IMPULSIVITY IN VETERANS WITH COMORBID PTSD AND TBI: AN FMRI STUDY

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INTRODUCTION

Comorbid PTSD and mTBI presents as a complex neurobiological and neuropsychological construct resulting in both cognitive and behavioral problems. Research has shown that veterans diagnosed with mTBI and PTSD experience severe executive function deficits. Perhaps the most prominent and debilitating aspect of executive dysfunction is impulsivity[1]. Impulsivity is recognized as the gateway to regulating other cognitive processes and directly affects quality of life and mental health[2]. Furthermore, impulsivity, and broader deficits in cognitive control can significantly impede the efficacy of rehab and intervention in individuals suffering from mTBI/PTSD.

AIM: To identify the underlying neurobiology of impulsivity in mTBI/PTSD, and to investigate the relationships between neural network behavior, symptom severity and neurocognitive deficits.

HYPOTHESIS: We predict that PTSD symptom severity and impulsivity will be correlated with aberrant activation and connectivity in forntal-limbic brain regions and networks responsible for emotional processing and cognitive control.

METHODS

1. Participants: N= 72 OEF/OIF veterans. OEF/OIF Veteran (ages of 18-65) who screened positive for TBI and PTSD in research registry and through re-screening prior to baseline interview.

2. Data Acquisition & Analysis: Images acquired on 3 Tesla SIEMENS MAGNETOM TrioTim syngo MR 817, with a 12-channel head coil at the UNC Biomedical Research Imaging Center(BRIC). (TR=1900ms, TE=2.26ms, FA=9def, TI=900ms, 256x256x192, 1mm isotropic).Functional images are acquired using echo-planar imaging (EPI) over 37 slices, AC_PC parallel voxel size 3.8mm[3], FoV read 243 mm, FoV phase 100.0%, TR 2000 ms, TE 27ms. Data processing [ROI % signal change and rs-fcMRI] was conducted using FEAT, a software tool for high quality model-based FMRI data analysis. FEAT is part of FSL (FMRIB's Software Library).

A. fMRI Task Paradigm1. Kanwisher Emotional 1-back working memory   2.Hariri: Face matching   3. Stroop: Inhibition

B. Resting State Functional Connectivity: Python/FSL Resting State Pipeline: Processed resting tate data from raw into node base correlation matrix Representing connectivity between different regions of the brain[3].

3. Neurocognitive & Symptom Severity Measures

a. The Barratt Impulsiveness Scale (BIS-11): 30-item Q. to assess the personality/behavioral construct of impulsivity [4].

a. Clinician Administered PTSD Scale (CAPS): 30 item structured interview to assess TOTAL PTSD symptom severity, symptoms related to intrusive recollection (CAPS_B), symptoms related to avoidant/numbing (CAPS_ C) and symptoms classified as hyper-arousal (CAPS_D) [5].

c. The Alcohol Use Disorders Identification Test (AUDIT) - ten questions

RESULTS

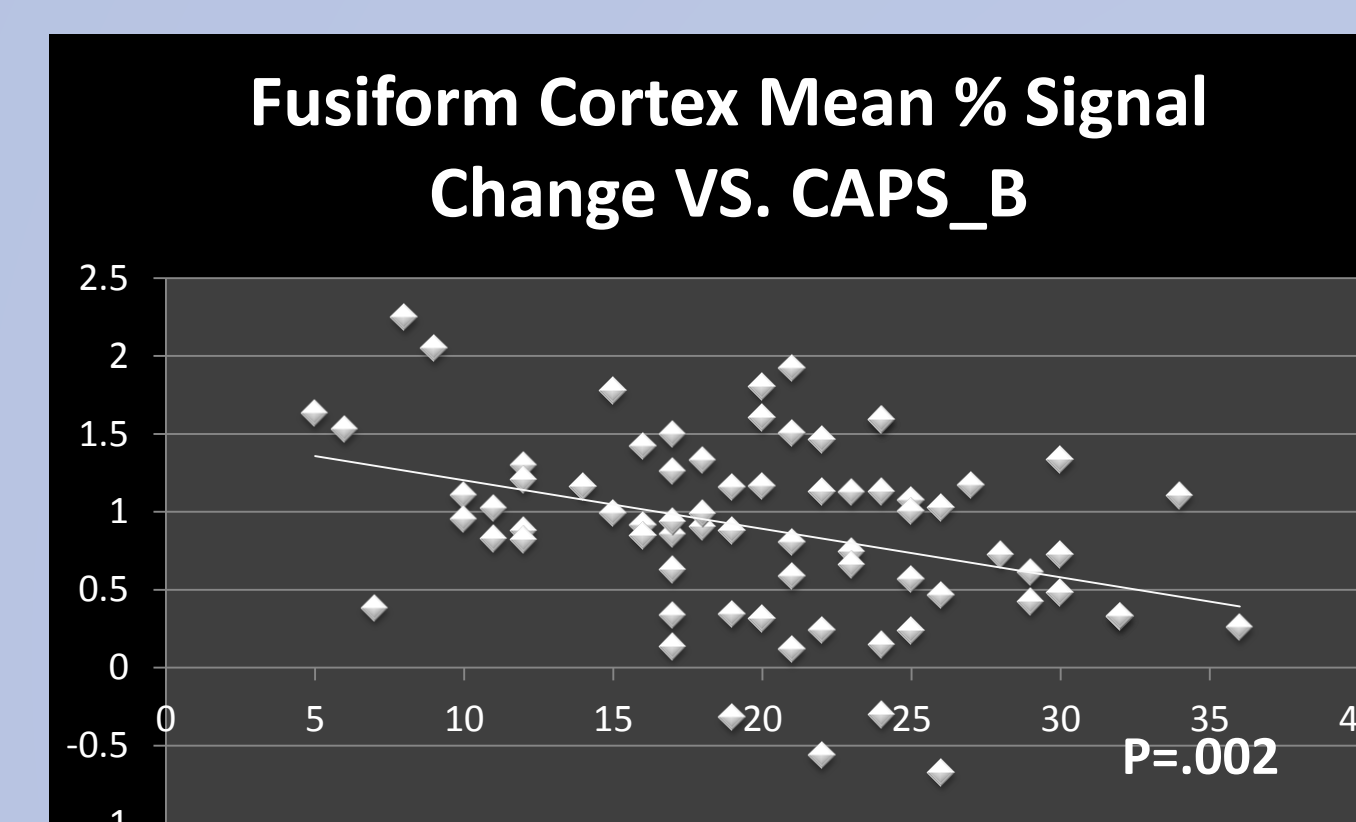**fMRI task based results: Univariate Linear Regression**
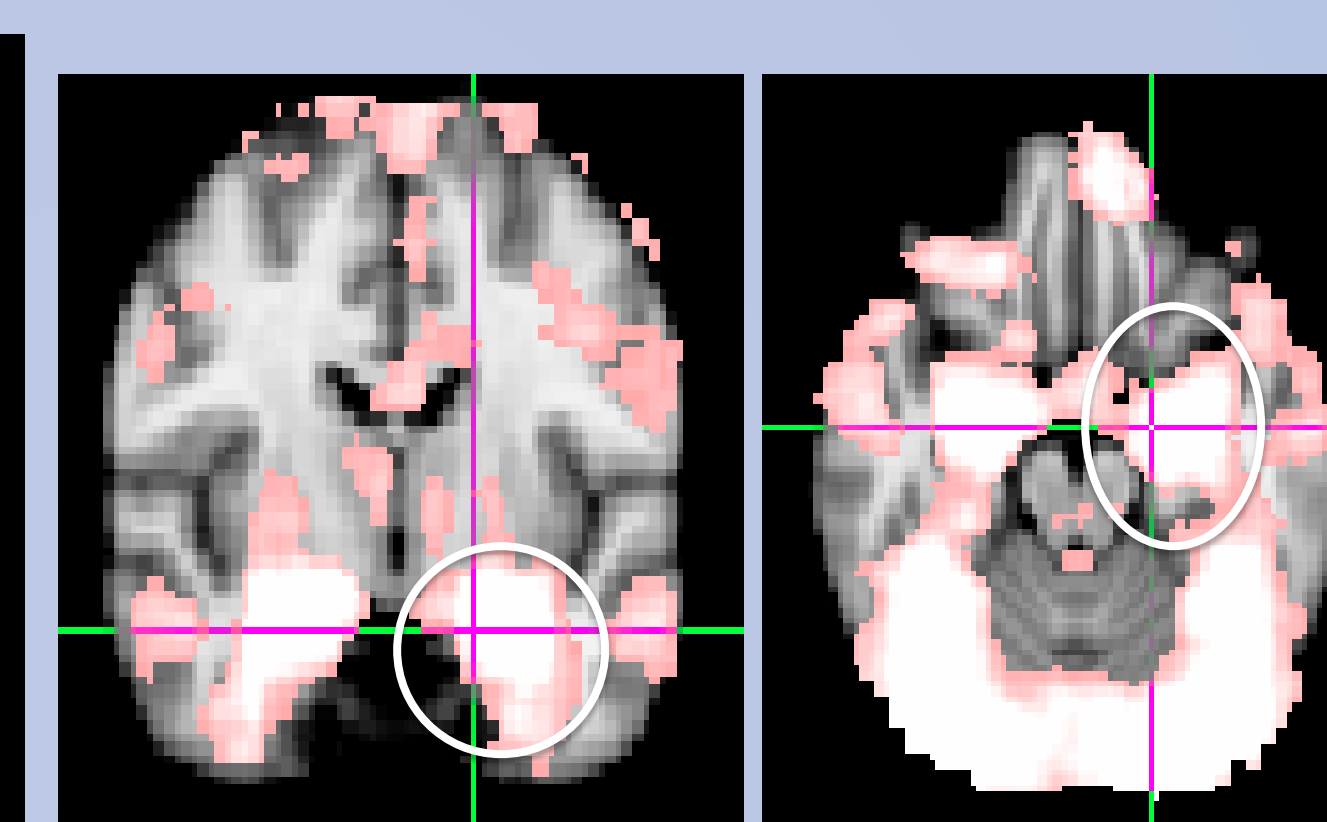
1.Emotional Face Matching Task

R/L Mean % Signal Change VS. CAPS_B
- Right Amygdala, P=.01
- Left Amygdala, P=.02
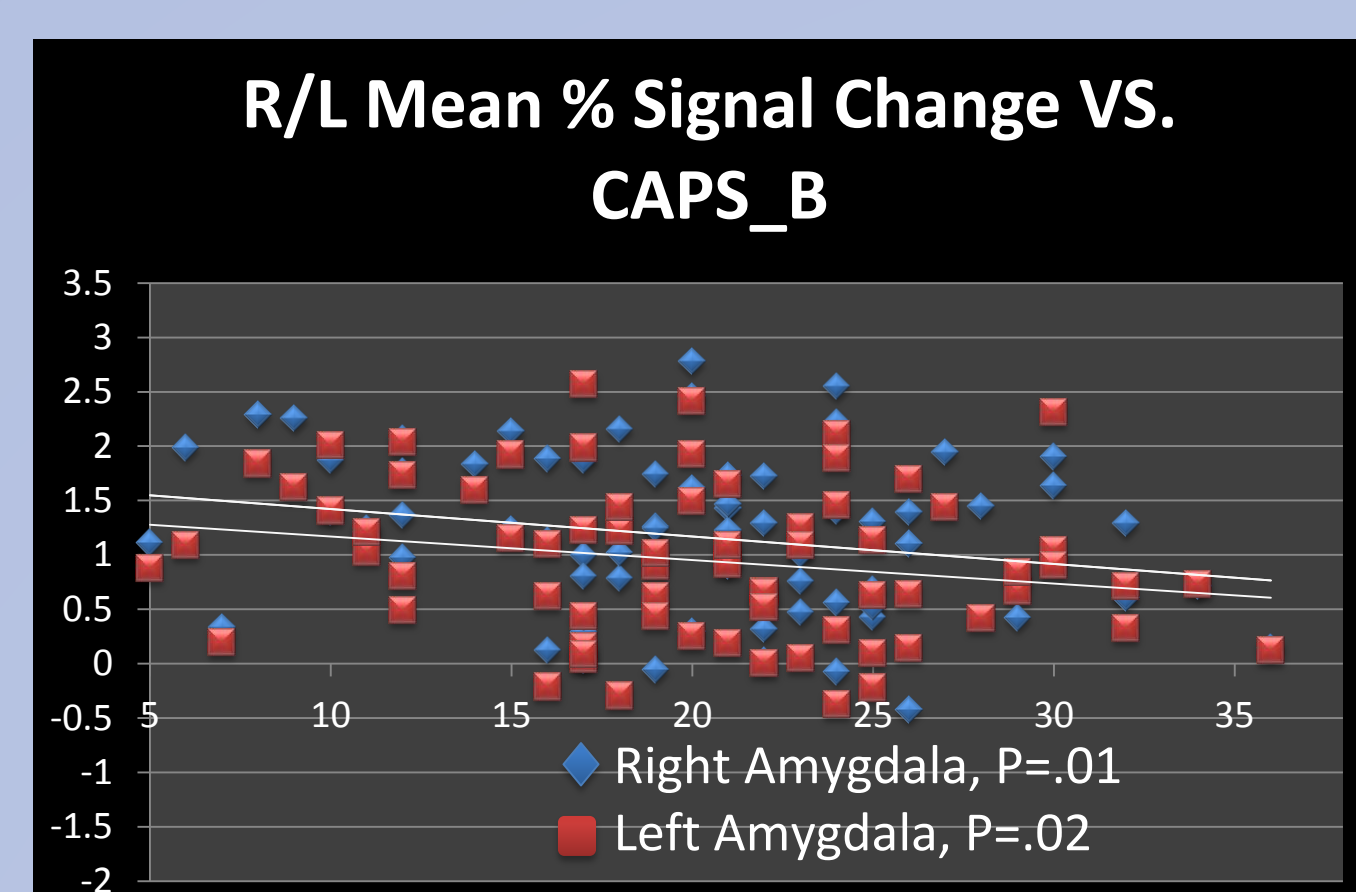
a. Increased PTSD symptom severity (CAPS_B) correlates negatively with R/L amygdala activation, [F>S].

Insula Mean % Signal Change VS. BIS_NonPlan
P=.03
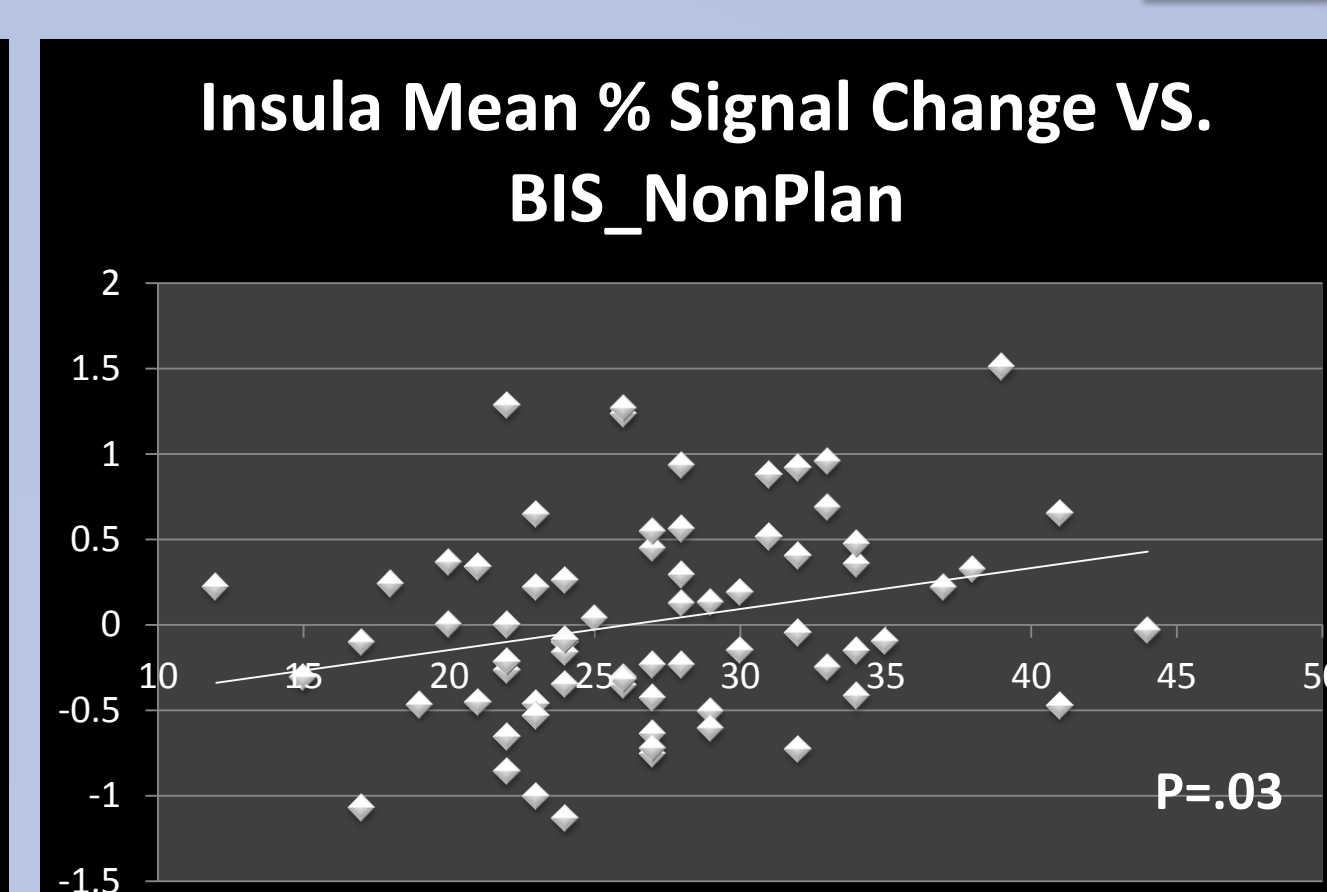
b. Increased impulsivity scores correlates positively with insula activation, [F>S].
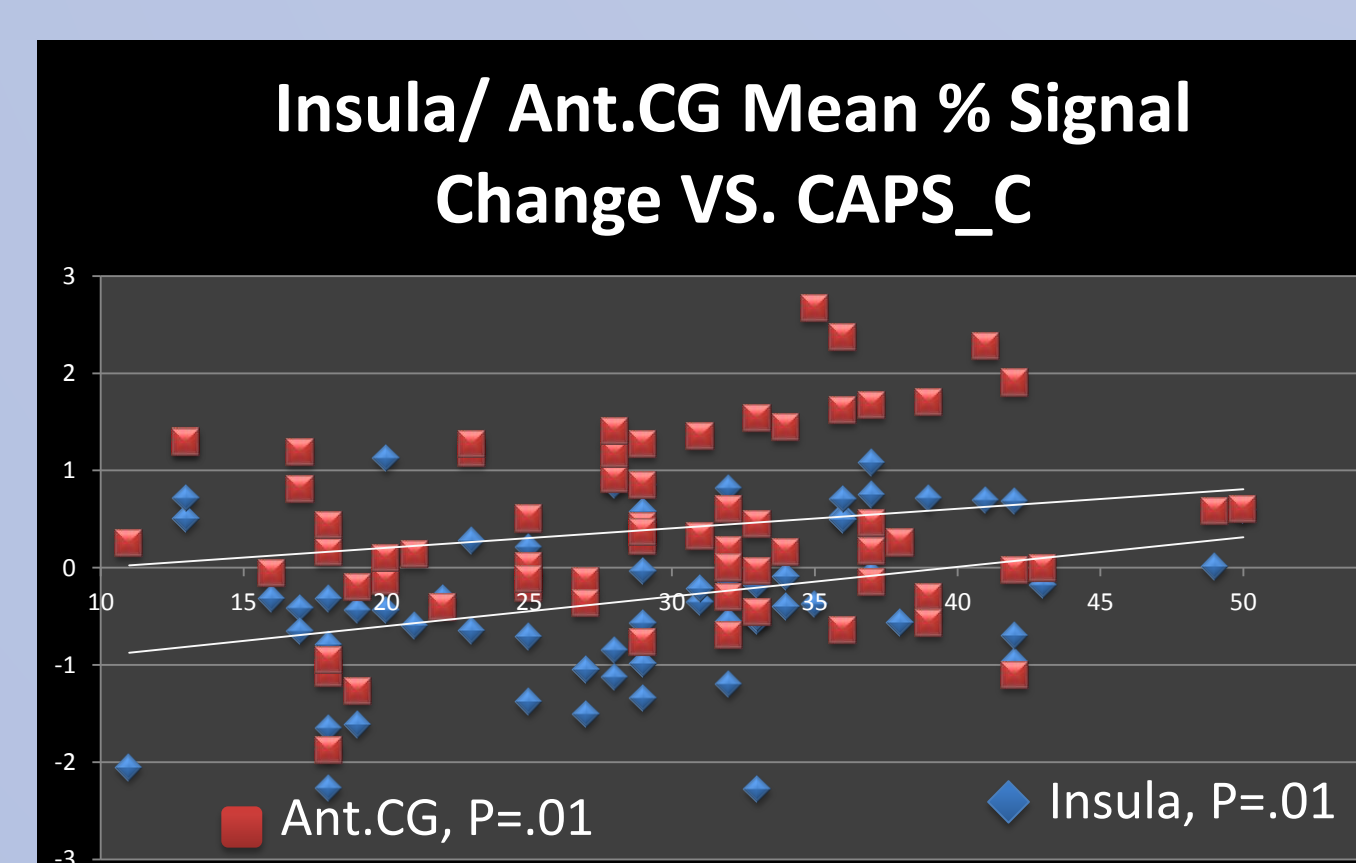
Fusiform Cortex Mean % Signal Change VS. CAPS_B
P=.002

c. Increased PTSD symptom severity (CAPS_B) correlates negatively with fusiform cortex activation, [F>S].

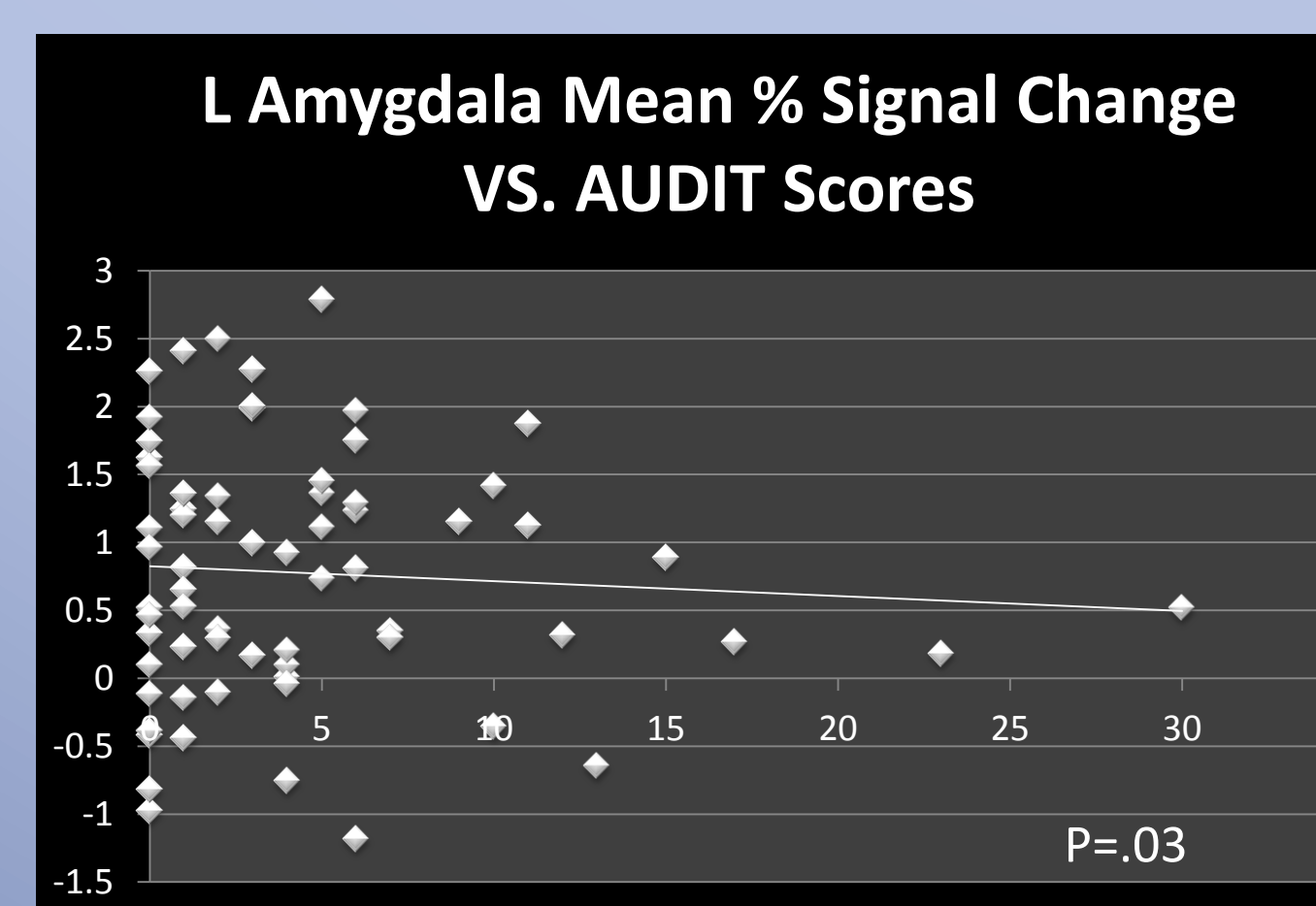d. Robust R/L amygdala and fusiform cortex activation during emotional face matching task, [F>S].
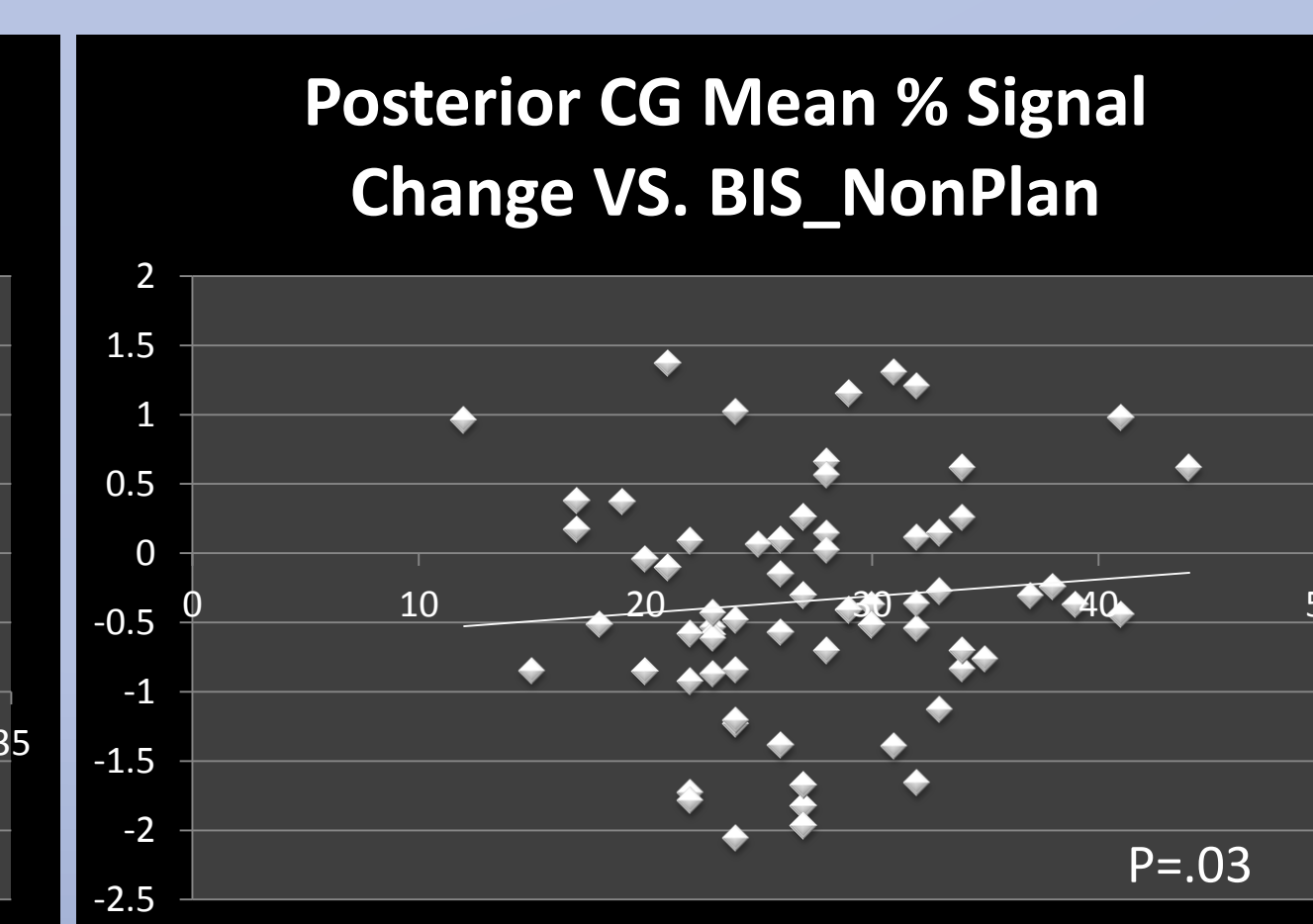
2 Emotional Working Memory Task

Insula/ Ant.CG Mean % Signal Change VS. CAPS_C
- Ant.CG, P=.01
- Insula, P=.01

a. Increased PTSD symptom severity (CAPS_C) correlates positively with insula and anterior cingulate gyrus activation [F>S]

MFG Mean % Signal Change VS. BIS_NonPlan
P=.03
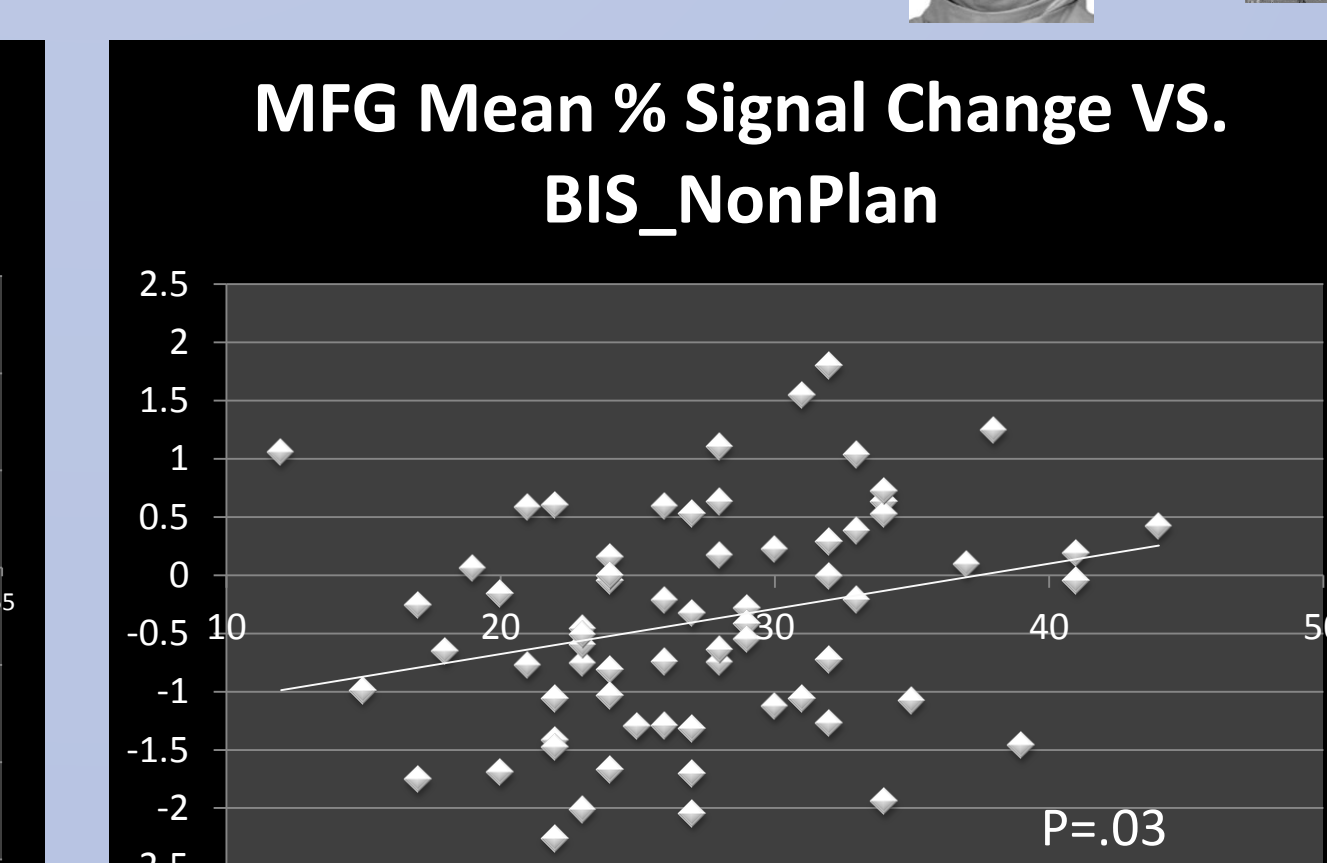
b. Increased impulsivity scores correlates positively with MFG activation [F>S].

L Amygdala Mean % Signal Change VS. AUDIT Scores
P=.03

c. Increased substance use scores correlates negatively with L amygdala activation [F>S]

Posterior CG Mean % Signal Change VS. BIS_NonPlan
P=.03

d. Increased impulsivity scores correlates positively with posterior CG activation

Demographics:

CHARACTERISTICS	PTSD/mTBI n=72
Age, y	37.34±8.67(24-59)
Sex, No.(%)F	6(8.3)
Race, No.(%)White	38(52.7)
Marital Status, No.(%)Married	36(50)
Barratt Impulsivity (BIS-11)	62±(40-98)
Clinician Administered PTSD Scale	74.27± 17.64(37-110)
Alcohol Screen (AUDIT)	25.13±22.21 (0-93)

3. Inhibition Task:
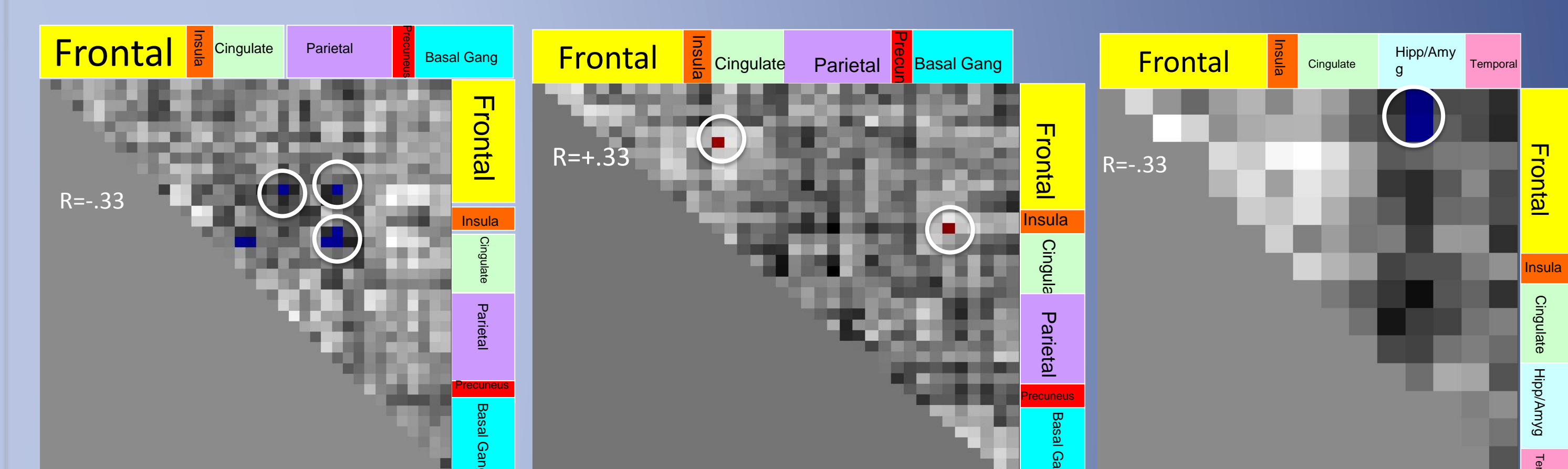
IFG Mean % Signal Change VS. BIS_TOTAL
P=.03
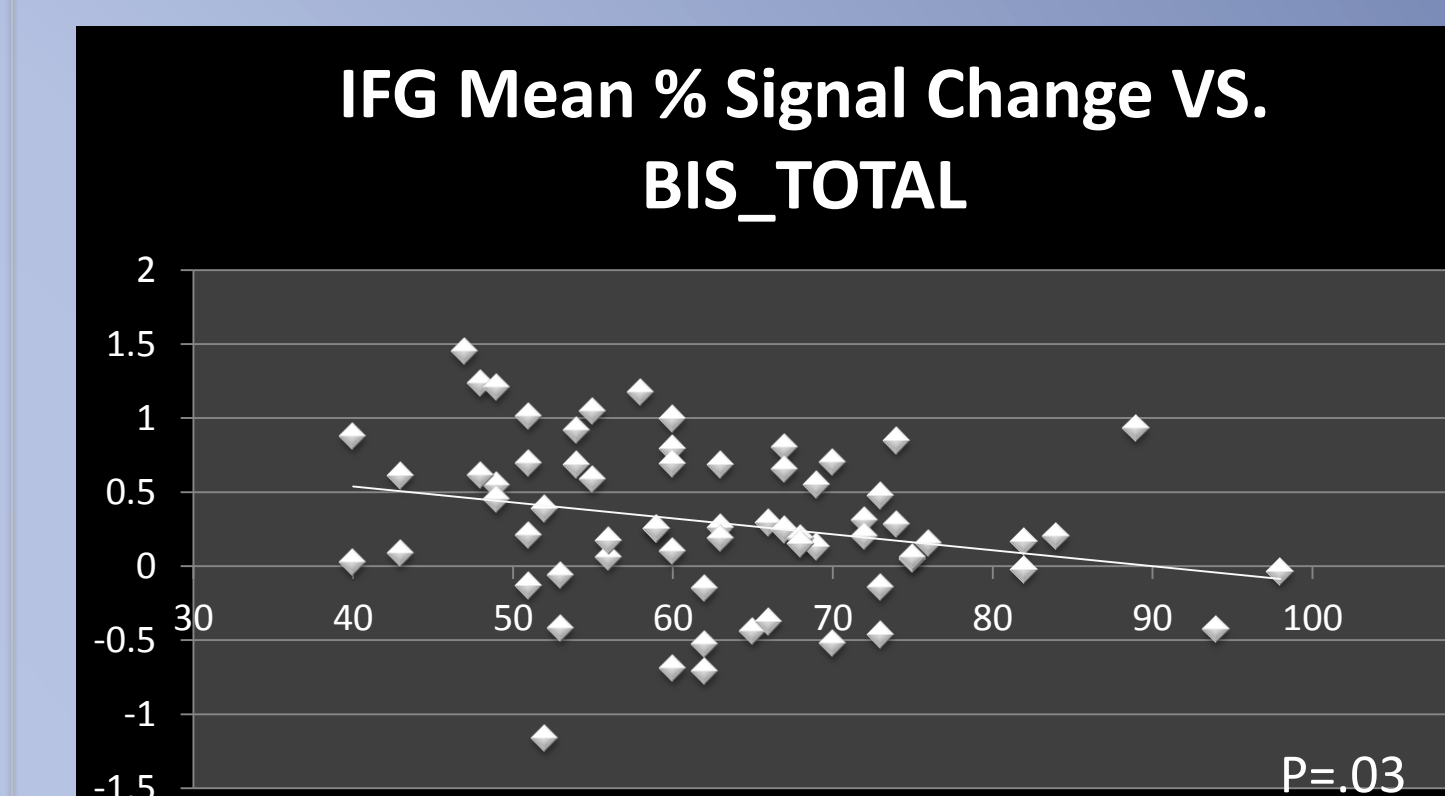
a. Increased total Impulsivity scores correlates negatively with IFG activation [Switch>Stars]
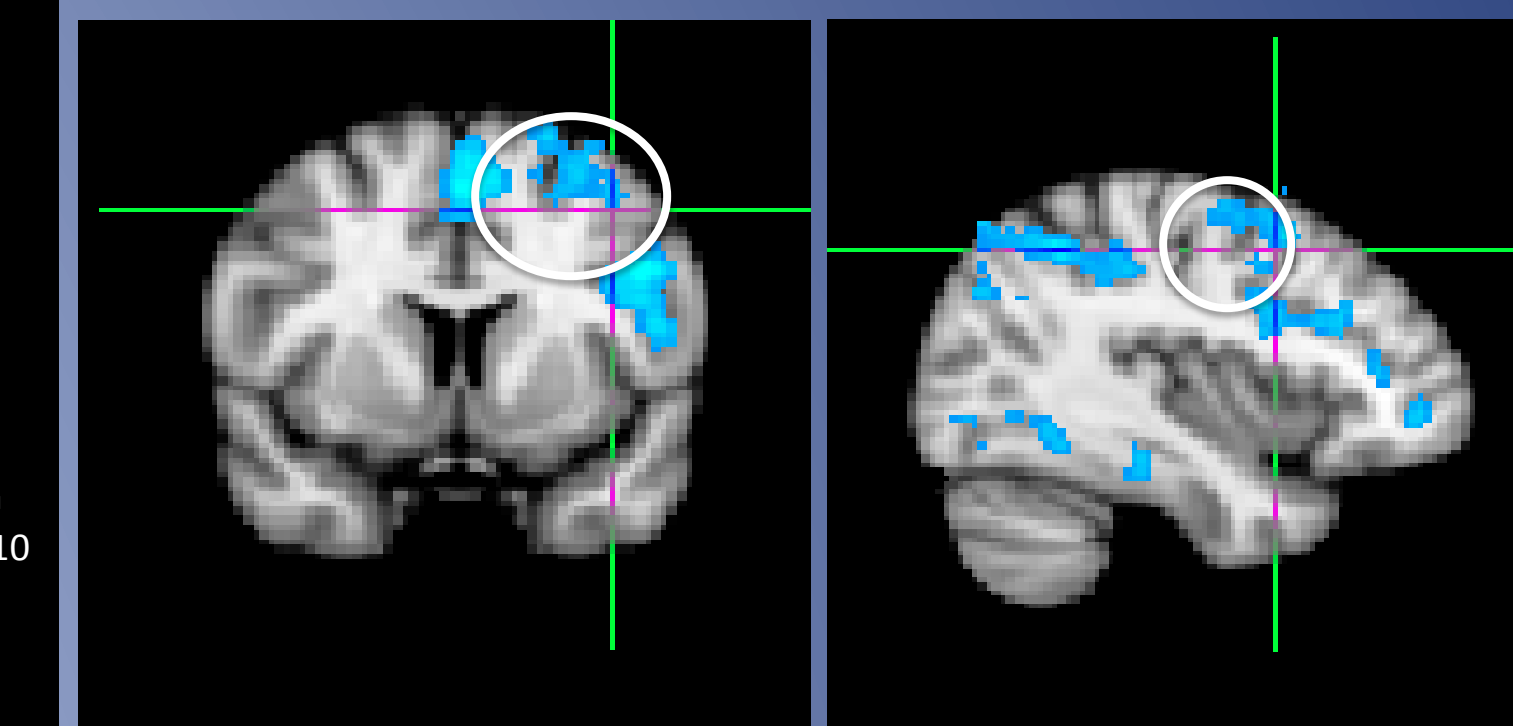
b. Robust activation seen in the IFG and MFG during inhibition

Resting State Functional Connectivity:
Intrinsic connectivity network mapping, ICN

R=-.33

1. CAPS total score (-)correlates with bilateral fronto-striate resting state functional connectivity

R=+.33

2. BIS_SelfControl (+) correlates with bilateral fronto-striate resting state functional connectivity

R=-.33

3. BIS_NonPlan (-)correlates with L fronto-limbic resting state functional connectivity

R=-.33
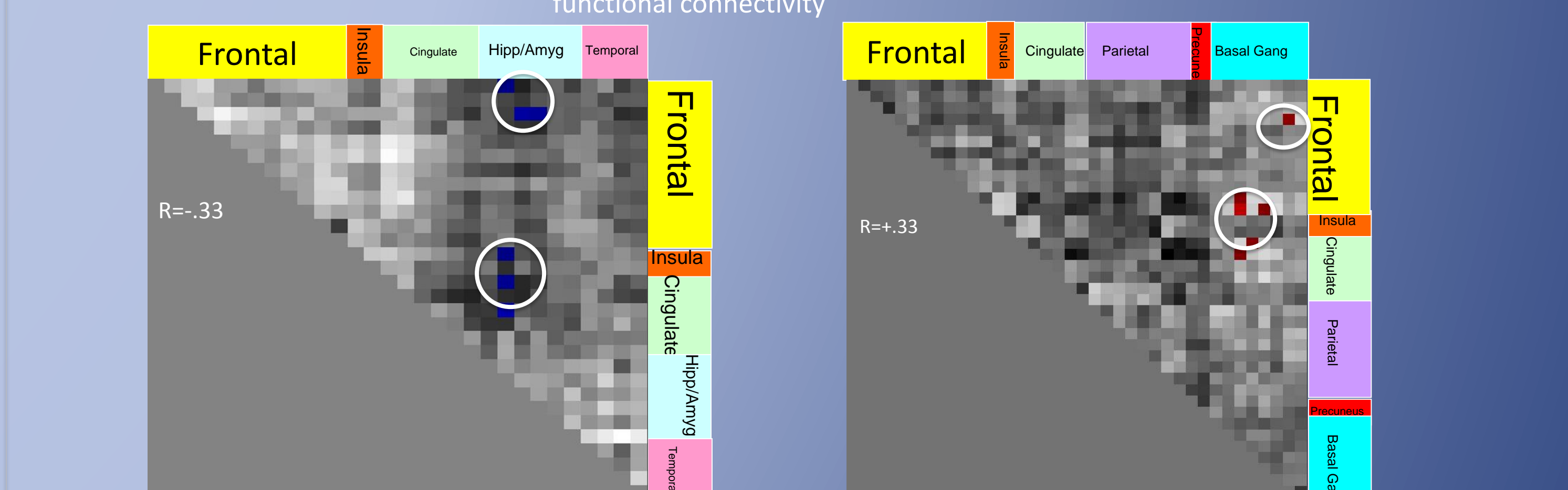
4. BIS total score (-)correlates with bilateral fronto-limbic resting sate functional connectivity

R=+.33

5. CAPS sub-score D (+)correlates with bilateral fronto-striate resting state functional connectivity

Summary:

Future Directions

Studies have shown that anger significantly mediates the relationship between PTSD and impulsivity, possibly providing an explanation for substance use. [6]
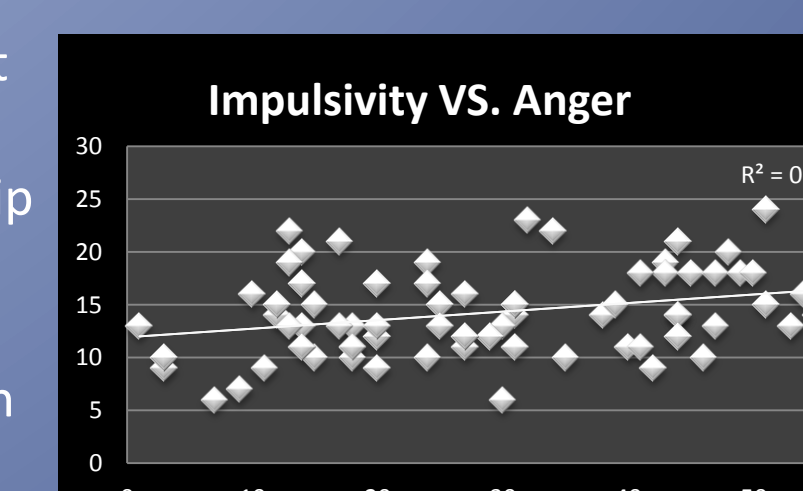
Therefore, my next step will be to investigate how anger plays a role in the relationship between brain function, PTSD symptom severity and neurocognitive deficits.

Impulsivity VS. Anger
R²=0.0883