

Background

Worry

Definition: Heavy burden of negative thoughts about future negative events; elicited to avoid a threat or a dangerous situation. Frequently onsets during adolescence.

Brain Regions: Medial Prefrontal Cortex (mPFC), Anterior Cingulate Cortex (ACC), & Anterior Insula

Vigilance

Definition: Increased attentional states regarding a perceived threat

Brain Region: Ventromedial Prefrontal Cortex (vmPFC), Amygdala, & Insula

Inhibition

Definition: A domain of executive function referring to the ability to consciously stop a thought, action, or response

Brain Regions: Dorsolateral Prefrontal Cortex, vmPFC & ACC

Hypotheses

- Adolescents with severe worry will exhibit impaired performance on a task of inhibitory control, relative to healthy peers.
- Adolescents with severe worry will demonstrate greater activation in brain regions related to inhibition and threat vigilance, relative to healthy peers.

Methods

Study Population

- 36 adolescents ages 13-18 (mean = 15.73, 75% female)
- Administered Penn State Worry Questionnaire-Child (PSWQ-C)

Neuroimaging

- 3.0 Tesla fMRI of entire cerebrum and part of the cerebellum

Experimental Task

- Mixed block/event-related design
- Go/No-Go paradigm (see Figure 1a)

Analysis

- Imaging data analyzed with MATLAB, CONN, SPM12, WFU_PickAtlas, MarsBaR
- ROIs: Insula, ACC, dIPFC, vmPFC, Amygdala
- Behavioral data analyzed using SPSS

fMRI = Functional magnetic resonance imaging, ROI = Region of Interest

Go/No-Go Paradigm

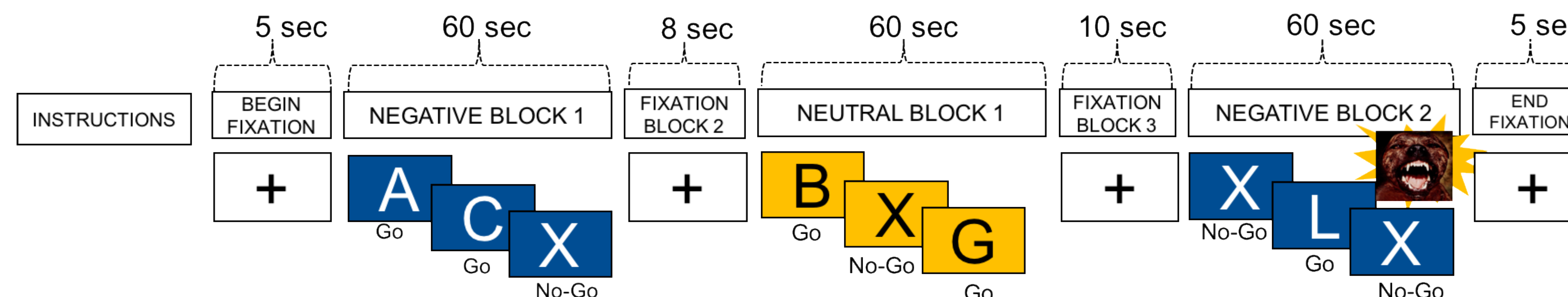


Figure 1a. The Go/No-Go paradigm models the behavioral task participants completed while in the fMRI scanner.

	Button Pressed	Button Not Pressed
Letter = NOT X (Go Trials)	Correct Response HIT	Incorrect Response Miss
Letter = X (No-Go Trials)	Incorrect Response FALSE ALARM	Correct Response Correct Rejection

Figure 1b. Schematic of hit-rate versus false-alarm rate

Neuroimaging Results

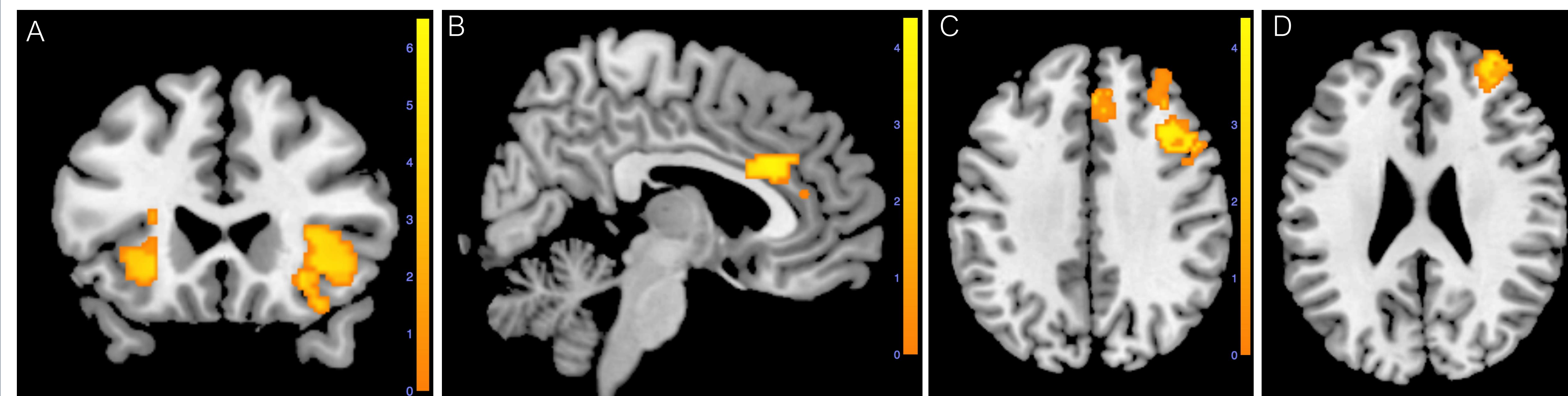


Figure 2. Neuroimaging results from Negative>Neutral contrast showed significant clusters of activation ($p < 0.001$, $k > 15$) at a FWE-corrected $p < 0.05$ cluster in the regions indicated. (A) Insula; (B) Anterior Cingulate Cortex; (C) Dorsolateral prefrontal cortex; (D) Ventromedial prefrontal cortex. Color bars represent t-values.

Table 1. Clusters of brain activation derived from negative > neutral contrast during the go/no-go task.

Region of Interest	Voxels	Side	t	MNI Coordinates		
				X	Y	Z
Insula	549	R	6.51	30	28	4
	159	L	4.95	-28	18	-6
ACC	18	L	3.72	-26	18	12
	267	R	4.39	2	24	26
dIPFC	30	R	3.78	12	42	14
	287	R	4.39	44	12	32
vmPFC	77	R	4.08	32	42	30
	41	R	3.74	6	30	34
Amygdala	165	R	5.13	36	52	26
No supra-threshold voxels						

Note. MNI = Montreal Neurologic Institute

Behavioral Results

Table 2. Means, standard deviations, and correlations of behavioral variables.

	Mean	S.D.
1. PSWQ-C	22.778	9.181
2. d' Negative	2.601	1.043
3. d' Neutral	2.666	1.075
4. HR-Neg. Go	0.976	0.062
5. HR-Neu. Go	0.974	0.085
6. FAR Neg. No-Go	0.370	0.231
7. FAR Neut. No-Go	0.359	0.241
8. Mean RT, Neg. Go	0.439	0.054
9. Mean RT, Neu. Go	0.434	0.054

Note. Neg. = Negative; Neu. = Neutral; HR = Hit Rate; FAR = False Alarm Rate; RT = Reaction Time. PSWQ-C score of 18-26 = moderate worry; PSWQ-C score > 26 = severe worry.

ROI (MNI Coordinates)	Correlation with PSWQ-C	
	Pearson Correlation	Significance
dIPFC1 (44,12,32)	-0.362	0.030
dIPFC3 (6,30,34)	-0.352	0.035
vmPFC (36,52,26)	-0.400	0.016

Note. Correlations are significant at the 0.05 level.

Conclusions

Findings

- Adolescents with and without severe worry demonstrate increased activation in the insula, ACC, dIPFC, and vmPFC during conditions of vigilance for threat.
- Adolescents with worry seem to be hypervigilant for threat during negative (threatening) conditions.
- No significant correlation between task accuracy (d') and neuroimaging data.
- Worry severity is negatively correlated with activation in the dIPFC and vmPFC during vigilance for threat.

Future Studies

- Examine the relationship between inhibition under negative and neutral contexts during both go and no-go trials by setting up four different contrasts.

Limitations

- Small sample size
- Over-representation of female high worriers

Acknowledgements

Thank you to Dr. John Thompson, Dr. Ernesto Salcedo, Jennifer Thurston, the MHA class of 2018, and the Modern Human Anatomy Program for all of their continued support and encouragement throughout the duration of this project.

This research was funded by NIH grant K23MH108640 (Mullin)

