli were the same as those used as pictures in the cVPT.

Procedure

Participants performed the experiment online, starting with a page with instructions and an informed consent button. The questionnaires were then filled in. This was followed by the training phase of the cVPT and the introductory phase of the rVPT. Participants subsequently filled in a funneled awareness check to assess whether they were aware of any contingencies between cue and probe location and between cue and pictorial stimuli. Participants were asked the following question: Did they think there was a relationship between cues and probe location? If so, which color cue predicted the probe location? Did they think there was a relationship between cues and pictures? If so, which color cue predicted the angry face? If participants did not know the answer, they were instructed to guess. Then the assessment phases of the cVPT and rVPT were then performed, in an ABBA scheme of the four half-parts of the cVPT. The assignment of cVPT and rVPT to the "A" or "B" positions was randomized over participants. This was followed by a repeat of the awareness check. The whole procedure lasted 60 minutes.

Preprocessing and statistical analyses

The first four trials per block, inaccurate trials, and trials following inaccurate trials were removed as for example, as these trials are likely to involve abnormal processes.

An attentional bias score was calculated per participant as the difference between the median reaction time (RT) on probe stimuli appearing at the threat and at the neutral location (tests using the mean RT are provided in Supplementary Materials, showing highly similar results). One-sample *t*-tests and repeated measures ANOVA were used to test whether there was any bias and whether there was an effect of CSI on bias, respectively. Split-half reliability was tested using the Spearman-Brown formula; the halves consisted of even versus odd blocks.

Additionally, exploratory analyses intended for future use in planning studies were conducted to investigate correlations between biases and a number of questionnaires. Those results are reported in Supplementary Materials together with their descriptive statistics.

Results

cVPT

As hypothesized, there was an anticipatory attention bias towards threat, $t(119) = -3.88$, $p < .001$, $d = -0.35$. The magnitude of the bias was -11 ms, indicating a bias towards threat: RT was 566 ms when probes appeared at the neutral location, and 556 ms when probes appeared at threat location. Essentially, this bias occurred in the absence of the predicted stimuli actually being presented, and must have been due to effects evoked by the predictive cues. There were no effects of CSI.

The split-half reliabilities were .56 over all CSIs; -.16 for the 200 ms CSI; .48 for 400 ms; .37 for 600 ms; .37 for 800 ms; and .41 for 1000 ms.

rVPT

There was also an attention bias towards threat in the reactive VPT, $t(119) = -4.11$, p < .001, $d =$ -0.38. The magnitude of the bias was -9 ms, indicating an attentional bias towards threat as well; RT was 530 ms when probes appeared at the location of the neutral cue (the neutral face), and

521 ms when probes appeared at the location of the threat cue (the angry face). There were no effects of CSI.

The split-half reliabilities were .34 over all CSIs; .22 for the 200 ms CSI; .0047 for 400 ms; .031 for 600 ms; .19 for 800 ms; and .31 for 1000 ms.

Discussion

The current study aimed to determine whether an anticipatory attentional bias to threat could be detected by the cued VPT (cVPT), and to compare its split-half reliability with that of a reactive VPT (rVPT). A clear anticipatory attentional bias was found on both the cVPT and rVPT. Participants were quicker to respond to probes at the location where a threatening stimulus could have appeared. This bias therefore does not reflect processes evoked by the viewing of an actual threatening stimulus. It appears that attention is consistently shifted towards a location predicted to reveal a threat. This would appear to make sense from an evolutionary perspective: survival would be enhanced by the ability to use predictive information to focus attention on locations where an as yet unobserved threat could appear. This aspect of *predictive* attentional biases involving emotional stimuli appears to have been understudied thus far, relative to *reactive* attentional biases. However, relatively recent lines of research have focused on anticipatory psychophysiological states under threat (Gladwin et al., 2016; Lojowska, Gladwin, Hermans, & Roelofs, 2015; Löw, Weymar, & Hamm, 2015; Mobbs et al., 2007; Nieuwenhuys & Oudejans, 2010; Wendt, Löw, Weymar, Lotze, & Hamm, 2017). For instance, in a task with a purely anticipatory period in which participants viewed a static screen but awaited a potential virtual attack, heart rate and body sway decreased, reflecting preparatory freezing (Gladwin et al., 2016). It may be fruitful to apply such psychophysiological approaches to threat-related spatial anticipation.

The prediction of an anticipatory attentional biases to threat and the design of the cVPT were derived partly from the R^3 model of automatic versus reflective processing (Gladwin & Figner, 2014; Gladwin et al., 2011). In this model, cognitive functions, whether “top-down” or “bottom-up”, are selected as any other response, based on associations between stimuli, responses, and outcomes. The time allotted to refining the selection process differentiates relatively reflective from relatively automatic processes, as in the iterative reprocessing model of evaluation (Cunningham, Zelazo, Packer, & Van Bavel, 2007). From this perspective, predictive cues provide foreknowledge of the outcome of shifting attention to or from cued locations, and thereby affect the cognitive response selection process. However, the current data only establish the existence and cue-based measurability of the anticipatory attentional bias for threat, not the underlying mechanisms. An important direction for further study would appear to be clarifying whether anticipatory attentional biases can be attributed to sign-tracking or goal-tracking (Morrison, Bamkole, & Nicola, 2015), and perhaps whether there are interesting individual differences in this regard.

Split-half reliability was almost uniformly higher in the cVPT than the rVPT, with the exception of the shortest CSI (i.e., 200 ms). This finding was largely as expected, based on the rationale of the removal of noise related to the actual presentation of varying pairs of pictures as cues. One source of noise is that each picture and each picture-pair could have a different effect on bias. Further, as explained in the Introduction, the response to pictorial stimuli could be more noisy due to the complex mixture of processes that could be evoked by their presentation. For instance, a threatening stimulus could draw attention due to fundamental attentional functions (e.g., directing resources towards likely threat), but also be aversive and therefore cause attention to be shifted away from the stimulus. Unless the temporal dynamics of these processes happen to be such that they can be adequately disentangled by varying the Cue-Stimulus Interval, this would lead to uncontrolled noise might account for the poor reliability scores of the Dot-probe reported in previous psychometric studies (we note this does not imply that every instance of Dot-Probe reliability analyses will be poor). By using visually neutral predictive cues noise may have been reduced, resulting in a more reliable assessment. While the test-retest reliability of the cVPT was still not at the level considered acceptable for questionnaire scales, it was conspicuously higher, in particular at the 400 and 600 ms CSIs. This increase in process purity may of course lose interesting information. Recent work has even focused on using the variability itself of attentional bias as a measure of underlying processes (Gladwin, 2016; Iacoviello et al., 2014; Zvielli, Bernstein, & Koster, 2014), such as conflicting evaluative associations (Gladwin & Vink, 2017). Clearly separating such different processes and sources of information would appear to be of importance in future attentional bias studies. We briefly note that advances in behavioral measures for attentional biases are important, in addition to lines of research moving into eye tracking. First, from a theoretical point of view, not all attentional processes are overt and detectable as eye movements. Indeed, EEG studies of spatial attention for instance even depend on the eyes remining focused on a central fixation point as attention moves covertly. Second, from a pragmatic perspective, behavioral measures allow research to be conducted in a wider range of settings than possible using eye tracking equipment. The field needs to remain open to multiple methods with different advantages and disadvantages. The cVPT will hopefully help address the methodological disadvantage of noisy behavioral bias measures.

A potential application of the cVPT is as a novel version of attentional bias modification (ABM). The same rationale as used in ABM based on manipulated versions of the Dot-Probe (Mogg, Waters, & Bradley, 2017) could be applied to training individuals to shift attention to or away from the predicted location of salient stimuli. Speculatively, an advantage of using the cVPT could be that the training would not paradoxically increase the task-relevance of stimulus categories. This has been termed the salience side-effect (Gladwin, 2017b); note that in usual ABM methods, even if the aim is to train attention away from, for example, threatening stimuli, such stimuli are actually highly salient because they predict probe locations. In a training version of the cVPT participants would learn to shift attention based on abstract symbols as cues, not the undesirably salient stimuli themselves. Early results indicate the cVPT may indeed be useful as a training task, and much work indicates that cognitive functions can be assigned to arbitrary cues via reinforcement (McLoughlin & Stewart, 2017), but predictive cue-based ABM as yet remains a direction for future research.

A limitation of the study is that it remains to be determined whether the results generalize outside the student sample. This population may be relatively skilled at recognizing predictive relationships. Even this population was however often unaware of the cue-stimulus contingencies. This does not imply they were unaffected by the contingencies, indeed, exploratory analyses (see Supplementary Materials) did not show any relationships between awareness and bias. Further, the current results do not indicate whether there would be clinical applications of using anticipatory attentional bias, although this would appear to be a clearly interesting direction for further study. An inherent limitation of the cVPT relative to the rVPT is the need for a training period, although it appears that the relatively short training phase used in the current study was sufficient to find a clear bias. However, the training period may also be of interest in itself, for instance by allowing analysis of the time course of the development of the bias.

In conclusion, an anticipatory attentional bias to threat was found using the cued Visual Probe Task. The split-half reliability of this bias was generally higher than the bias evoked by presented emotionally cues, as used in more classical paradigms such as the Dot-Probe task. Further studies into the anticipatory attentional bias appears warranted, and the cVPT would appear to be a suitable method for such study.

DECLARATION OF INTEREST

The authors report no conflicts of interest.

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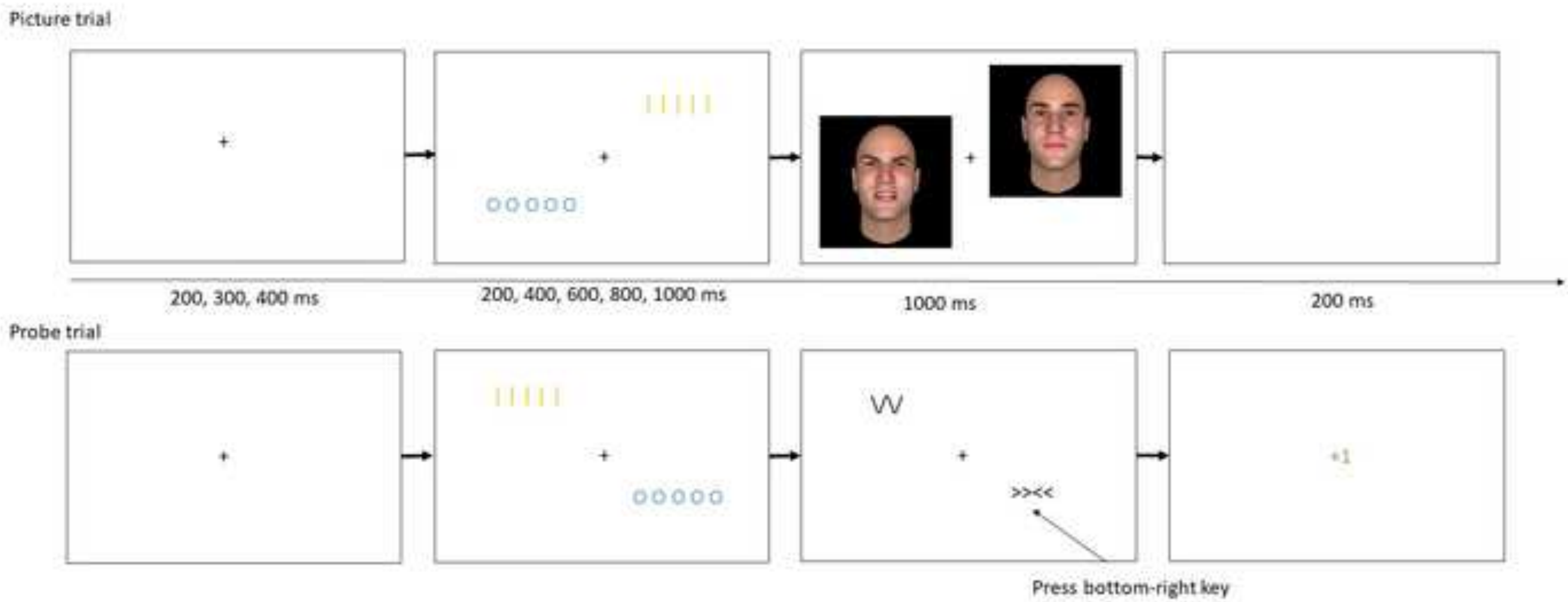
Picture trial
200, 300, 400 ms
200, 400, 600, 800, 1000 ms
1000 ms
200 ms
Probe trial
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Supplementary Materials

Test Results Using the Arithmetic Mean

We present here the test results using mean RT instead of the median RT, showing that the pattern of results is highly similar.

cVPT

On the cVPT, there was an anticipatory attention bias towards threat, $t(119) = -3.69$, $p < .001$, $d = -0.34$. The magnitude of the bias was -9 ms, indicating a bias towards threat: RT was 580 ms when probes appeared at the neutral location, and 571 ms when probes appeared at the threat location. There were no effects of CSI.

The split-half reliabilities were .61 over all CSIs; .088 for the 200 ms CSI; .40 for 400 ms; .51 for 600 ms; .42 for 800 ms; and .50 for 1000 ms.

rVPT

On the rVPT, there was a stimulus-evoked bias towards threat, $t(119) = -4.72$, p < .001, $d = -0.43$. The magnitude of the bias was -11 ms, indicating an attentional bias towards threat; RT was 542 ms when probes appeared at the location of the neutral cue (the neutral face), and 531 ms when probes appeared at the location of the threat cue (the angry face). There were no effects of CSI.

The split-half reliabilities were .34 over all CSIs; .19 for the 200 ms CSI; -.0042 for 400 ms; .011 for 600 ms; .38 for 800 ms; and .31 for 1000 ms.

Correlational Analyses

Correlations were calculated between attentional biases on the cVPT and rVPT, at each CSI, and a number of questionnaires. These analyses clearly involve a multiple testing problem and were purely intended to provide a published basis for future more focused or confirmatory studies, and are therefore provided as Supplementary Materials. We also include correlations between questionnaire scales for interested readers.

Questionnaires

Participants completed the following questionnaires related to mental health. The Buss-Perry Aggression Questionnaire, BP (Buss & Perry, 1992), was used to measure four subscales of aggression: Physical Aggression, Verbal Aggression, Hostility, and Anger. The Patient Health Questionnaire-4 for depression, PHQ4 (Kroenke, Spitzer, & Williams, 2001), was used to measure depression and anxiety. The Trauma Screening Questionnaire, TSQ (Brewin et al., 2002), was used to measure Post-Traumatic Stress Disorder (PTSD). The Early Trauma Inventory, ETI (Bremner, Bolus, & Mayer, 2007), was used to measure three subscales of childhood abuse: Physical abuse, Emotional abuse, Sexual abuse. Additionally the ETI provided binary measures of intense emotional distress and of disconnection (a sense of being out-of-body) during the early trauma, and a measure of experiences of traumatic events in adulthood. The Rosenbaum Self-Esteem Scale, RSES (Rosenberg, 1965), was used to measure self-esteem. Finally, the short English version of the UPPS-P, SUPPSP (Cyders, Littlefield, Coffey, & Karyadi, 2014), was used to measure five aspects of impulsive behavior: Negative urgency, Lack of Perseverance, Lack of Premeditation, Sensation Seeking, and Positive Urgency.

Correlations Listing

Due to the large number of tests, the usual all-by-all correlation table would be difficult to present. All pairs of correlations nominally significant at a criterion of .005 are listed below. Sex codes gender as 0 = female and 1 = male. The labels cVPT and rVPT refer to the cued and reactive Visual Probe Tasks, respectively; the labels are followed by a number giving the CSI in ms. In the subsequent table, correlations at .05 nominal significance are given for the attentional bias variables.

Sex x PhysicalAggr	r = 0.45, p = 2.9e-07
Sex x ETI_Phys	r = 0.52, p = 8.6e-10
PhysicalAggr x Sex	r = 0.45, p = 2.9e-07
PhysicalAggr x VerbalAggr	r = 0.44, p = 4.3e-07
PhysicalAggr x Anger	r = 0.63, p = 1e-14
PhysicalAggr x Hostility	r = 0.4, p = 5e-06
PhysicalAggr x SUPPSP_NegUrg	r = 0.34, p = 0.00014
PhysicalAggr x SUPPSP_LackPers	r = 0.27, p = 0.0028
PhysicalAggr x SUPPSP_SensSeek	r = 0.31, p = 0.00048
PhysicalAggr x SUPPSP_PosUrg	r = 0.39, p = 1.2e-05
PhysicalAggr x ETI_Phys	r = 0.48, p = 2.3e-08
PhysicalAggr x ETI_Emo	r = 0.34, p = 0.00015
VerbalAggr x PhysicalAggr	r = 0.44, p = 4.3e-07
VerbalAggr x Anger	r = 0.55, p = 6.1e-11
VerbalAggr x Hostility	r = 0.32, p = 0.00044

Anger x PhysicalAggr	r = 0.63, p = 1e-14
Anger x VerbalAggr	r = 0.55, p = 6.1e-11
Anger x Hostility	r = 0.35, p = 8.3e-05
Anger x SUPPSP_NegUrg	r = 0.34, p = 0.00016
Anger x SUPPSP_SensSeek	r = 0.28, p = 0.0023
Anger x SUPPSP_PosUrg	r = 0.33, p = 0.00026
Hostility x PhysicalAggr	r = 0.4, p = 5e-06
Hostility x VerbalAggr	r = 0.32, p = 0.00044
Hostility x Anger	r = 0.35, p = 8.3e-05
Hostility x AnxPHQ4	r = 0.42, p = 1.9e-06
Hostility x DepPHQ4	r = 0.36, p = 5.2e-05
Hostility x TSQ	r = 0.41, p = 2.7e-06
Hostility x SUPPSP_NegUrg	r = 0.41, p = 2.5e-06
Hostility x SUPPSP_PosUrg	r = 0.26, p = 0.0041
Hostility x ETI_Phys	r = 0.26, p = 0.0038
Hostility x ETI_Emo	r = 0.39, p = 1.4e-05
Hostility x ETI_AdultTrauma	r = 0.29, p = 0.0013
Hostility x RSES	r = -0.54, p = 1.5e-10
Hostility x rVPT600	r = -0.31, p = 0.00049
AnxPHQ4 x Hostility	r = 0.42, p = 1.9e-06
AnxPHQ4 x DepPHQ4	r = 0.48, p = 2.8e-08
AnxPHQ4 x TSQ	r = 0.45, p = 1.8e-07
AnxPHQ4 x SUPPSP_NegUrg	r = 0.41, p = 3e-06

AnxPHQ4 x ETI_Emo	r = 0.34, p = 0.00013
AnxPHQ4 x ETI_AdultTrauma	r = 0.28, p = 0.0023
AnxPHQ4 x RSES	r = -0.47, p = 6.9e-08
DepPHQ4 x Hostility	r = 0.36, p = 5.2e-05
DepPHQ4 x AnxPHQ4	r = 0.48, p = 2.8e-08
DepPHQ4 x TSQ	r = 0.38, p = 1.7e-05
DepPHQ4 x SUPPSP_PosUrg	r = 0.28, p = 0.0022
DepPHQ4 x RSES	r = -0.4, p = 6.8e-06
TSQ x Hostility	r = 0.41, p = 2.7e-06
TSQ x AnxPHQ4	r = 0.45, p = 1.8e-07
TSQ x DepPHQ4	r = 0.38, p = 1.7e-05
TSQ x SUPPSP_NegUrg	r = 0.35, p = 9.2e-05
TSQ x SUPPSP_PosUrg	r = 0.28, p = 0.0021
TSQ x ETI_Emo	r = 0.29, p = 0.0013
TSQ x ETI_Sex	r = 0.33, p = 0.00022
TSQ x ETI_intense	r = 0.29, p = 0.0015
TSQ x ETI_AdultTrauma	r = 0.42, p = 1.8e-06
TSQ x RSES	r = -0.38, p = 2.4e-05
TSQ x rVPT600	r = -0.3, p = 0.00076
SUPPSP_NegUrg x PhysicalAggr	r = 0.34, p = 0.00014
SUPPSP_NegUrg x Anger	r = 0.34, p = 0.00016
SUPPSP_NegUrg x Hostility	r = 0.41, p = 2.5e-06
SUPPSP_NegUrg x AnxPHQ4	r = 0.41, p = 3e-06

SUPPSP_NegUrg x TSQ	r = 0.35, p = 9.2e-05
SUPPSP_NegUrg x SUPPSP_LackPers	r = 0.32, p = 0.00031
SUPPSP_NegUrg x SUPPSP_LackPremed	r = 0.31, p = 0.00049
SUPPSP_NegUrg x SUPPSP_PosUrg	r = 0.58, p = 4.4e-12
SUPPSP_NegUrg x ETI_Phys	r = 0.31, p = 0.00066
SUPPSP_NegUrg x ETI_Emo	r = 0.47, p = 8.5e-08
SUPPSP_NegUrg x ETI_Sex	r = 0.33, p = 0.00019
SUPPSP_NegUrg x ETI_intense	r = 0.29, p = 0.0013
SUPPSP_NegUrg x ETI_AdultTrauma	r = 0.31, p = 0.00069
SUPPSP_NegUrg x RSES	r = -0.52, p = 9.3e-10
SUPPSP_LackPers x PhysicalAggr	r = 0.27, p = 0.0028
SUPPSP_LackPers x SUPPSP_NegUrg	r = 0.32, p = 0.00031
SUPPSP_LackPers x SUPPSP_LackPremed	r = 0.33, p = 0.00023
SUPPSP_LackPers x SUPPSP_PosUrg	r = 0.27, p = 0.0027
SUPPSP_LackPers x ETI_Phys	r = 0.27, p = 0.003
SUPPSP_LackPremed x SUPPSP_NegUrg	r = 0.31, p = 0.00049
SUPPSP_LackPremed x SUPPSP_LackPers	r = 0.33, p = 0.00023
SUPPSP_LackPremed x SUPPSP_PosUrg	r = 0.39, p = 1.2e-05
SUPPSP_LackPremed x ETI_Emo	r = 0.33, p = 0.00021
SUPPSP_SensSeek x PhysicalAggr	r = 0.31, p = 0.00048
SUPPSP_SensSeek x Anger	r = 0.28, p = 0.0023
SUPPSP_SensSeek x SUPPSP_PosUrg	r = 0.38, p = 2.4e-05
SUPPSP_SensSeek x ETI_Phys	r = 0.36, p = 6.3e-05

SUPPSP_PosUrg x PhysicalAggr	r = 0.39, p = 1.2e-05
SUPPSP_PosUrg x Anger	r = 0.33, p = 0.00026
SUPPSP_PosUrg x Hostility	r = 0.26, p = 0.0041
SUPPSP_PosUrg x DepPHQ4	r = 0.28, p = 0.0022
SUPPSP_PosUrg x TSQ	r = 0.28, p = 0.0021
SUPPSP_PosUrg x SUPPSP_NegUrg	r = 0.58, p = 4.4e-12
SUPPSP_PosUrg x SUPPSP_LackPers	r = 0.27, p = 0.0027
SUPPSP_PosUrg x SUPPSP_LackPremed	r = 0.39, p = 1.2e-05
SUPPSP_PosUrg x SUPPSP_SensSeek	r = 0.38, p = 2.4e-05
SUPPSP_PosUrg x ETI_Phys	r = 0.4, p = 5.6e-06
SUPPSP_PosUrg x ETI_Emo	r = 0.42, p = 1.7e-06
SUPPSP_PosUrg x ETI_intense	r = 0.26, p = 0.0035
SUPPSP_PosUrg x RSES	r = -0.28, p = 0.0017
ETI_Phys x Sex	r = 0.52, p = 8.6e-10
ETI_Phys x PhysicalAggr	r = 0.48, p = 2.3e-08
ETI_Phys x Hostility	r = 0.26, p = 0.0038
ETI_Phys x SUPPSP_NegUrg	r = 0.31, p = 0.00066
ETI_Phys x SUPPSP_LackPers	r = 0.27, p = 0.003
ETI_Phys x SUPPSP_SensSeek	r = 0.36, p = 6.3e-05
ETI_Phys x SUPPSP_PosUrg	r = 0.4, p = 5.6e-06
ETI_Phys x ETI_Emo	r = 0.39, p = 1.1e-05
ETI_Phys x ETI_disconnect	r = 0.29, p = 0.0011
ETI_Emo x PhysicalAggr	r = 0.34, p = 0.00015

ETI_Emo x Hostility	r = 0.39, p = 1.4e-05
ETI_Emo x AnxPHQ4	r = 0.34, p = 0.00013
ETI_Emo x TSQ	r = 0.29, p = 0.0013
ETI_Emo x SUPPSP_NegUrg	r = 0.47, p = 8.5e-08
ETI_Emo x SUPPSP_LackPremed	r = 0.33, p = 0.00021
ETI_Emo x SUPPSP_PosUrg	r = 0.42, p = 1.7e-06
ETI_Emo x ETI_Phys	r = 0.39, p = 1.1e-05
ETI_Emo x ETI_Sex	r = 0.26, p = 0.0037
ETI_Emo x ETI_intense	r = 0.29, p = 0.0015
ETI_Emo x ETI_disconnect	r = 0.32, p = 0.00044
ETI_Emo x ETI_AdultTrauma	r = 0.41, p = 3.5e-06
ETI_Emo x RSES	r = -0.43, p = 9.5e-07
ETI_Sex x TSQ	r = 0.33, p = 0.00022
ETI_Sex x SUPPSP_NegUrg	r = 0.33, p = 0.00019
ETI_Sex x ETI_Emo	r = 0.26, p = 0.0037
ETI_Sex x ETI_intense	r = 0.36, p = 5e-05
ETI_intense x TSQ	r = 0.29, p = 0.0015
ETI_intense x SUPPSP_NegUrg	r = 0.29, p = 0.0013
ETI_intense x SUPPSP_PosUrg	r = 0.26, p = 0.0035
ETI_intense x ETI_Emo	r = 0.29, p = 0.0015
ETI_intense x ETI_Sex	r = 0.36, p = 5e-05
ETI_intense x ETI_disconnect	r = 0.33, p = 0.00021
ETI_intense x ETI_AdultTrauma	r = 0.31, p = 0.00056

ETI_intense x RSES	r = -0.34, p = 0.00012
ETI_disconnect x ETI_Phys	r = 0.29, p = 0.0011
ETI_disconnect x ETI_Emo	r = 0.32, p = 0.00044
ETI_disconnect x ETI_intense	r = 0.33, p = 0.00021
ETI_disconnect x RSES	r = -0.26, p = 0.0047
ETI_AdultTrauma x Hostility	r = 0.29, p = 0.0013
ETI_AdultTrauma x AnxPHQ4	r = 0.28, p = 0.0023
ETI_AdultTrauma x TSQ	r = 0.42, p = 1.8e-06
ETI_AdultTrauma x SUPPSP_NegUrg	r = 0.31, p = 0.00069
ETI_AdultTrauma x ETI_Emo	r = 0.41, p = 3.5e-06
ETI_AdultTrauma x ETI_intense	r = 0.31, p = 0.00056
ETI_AdultTrauma x RSES	r = -0.43, p = 7.7e-07
RSES x Hostility	r = -0.54, p = 1.5e-10
RSES x AnxPHQ4	r = -0.47, p = 6.9e-08
RSES x DepPHQ4	r = -0.4, p = 6.8e-06
RSES x TSQ	r = -0.38, p = 2.4e-05
RSES x SUPPSP_NegUrg	r = -0.52, p = 9.3e-10
RSES x SUPPSP_PosUrg	r = -0.28, p = 0.0017
RSES x ETI_Emo	r = -0.43, p = 9.5e-07
RSES x ETI_intense	r = -0.34, p = 0.00012
RSES x ETI_disconnect	r = -0.26, p = 0.0047
RSES x ETI_AdultTrauma	r = -0.43, p = 7.7e-07
cVPT200 x cVPT1000	r = 0.26, p = 0.0038

cVPT400 x cVPT600	r = 0.28, p = 0.0019
cVPT600 x cVPT400	r = 0.28, p = 0.0019
cVPT600 x cVPT800	r = 0.33, p = 0.00019
cVPT800 x cVPT600	r = 0.33, p = 0.00019
cVPT1000 x cVPT200	r = 0.26, p = 0.0038
rVPT600 x Hostility	r = -0.31, p = 0.00049
rVPT600 x TSQ	r = -0.3, p = 0.00076
rVPT600 x rVPT1000	r = 0.32, p = 0.00038
rVPT1000 x rVPT600	r = 0.32, p = 0.00038

At a .05 nominal significance level, and thus clearly not truly significant given the multiple testing, the following effects were found for the attentional bias variables. While the cVPT showed some indication of a relationship between anticipatory bias towards threat and the scales for Hostility and Self-Esteem, at the 200 and 1000 ms CSIs respectively, the strongest effects were found for the rVPT at the 600 ms CSI, in particular for Hostility, Anxiety, and PTSD measures. Future study is needed to determine whether the cVPT, although insensitive to non-clinical variation in symptoms, could distinguish healthy from clinical populations, or is simply a symptom-independent common feature of attention.

cVPT200 x Hostility	r = -0.19, p = 0.035
cVPT1000 x RSES	r = -0.21, p = 0.019
rVPT400 x ETIGen	r = 0.24, p = 0.0079
rVPT400 x rVPT1000	r = 0.21, p = 0.018

rVPT600 x VerbalAggr	r = -0.19, p = 0.035
rVPT600 x Hostility	r = -0.31, p = 0.00049
rVPT600 x AnxPHQ4	r = -0.25, p = 0.0051
rVPT600 x TSQ	r = -0.3, p = 0.00076
rVPT600 x ETI_Sex	r = -0.18, p = 0.049

Means and standard deviations

Variable	Mean (SD)
BP: PhysicalAggr	22.3 (8.87)
BP: VerbalAggr	18.6 (5.62)
BP: Anger	18.9 (6.64)
BP: Hostility	21.8 (8.73)
PHQ4: Anxiety	1.99 (0.692)
PHQ4: Depression	1.57 (0.654)
TSQ	2.93 (2.46)
SUPPSP: NegUrg	1.24 (0.591)
SUPPSP: LackPers	2.96 (0.399)
SUPPSP: LackPremed	2.74 (0.369)
SUPPSP: SensSeek	1.58 (0.606)
SUPPSP: PosUrg	0.885 (0.622)
ETI: ETI_Phys	0.532 (0.322)
ETI: ETI_Emo	0.262 (0.313)
ETI: ETI_Sex	0.104 (0.183)
ETI: ETI_intense	0.475 (0.501)

ETI: ETI_disconnect	0.267 (0.444)
ETI: ETI_AdultTrauma	0.147 (0.141)
RSES	4.38 (5.63)
Awareness T1	0.5 (0.502)
Awareness T2	0.708 (0.456)
Biases: cVPT200	-8.63 (41.3)
Biases: cVPT400	-8.65 (54.1)
Biases: cVPT600	-14.3 (52.6)
Biases: cVPT800	-9 (57.1)
Biases: cVPT1000	-13.8 (54.5)
Biases: rVPT200	-9.13 (41.1)
Biases: rVPT400	-10.5 (38)
Biases: rVPT600	-8.19 (44.6)
Biases: rVPT800	-7.88 (47.6)
Biases: rVPT1000	-11.4 (46.2)