Changes in alcohol consumption post-trauma are significantly associated with reward—related brain activation

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EMORY UNIVERSITY SCHOOL OF MEDICINE

Grady Trauma Project

Background

- Posttraumatic stress disorder (PTSD) and problematic alcohol use frequently co-occur,[1] and the neural factors that contribute to the development of problematic alcohol use after acute trauma exposure are unknown.
- Using a multi-site longitudinal study design, we explored whether the change in alcohol consumption pre-trauma to 8 weeks post-trauma was associated with reward-related brain reactivity and functional connectivity (FC) measures gathered 2-weeks post-trauma.
- Exploring reward-related brain alterations in PTSD is important to potentially uncover the underlying mechanisms promoting alcohol use.

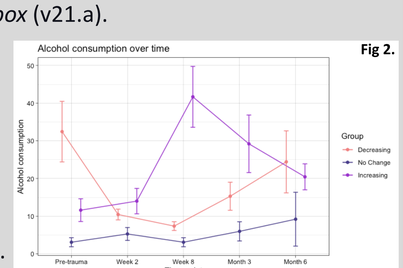
Research Question

1. Explore associations between alcohol change scores (pre-trauma to 8 weeks post-trauma) and reward-related reactivity and functional connectivity (2-weeks post-trauma).
2. Determine whether significant differences in brain measures exist between three alcohol change groups: those who increased use, decreased use, or showed now change in alcohol use.

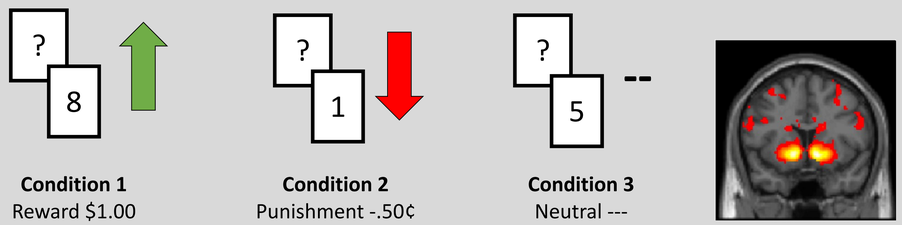
Methods

- Participants were recruited from emergency departments across the U.S. as part of the AURORA study (N=286; *n*=178 Female).
- Alcohol consumption (drinks per month; PhenX Toolkit[2]) was assessed for the month prior to the trauma and again 8 weeks post-trauma.
- Trauma-related change in drinking was quantified as the change in 30-day total drinking at 8 weeks, relative to pre-trauma.
- Reward-related neural reactivity was assessed at 2 weeks post-trauma using functional magnetic resonance imaging (fMRI) during a monetary reward task (**Fig. 1**) and analyzed in *fMRIprep* and *SPM12.* Structural regions of interests (ROIs) were extracted using the Reinforcement Learning Atlas.[3] *R* (v4.2.1) was used to conduct statistical analyses.
- Seed-based FC analyses examining the association between reward-related reactivity and change in alcohol consumption were conducted using *CONN Toolbox* (v21.a).
- Reward-related neural reactivity was compared across those whose alcohol consumption increased (*n*=99, *n*=60 Female), decreased (*n*=103, *n*=67 Female), or did not change (*n*=84, *n*=51 Female), (**Fig. 2**).

Fig 2.



Monetary Reward Task



Condition 1
Reward $1.00

Condition 2
Punishment -.50¢

Condition 3
Neutral ---

Fig. 1. Overview of the modified monetary reward task from Delgado et al., 2000[4]

Results

Correlational Analyses

Table 1. Correlation Matrix Across Alcohol Change Scores and Reward-related Reactivity (Gain > Loss)

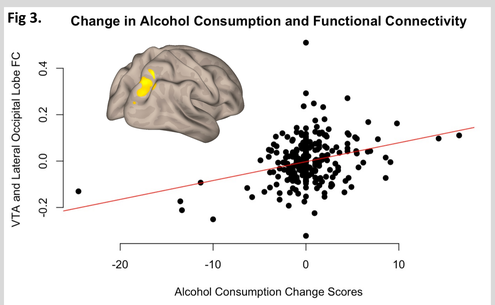
Variable	Mean (SD)	1	2	3	4	5	6	7
1. Alcohol Consumption Change Scores	.17 (3.38)	-						
2. VTA	-.02 (.64)	.22**	-					
3. Nucleus Accumbens	.56 (.62)	.12	.20**	-				
4. Globus Pallidus External	.05 (.35)	.07	.19**	.05	-			
5. Globus Pallidus Internal	-.02 (.37)	.01	.17**	.03	.54**	-		
6. Caudate	.17 (.41)	.02	.22**	.42**	.36**	.12*	-	
7. Putamen	.16 (.36)	.03	.13*	.34**	.49**	.21**	.59**	-

Note. Abbreviations: VTA = ventral tegmental area.
**p<.001, *p<.05

A significant positive correlation was found between VTA reactivity to the Gain > Loss contrast and change scores in alcohol consumption.

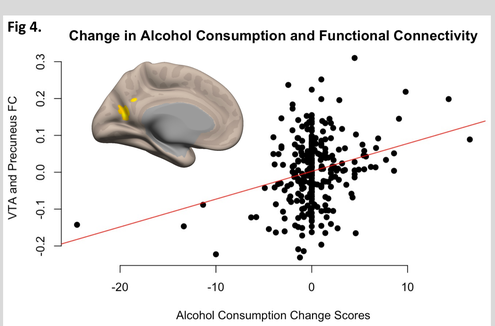
Functional Connectivity Analyses

Fig 3.



Greater FC between the VTA seed and lateral occipital cortex (MNI, x=28, y=-76, z=50) was associated with greater change in alcohol consumption, cluster-level P_{FWE}<.001, K_E=607, (**Fig. 3**).

Fig 4.



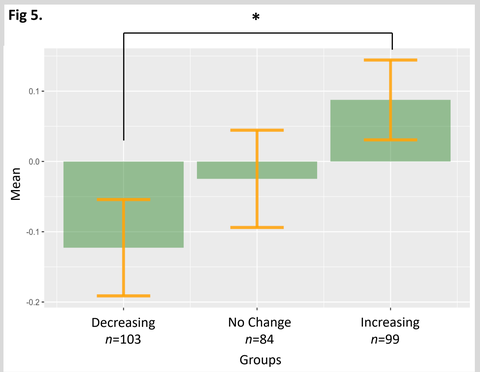
Greater FC between the VTA seed and the precuneus (MNI, x=-20, y=-60, z=18) was associated with greater change in alcohol consumption, cluster-level P_{FWE}=0.014, K_E=290, (**Fig. 4**).

Results

Group Differences

Analysis of variance (ANOVA) exhibited a significant group difference, $F(1, 284)=5.56$, $p=0.02$. The increasing alcohol consumption group exhibited greater VTA activation (M=.09, SD=.56) than the decreasing alcohol consumption group (M=-0.12, SD=.70; **Fig. 5**).

Fig 5.



Implications

- Clarifying the relationship between PTSD symptoms and alcohol use will lead to intervention development for those recently exposed to trauma.
- The findings presented provide evidence that changes in alcohol consumption early post-trauma may contribute to reward alterations in trauma-exposed individuals.
- Uncovering the neural correlates of alcohol use in recently trauma-exposed participants is pivotal in determining who would benefit most from early interventions to prevent the development of trauma-related psychopathology.

Future Directions

- These findings align with previous research that suggest an initial increase in reward-related brain activation may contribute to the reinforcing effects of substances contributing to increased use of the substance, potentially leading to dependence.
- Latent class analysis can be used to determine different longitudinal trajectories of alcohol use after trauma exposure and whether significant differences exist between these classes in reward-related neurocircuitry.

References

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