

Associations between Risky Drinking, Suicidality and Network Activation During Emotional Response Inhibition

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Introduction

- Among young adults, suicidal ideation (SI) is strongly associated with dangerous patterns of alcohol use that are highly prevalent in this group, including binge drinking.¹
- Binge drinkers in a college sample were found to be twice as likely to report serious thoughts of suicide² and national survey data show multiplicative effects of depression and alcohol misuse on suicide risk in this group.³
- In young adults who report SI, risky alcohol use is associated with higher rates of health risk behaviors,⁴ negative alcohol-related consequences⁵ and alcohol use disorders⁶ relative to youth without SI.
- Ongoing maturation of cognitive control during emotion processing and associated brain circuitry, which continues into early adulthood,^{7,8} can potentiate both risky drinking and suicidality.
- Distinct neurocognitive mechanisms may be relevant to problematic drinking in young adults with versus without SI. Thus, this study seeks to identify a moderating effect of SI on the relationship between activation of large-scale brain networks and risky drinking.

Participants

- Participants were 48 college freshmen (age=18.8 ± 0.4 yrs, 28 female) who completed an emotional Go-NoGo task designed to measure cognitive control in the presence of emotional distractors during functional magnetic resonance imaging (fMRI). Participants were divided into two groups based on presence of self-reported SI at baseline or 1-year follow-up.
- Problematic alcohol use was assessed at baseline and 1-year follow-up via the Alcohol Use Disorders Identification Test (AUDIT). Participants were asked to not drink alcohol for 48 hours prior to scanning.
- This study was approved by the McLean Hospital IRB.

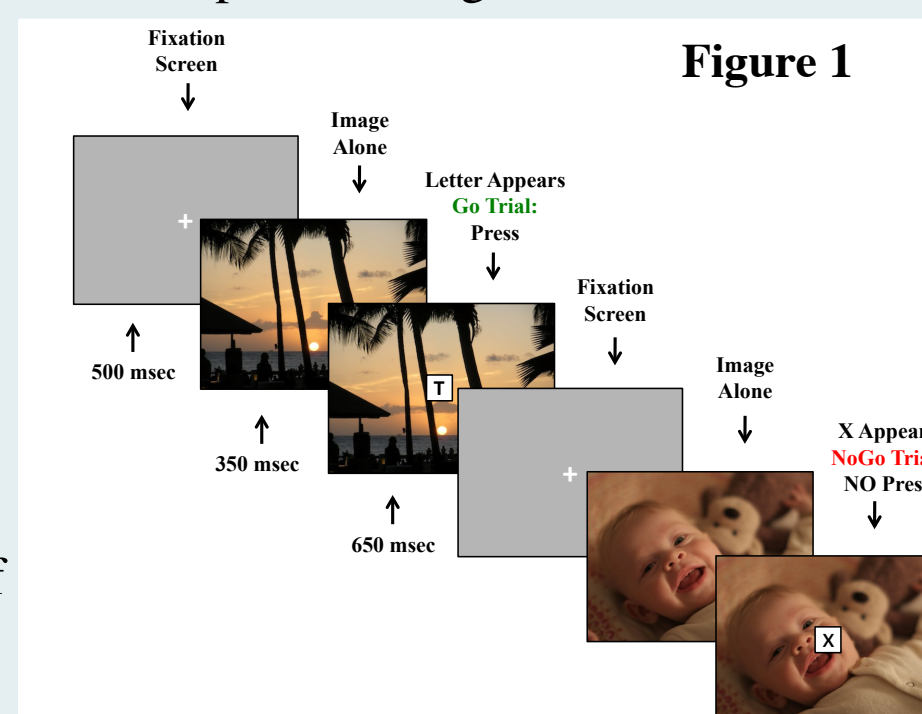
Table 1. Group Demographics and Alcohol Use

	<u>n</u>	<u>female/male</u>	<u>age</u>	<u>AUDIT Baseline</u>	<u>AUDIT 1-Year</u>
No SI	31	19/12	18.1±.5	5.9±2.4	5.4±4.0
SI	17	9/8	18.3±.4	7.2±4.4	7.4±3.2

Emotional Go-NoGo Task^{8,9}

- Participants made a button press for every letter except X while ignoring background images.
- Participants built up a prepotent tendency to press that had to be actively inhibited on NoGo trials (Xs = 25% of trials).
- Background images were selected from the International Affective Picture System (IAPS) and were positive, negative, neutral or scrambled.

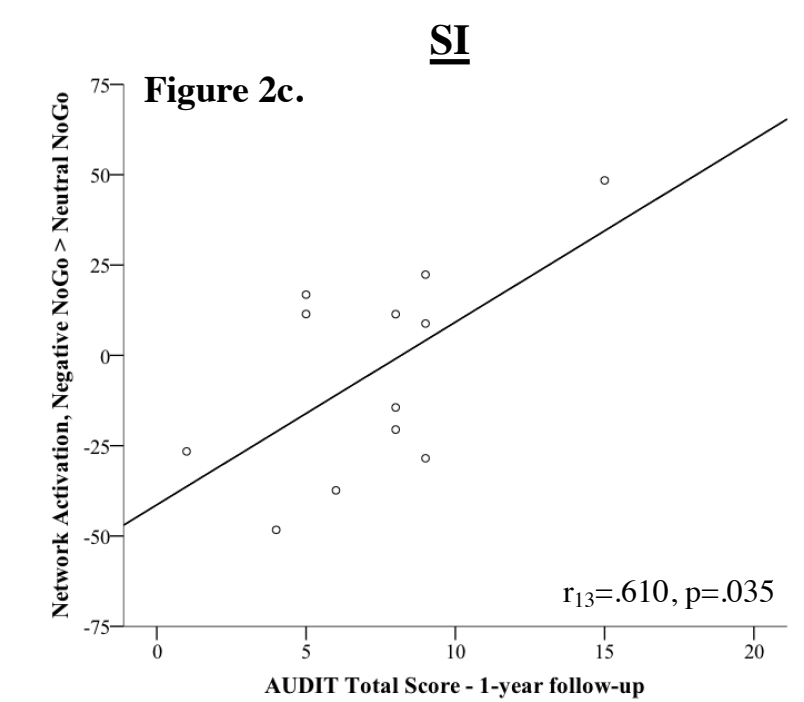
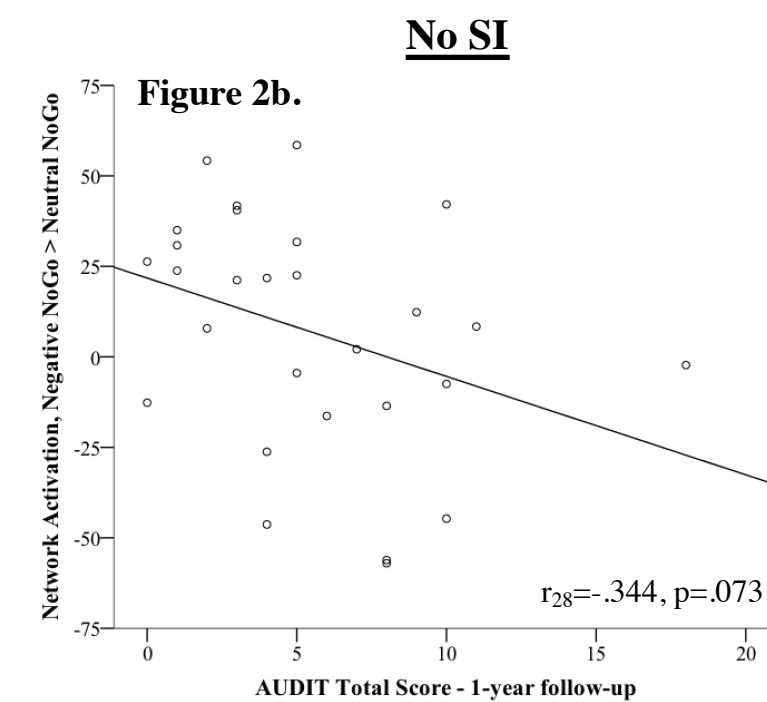
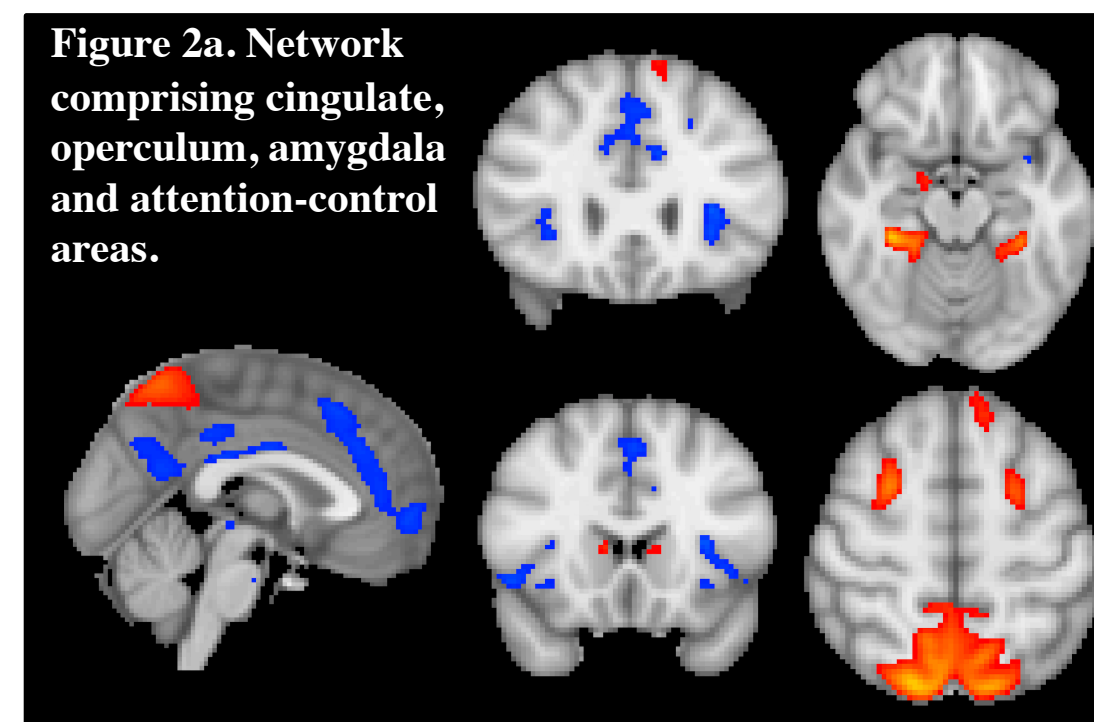
- 360 total trials were presented in three 5-minute runs.
- Each image was presented once.
- Images were presented in blocks of 20 trials of the same valence.



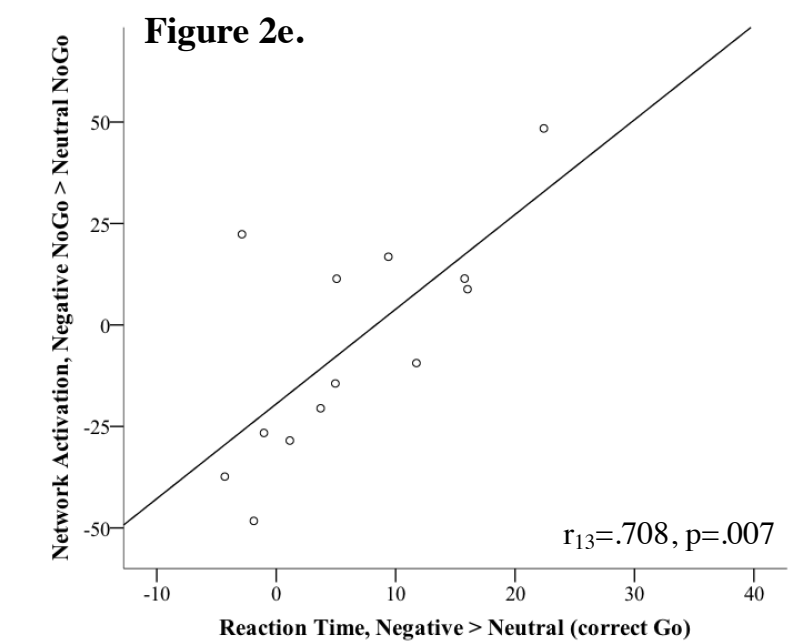
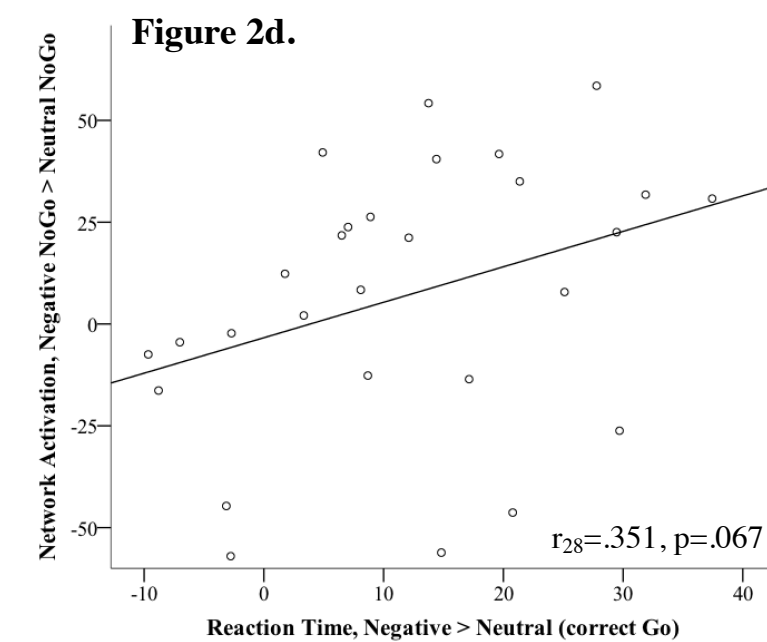
fMRI Data Acquisition and Processing

- Whole brain multiband EPI BOLD data were acquired on a 3T Siemens TIM Trio (Siemens, Erlangen, Germany) with a 32-channel phased array head coil (TR: 750ms, TE: 30ms, voxel size: 2.8x2.8x2.8mm). Preprocessing (slice scan time correction, linear trend removal, high-pass temporal filtering, spatial smoothing, motion correction) and first-level statistical analyses were performed using FSL. Data denoising was done using ICA-AROMA.¹⁰ GLM regressors modeled NoGo trials within positive, negative, neutral, scrambled conditions. For this analysis, contrasts of parameter estimates were calculated between negative and neutral conditions for each subject to identify activation patterns associated with increased negative emotional distraction during inhibitory trials (Negative NoGo > Neutral NoGo contrast).
- Templates of brain networks provided by the Human Connectome Project (HCP; <https://www.humanconnectome.org/study/hcp-young-adult>),¹¹ derived from group ICA of resting state fMRI data collected in more than 1000 participants, with ICA dimensionality = 50, were used to examine task-related network activation strengths.
- Network spatial map templates were regressed against the full set of 48 brain activation maps for the Negative NoGo > Neutral NoGo contrast¹² to estimate the impact of negative emotional stimuli during response inhibition on the strength of activation of each associated network, resulting in a subject-series of activation strengths for each of the 50 template brain networks for each participant. Multiple regression analyses were done to examine associations between task-related network strengths, AUDIT and SI for selected networks of interest.

Results



- The network in **Figure 2a**, derived from HCP data, comprises positive connectivity between regions involved in emotion (e.g. amygdala) and attention regulation (e.g. fusiform, precuneus), and negative connectivity with cingulo-opercular network nodes.
- A multiple linear regression including SI, AUDIT Year 1 follow-up total scores, and the SI x AUDIT interaction as predictors showed a significant interaction effect on activation of the above network (standardized beta=.949, t=2.70, p=.011), with recruitment of this network being significantly positively associated with AUDIT only in the SI group (**Figure 2b, c**).



- In the full sample, activation of this network was also associated with slowed reaction times on negative versus neutral Go trials (negative Go RT – neutral Go RT; r=.441, p=.004), with a particularly strong association observed in the SI group (r=.708, p=.007) (**Fig 2d, e**).

Discussion

- The spatial profile of the brain network we found to be associated with an SI x AUDIT interaction suggests that this network could play a role in directing cognitive resources between the maintenance of stable task performance (cingulo-opercular network nodes) and the processing of emotionally salient visual stimuli in the environment (limbic and attention-regulation nodes).
- In support of this proposed function, activation of this network was also associated with slowed Go-trial reaction times on emotionally negative relative to neutral distractor trials.
- The relationship between network activation and risky drinking at follow-up in the SI group suggests that the ability to redirect cognitive focus away from negative emotions might play an important role in regulating alcohol use among college students experiencing suicidal ideation.
- These findings underscore the importance of interactions between mental health and brain function in understanding problematic alcohol use in young adults.

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