

Two Sides of the Same Coin? Comparing Behavioral and Neurocognitive Measures of the Anxiety-Related Attention Bias

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BACKGROUND

- Threat bias (TB)**, or exaggerated attention towards threat, is a core cognitive mechanism in anxiety (Bar-Haim, Lamy, Pergamin, et al., 2007).
- The dot probe task is a behavioral paradigm commonly used to assess TB. However, there has been controversy over its validity and reliability (Schmukle, 2005; Waechter, Nelson, Wright, et al., 2014).
- A potential alternative to measuring TB are **steady-state visually evoked potentials (ssVEPs)**. The ssVEP is an electrocortical response in the visual cortex to a rapidly flickering stimulus.
- ssVEPs mirror the frequency rate of the driving stimulus, which allows for detection of where an individual is allocating their visual attention.
- Frequency tagging is a technique that involves presenting multiple stimuli simultaneously flickering at different frequencies. By examining the ssVEPs generated in these specific frequencies, it is possible to identify the stimulus to which an individual is allocating their attention.
- Examining ssVEPs using frequency tagging in a modified version of the dot probe could be a more direct way, with fewer methodological limitations, to study attentional TB.

AIMS

- Aim #1:** Examine correlations between ssVEPs and TB scores derived from the dot probe task
- Aim #2:** Examine whether ssVEPs or attentional TB scores (or both) accounted for variance in self-reported anxiety

METHOD

Participants

- Participants were 50 adults aged 18-38 ($M_{age} = 26.59$, $SD = 6.29$) who were pre-screened for moderate anxiety (scores higher than 5) using the *Depression Anxiety Stress Scales* (Lovibond & Lovibond, 1995). There were 16 males (32.0%) and 34 females (75.7%).

Self-Report Measures

- The *State-Trait Anxiety Inventory* (Spielberger, 1983) was used to measure both trait and state anxiety.
- The *Hamilton Anxiety Scale* (Hamilton, 1959) assesses the severity of anxiety symptoms.
- The *Depression Anxiety Stress Scale* (Lovibond & Lovibond, 1995) screens for mood and stress symptoms.

Dot Probe

- Stimuli consisted of images of angry (threat) and neutral (non-threat) faces from the NimStim Set (Tottenham et al., 2009). Faces were either paired angry/neutral or neutral/neutral. Every pair of faces were presented for 500 ms.
- On each trial, one of the face cues was randomly replaced by an arrow (probe). Participants were asked to identify the direction of the arrow using a mouse and reaction times (RT) were collected.

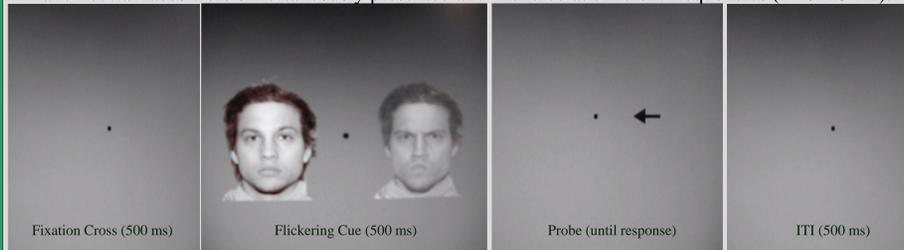


TB = Average RT of neutral cues – Average RT of threatening cues

- A positive score indicated a bias towards threat and a negative score indicated a bias away from threat. Participants were then divided into groups depending on whether they had a bias towards, away, or no bias.

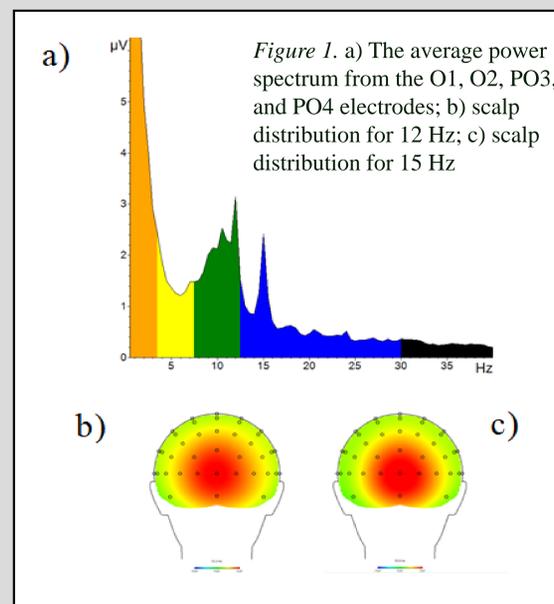
ssVEP Task

- ssVEPs were generated while participants completed a modified version of the dot probe where angry and neutral faces were simultaneously presented and flickered at different frequencies (12 or 15 Hz).



EEG Recording and Data Reduction

- EEG activity was recorded during the tasks via BioSemi 64 Ag/AgCl scalp electrodes, sampled at 512 Hz. Eye movements were monitored by electro-oculogram (EOG) signals. Trials with saccades and artifacts for data points exceeding a difference of 150 uV were rejected.
- ssVEPs were calculated as fast Fourier transformed frequencies at the PO3/O1 and PO4/O2 electrode sites from 750 to 2750 ms post stimulus onset, and averaged across position and frequency separately by emotion (threat or non threat).
- ssVEP ratio scores were created such that a positive score indicated greater threat discrimination while a negative score indicated poor threat discrimination.



RESULTS

Descriptive Statistics

Table 1. Descriptive Statistics of ssVEP and Attentional TB scores, and Questionnaires

	Minimum	Maximum	Mean	Std. Deviation
ssVEP Ratio Score	-1.61	7.82	.8592	1.55362
Attentional TB Score	-35.00	50.00	-.0400	17.68195
STAI Trait Score	25.00	77.00	50.7727	12.32102
DASS Anxiety	.00	20.00	6.7111	5.00737
DASS Depression	.00	21.00	7.0667	5.82861
DASS Stress	.00	20.00	9.2444	4.62776
HAM-A Score	1.00	66.00	19.1341	11.72765

ssVEP ratio scores and TB scores were independent

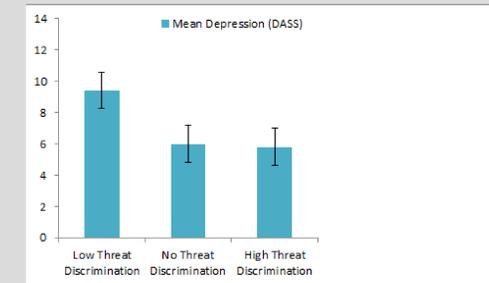
- There was no significant relation between the ssVEP ratio scores and the TB scores, $r(50) = -.09$, $p > .05$.
- A chi-square test for independence demonstrated no significant difference in ssVEP ratio scores based on TB scores, $\chi^2(4, n = 50) = 2.87$, $p > .05$.

Table 2. Crosstabulation of ssVEP Ratio Scores and Attentional TB Scores

ssVEP Ratio Score Groups	Attentional TB Score Groups			Total
	Bias Away from Threat	No Bias	Bias Towards Threat	
Low Threat Discrimination	4	7	6	17
No Threat Discrimination	8	4	4	16
High Threat Discrimination	5	6	6	17
Total	17	17	16	50

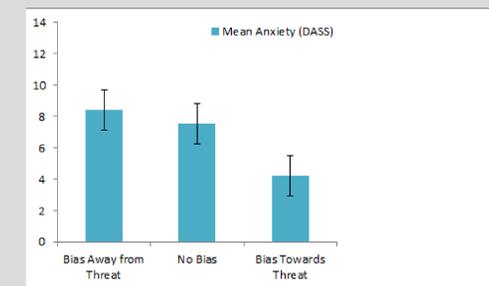
ssVEP ratio scores and self-report measures of mood and stress

- ssVEP ratio scores did not significantly predict anxiety or stress (p 's $> .05$).
- Higher ssVEP ratio scores predicted lower levels of depression, at the level of a trend (DASS), $B = -1.78$, $t(42) = -1.72$, $p = .093$.

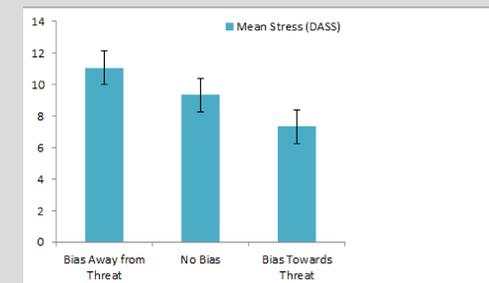


TB scores and self-report measures of mood and stress

- For TB scores, having a bias towards threat significantly predicted lower levels of anxiety (DASS), $B = -2.10$, $t(42) = -2.40$, $p = .021$.



- Having a bias towards threat also significantly predicted lower levels of stress (DASS), $B = -1.87$, $t(42) = -2.30$, $p = .026$.



DISCUSSION

- ssVEP ratio scores and TB scores were not significantly correlated suggesting that these two metrics may index independent components of TB.
- ssVEP ratio scores also were not able to account for variance in self-reported anxiety. However, having a positive ratio score, indicating greater threat discrimination, did marginally predict lower levels of depression.
- For TB scores, having a bias towards threat significantly predicted lower levels of anxiety and stress. This counter-intuitive finding highlights the need for more research on TB heterogeneity.
- Taken together, future research is needed to disentangle whether the ssVEP indexes threat-related processes in anxiety that are not captured by TB.

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