Functional Neural Correlates Of PTSD Symptoms And Trauma Exposure In Young Combat Veterans

Ryan J. Herringa, MD, PhD[1,2]; Mary L. Phillips, MD, MD[2]; Jay C. Fournier, PhD[2]; Dina M. Kronhaus, PhD[3]; Anne Germain, PhD[2]
[1]University of Wisconsin School of Medicine & Public Health, Madison, WI; [2]University of Pittsburgh School of Medicine, Pittsburgh, PA; [3]St. Catharine's College, Cambridge United Kingdom

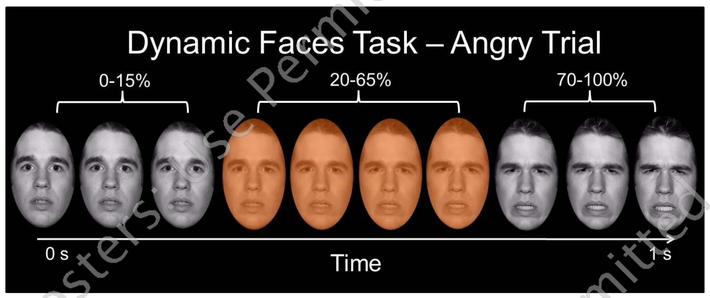
1. Background

A history of childhood maltreatment represents one of the largest risk factors for the development of post-traumatic stress disorder (PTSD) as an adult. In the military population, the risk is similar to that of the adult index trauma (effect size ~0.25)[1]. Neural models of adult PTSD suggest heightened amygdala, insula, and dorsal cingulate (dACC) activity in response to emotional stimuli. At the same time, there appears to be impaired recruitment of the ventromedial prefrontal cortex (vmPFC), a structure normally involved in emotion regulation and fear extinction[2]. **However, the contribution of cumulative trauma, in particular childhood maltreatment, to this neural dysfunction remains largely unexplored.** A study of adults with childhood maltreatment history suggests increased amygdala activation[3], and combat exposure alone has been shown to increase amygdala and insula activation[4]. Thus, childhood and adult trauma may cumulatively impact brain function to create vulnerability for the development of adult PTSD symptoms.

Here we examined, **within a single model**, the functional neural correlates of childhood maltreatment, combat exposure and post-traumatic stress symptoms (PTSS) in young combat veterans. We hypothesized that childhood and adult trauma, and current PTSS would correlate positively with amygdala and insula activation, and negatively with vmPFC activation, in an additive manner.

2. Methods

-Clinical measures: Clinician-Administered PTSD Scale (CAPS), Childhood Trauma Questionnaire (CTQ), Combat Exposure Scale (CES)
-Subjects (n=28) were unmedicated, and free of major comorbid psychiatric disorders except depression (SCID)
-3T brain fMRI while subjects performed a dynamic faces task[5], an implicit emotion regulation task, block design
-1st level analysis in SPM8 contrasting angry or happy faces minus shape morph
-2nd level analysis in SPM8 using multiple regression: CAPS, CES, CTQ; covaried for depressive symptoms and IQ
-A priori ROIs: vmPFC, dACC, insula, amygdala, hippocampus
-Cluster threshold 10 voxels, p<0.001 uncorrected



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3. Results

Demographic and clinical data

	All Subjects (n=28)		PTSD (n=18)		Non-PTSD (n=10)	
	Average	SD	Average	SD	Average	SD
Age	26.6	2.6	26.2	2.8	27.4	2.0
CAPS Past Month	40.9	20.9	**53.1**	12.8	**19.0**	12.8
Combat Exposure Scale	17.2	9.9	18.6	10.5	14.7	7.5
Childhood Trauma Questionnaire	36.9	14.5	**40.4**	16.1	**30.7**	8.7
Beck Depression Inventory	7.0	5.4	**8.4**	5.4	**4.3**	4.5
NART (IQ)	106.5	8.0	106.6	6.9	106.4	10.4
Current DSM-IV Diagnoses	**Count**	**%**	**Count**	**%**	**Count**	**%**
Major Depressive Disorder	3	11%	3	17%	-	-
Past DSM-IV Diagnoses	**Count**	**%**	**Count**	**%**	**Count**	**%**
Major Depressive Disorder	5	18%	2	11%	3	30%
Bulimia Nervosa	1	4%	-	-	1	10%
Alcohol Abuse/Dependence	15	26%	11	61%	4	40%
Cannabis Abuse/Dependence	4	14%	3	17%	1	10%
Cocaine Abuse/Dependence	1	4%	-	-	1	10%

Bolded numbers: p<0.05, PTSD vs. non-PTSD

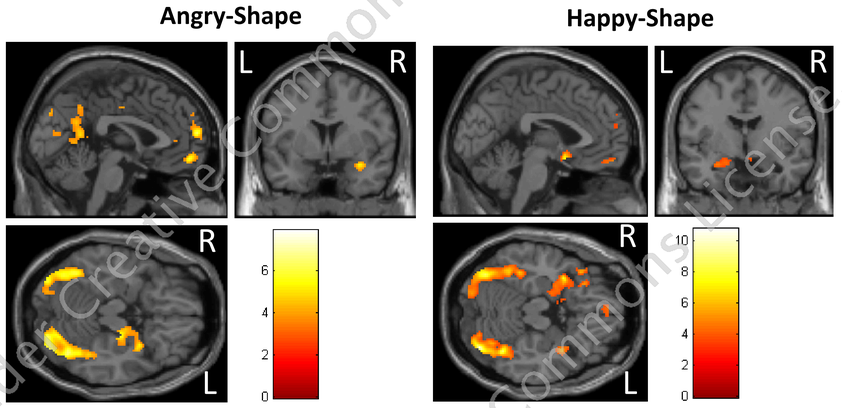
Spearman correlations (p<0.05)

Variable 1	Variable 2	ρ
CAPS	BDI	0.57
	CES	0.44
	CTQ	0.41
BDI	CTQ	0.41

Task Performance

- **High accuracy** for color identification: 90% (angry trials), 91% (happy trials)
- Multivariate regression: BDI predicted longer reaction time to happy vs. shape; β=0.50, p=0.04
- No other clinical variables predicted relative reaction time or accuracy

Task Effects: Angry and happy conditions activate vmPFC, amygdala, hippocampus, and fusiform gyrus



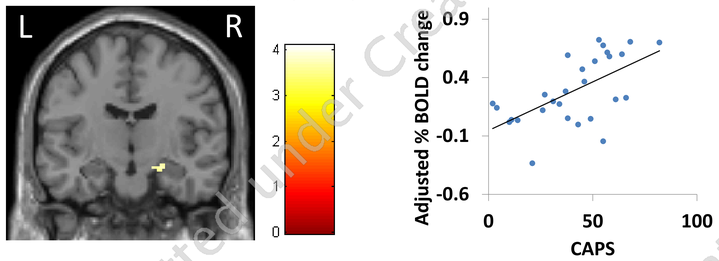
Happy-Shape: Task-related effects

No correlation with CAPS, CES, or CTQ

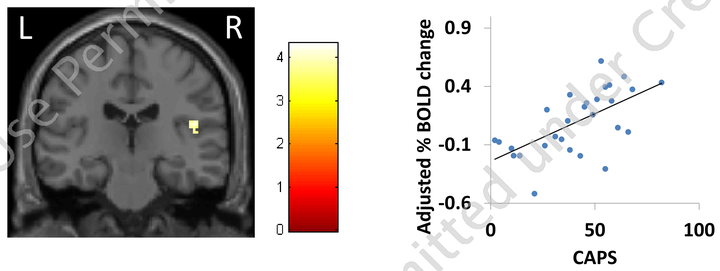
Angry-Shape: Task-related effects

PTSS correlate with right insula and hippocampus activation

Hippocampus (18, -14, -16; k=26; Z=3.47)

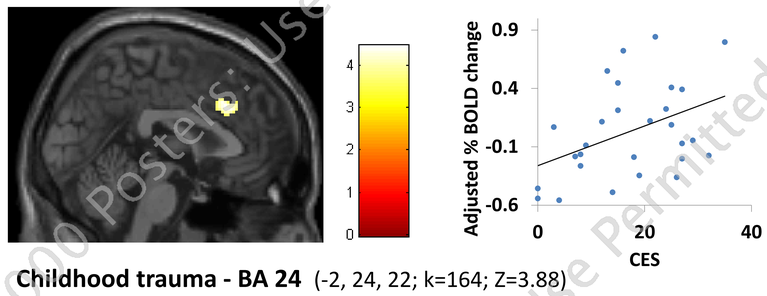


Insula (BA 13) (46, -24, 16; k=98; Z=3.62)

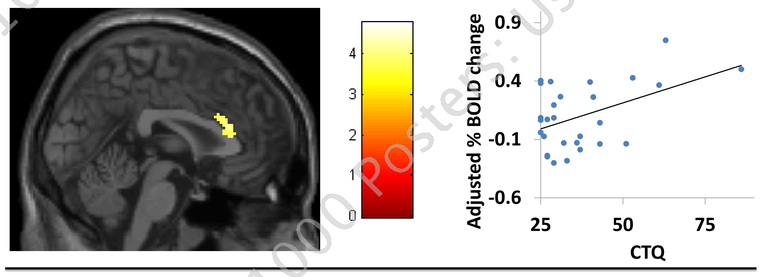


Childhood and adult trauma correlate with dACC activation

Combat Exposure - BA 32 (4, 24, 34; k=85; Z=3.70)



Childhood trauma - BA 24 (-2, 24, 22; k=164; Z=3.88)



4. Conclusions

Dorsal ACC activation observed in prior studies of PTSD may be attributable to childhood and adult trauma exposure. In contrast, abnormal insula and hippocampal activation may be specific to the PTSD syndrome. The specificity of these results to threat, and not positive stimuli, is consistent with abnormalities in threat processing associated with PTSD.

References

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