PTSD and the social brain: affect-related disruption of the default and mirror networks

Kevin M. Tan, Lisa J. Burklund, Michelle G. Craske, Matthew D. Lieberman
University of California, Los Angeles – Department of Psychology

Introduction

- Post-traumatic stress disorder (PTSD) is strongly associated with impairments in social inference[1]
- The etiology of social inference impairments in PTSD is unknown due to a lack of neuroimaging studies[1]
- Social inference recruits the default mode network (DMN) and mirror neuron system (MNS)[2]
  - MNS represents observable sensorimotor features
  - DMN infers unobservable mental states, traits, and intentions
- We probed DMN & MNS regions in the first neuroimaging study of social inference in PTSD

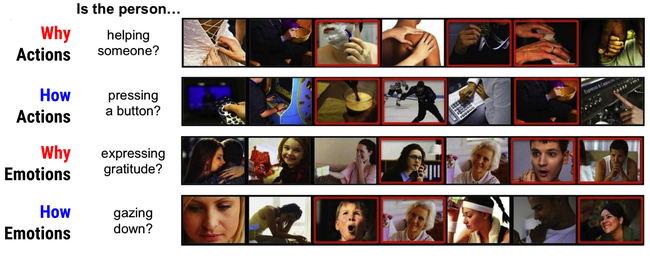
Materials & Methods

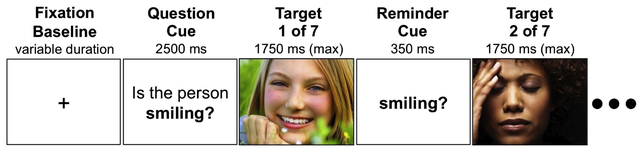
Participants – 35 combat trauma-exposed US veterans with & without PTSD (PTSD *N* = 18)

Procedure

- **Pre-treatment session:** baseline clinical interview (Clinician Administered PTSD Scale; CAPS) & fMRI (Siemens TimTrio 3T)
- **Affect labeling therapy:** PTSD group continued with 3 weeks of psychotherapy using inhibitory affect regulation strategies[3]
- **Post-treatment session:** PTSD patients who completed therapy (*N* = 13) underwent second clinical interview & fMRI

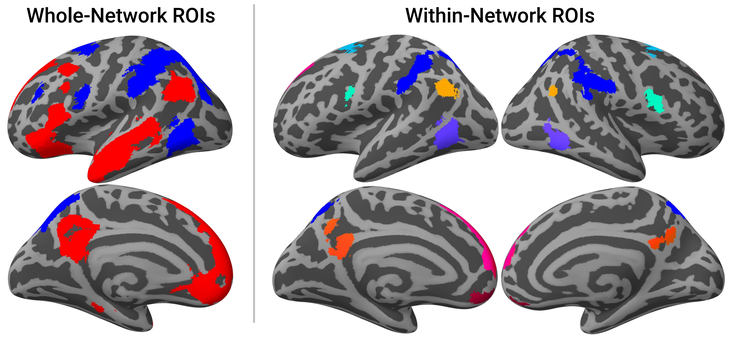
Why/How social inference task





- **Prompts** – Why (mentalizing) & How (action identification)
- **Stimuli** – Emotions (emotional expressions) & Actions (intentional actions)
- Why-How contrast dissociates DMN & MNS activity[2]
- Why-How contrast within stimulus type used for all fMRI analyses here

Regions of Interest (ROIs)

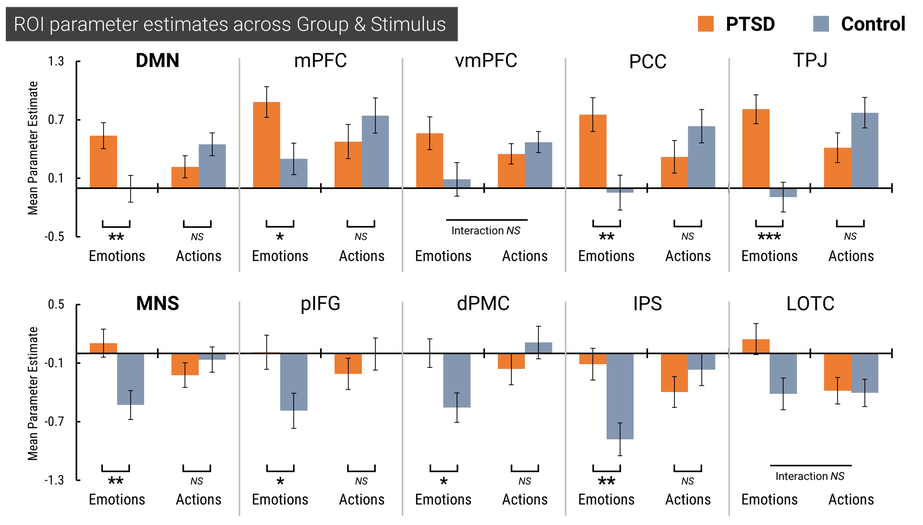


DMN (Why > How)
MNS (How < Why)

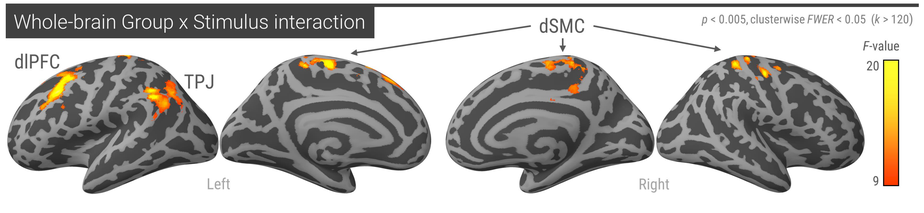
- ROIs defined by Why-How contrast in an independent dataset[2] (*N* = 50)
- Within-network ROIs thought to be key nodes of DMN & MNS[2,4]

PTSD vs controls (pre-treatment)

ROI parameter estimates across Group & Stimulus

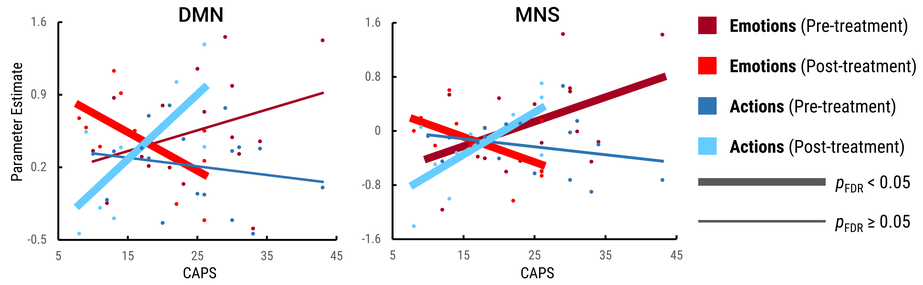


Whole-brain Group x Stimulus interaction



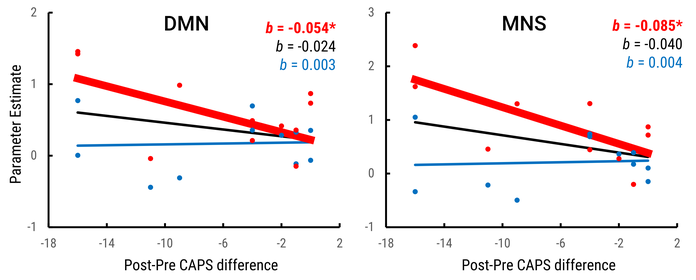
- Main effect of Group not significant, CAPS x Stimulus interaction was robust
- Emotions elicited hyperactivation in the PTSD group relative to controls
- Actions did not elicit significant Group differences

Symptom severity correlations (PTSD only)



Correlation between Emotions-evoked activation & PTSD severity was positive pre-treatment but negative post-treatment

Predicting treatment outcomes from pre-treatment activation (PTSD only)



Greater activation to Emotions predicted better treatment outcomes

Discussion

- Hyperactivation to emotional stimuli may be a defining characteristic of social inference processing in PTSD
- No PTSD-related effects significant in core affect regions like vmPFC, OFC, amygdala & insula
- PTSD-related effects strongest in whole-network DMN & MNS ROIs, and in regions that overlap with the attention networks
- Affective attentional biases, not altered core affect processing, may drive widespread affect-selective processing during social inference in PTSD
- Many studies show that attention is inordinately biased towards emotional stimuli in PTSD[4]
- Attentional biases in PTSD are associated with affect-evoked hyperactivation in DMN & attentional regions[4]
- Future studies should independently manipulate affect & attention, include functional localizers for the attention networks, and have larger sample sizes

References

1. Lavoie MA, Battaglia M & Achim AM. (2014). A meta-analysis and scoping review of social cognition performance in social phobia, posttraumatic stress disorder and other anxiety disorders. *Journal of anxiety disorders*, 28(2), 169-177.
2. Spunt RP & Adolphs R. (2014). Validating the why/how contrast for functional MRI studies of theory of mind. *Neuroimage*, 99, 301-311.
3. Lieberman MD, Eisenberger NI, Crockett MJ, Tom SM, Pfeifer JH & Way BM. (2007). Putting feelings into words. *Psychological science*, 18(5), 421-428.
4. Block SR & Liberzon I. (2016). Attentional processes in posttraumatic stress disorder and the associated changes in neural functioning. *Experimental neurology*, 284, 153-167.

Correspondence: kevmtan@ucla.edu

Funding: this research was supported by the Defense Advanced Research Projects Agency, an agency of the U.S. Department of Defense (PIs: Burklund, Craske & Lieberman; W911NF-14-C-0056) and the National Science Foundation Graduate Research Fellowship (DGE-1650604)