Amygdala and behavioral responses to ambiguous emotional stimuli in posttraumatic stress disorder

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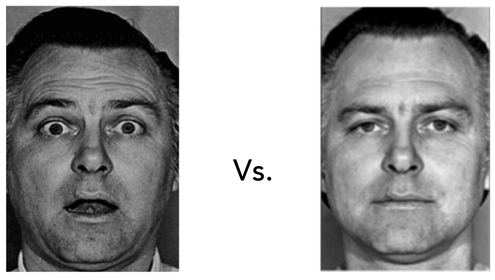
BACKGROUND

The amygdala is a brain structure involved in the detection of salience in environmental stimuli (1). Amygdala hyperactivity has been identified as a feature of the underlying neurocircuitry of PTSD (2). It is possible that amygdala hyperactivity could bias attention towards threat in individuals with PTSD and create negative interpretation bias (3). While some evidence has been found to support negative interpretation biases to ambiguous stimuli in PTSD (4), it is unclear whether this bias extends to *emotional* stimuli.

Surprised facial expressions are ambiguous given that they predict novelty, however, the emotional content of the novelty is unknown (5). It is possible that individuals with PTSD may interpret surprised faces as more negative or more frequently interpret surprised faces as fearful. Previous evidence in healthy participants has shown heightened amygdala activation to surprised faces when they were interpreted with negative valence (6), thus it is possible that individuals with PTSD may interpret surprised faces as even more negative and experience heightened amygdala activation when viewing surprised faces. We investigated this potential bias and its neural substrate.

METHOD

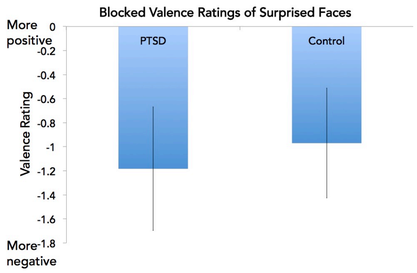
12 male combat veterans of the Vietnam War with PTSD and 16 combat veterans of the Vietnam War without PTSD were shown blocks of surprised and neutral faces. Brain activity was measured with functional magnetic resonance imaging (fMRI) BOLD signal using a Siemens 3T scanner with a 12-channel head coil. After scanning, participants rated the set of faces for valence (-4 to +4) and chose what emotion they thought the faces were displaying from a list of 7 possibilities (fear, anger, sadness, surprise, happy, neutral, and disgust). Analyses were conducted using SPM8 to create Surprise vs. Neutral, Surprise vs. Fixation, and Neutral vs. Fixation contrast images. We used the MarsBaR toolbox to extract ROI data in 4mm radius spheres around the peak voxel.

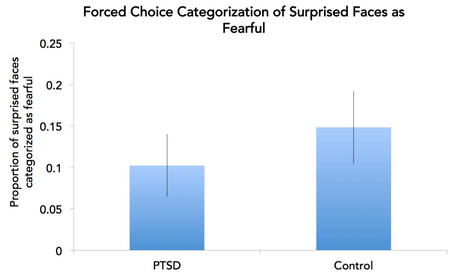


Vs.

VALENCE RATINGS & CATEGORIZATION RESULTS

There were no between group differences on valence ratings for surprised facial expressions or in the emotional categorization task.





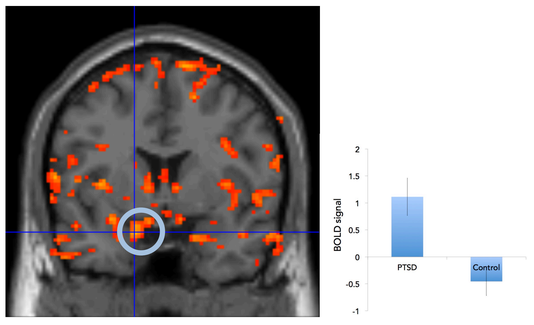
IMAGING RESULTS: PTSD > CONTROL

Surprise vs. Neutral Contrasts:

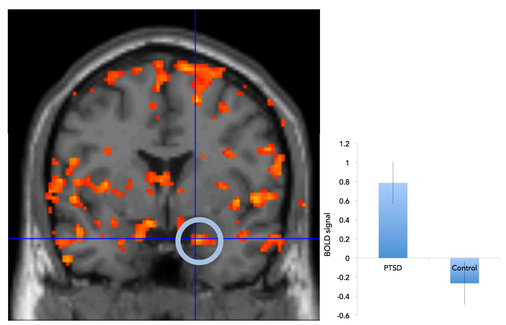
There were no significant activations in any *a priori* regions of interest in the PTSD > Control comparison in the Surprised vs. Neutral contrast.

Surprise vs. Fixation Contrasts:

There was significantly higher activation in those with PTSD compared to Controls in the right and left amygdala in the Surprised vs. Fixation contrast.



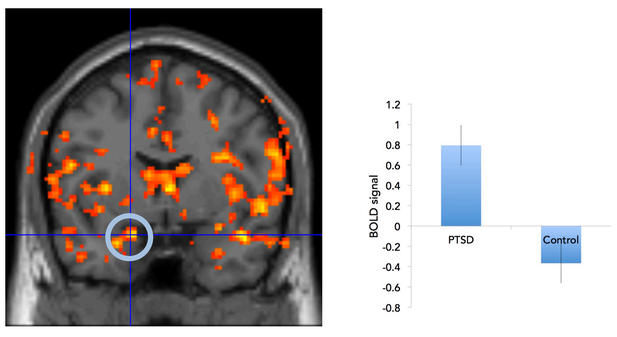
Left amygdala (-16, 4, -22) $z = 3.17$



Right amygdala (18, 2, -24) $z = 3.11$

Neutral vs. Fixation Contrasts:

There was also significantly higher activation in the left amygdala in the PTSD group compared to Controls in the left amygdala in the Neutral vs. Fixation contrast.



Left amygdala (-18, 4, -20) $z = 3.62$

DISCUSSION

Our results do not show evidence of behavioral differences in surprise valence interpretation or categorization in PTSD. However, greater BOLD responses in those with PTSD in fear-related brain regions were observed while viewing surprised faces. These responses were not significantly different from BOLD activity while viewing neutral facial expressions.

FUTURE RESEARCH

We are currently investigating correlations between valence rating scores and BOLD activity in certain a priori fear-related regions of interest.

Other future areas of research include investigating brain and behavioral responses to these same tasks in participants' identical twin brothers to discern familial risk factors, acquired traits of PTSD, or effects of trauma exposure.

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ACKNOWLEDGEMENTS

Mr. James Fowler, Mrs. Catherine Fowler, Antonelli, Dr. Anne Moore, and the Tufts Summer Scholars program.