

Investigating the Effect of Adolescent Alcohol Binge Drinking on the Development of Value-Driven Attentional Bias and Associated Neural Activity

Banban Tan, Elena Vidrascu, Charlotte Boettiger
University of North Carolina at Chapel Hill



THE UNIVERSITY
of NORTH CAROLINA
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BACKGROUND

Three types of attentional bias (AB)

- Goal-driven AB: intentionally look for the car key
- Stimulus-driven AB: be attracted to a visually obvious color
- Value-driven AB (VDAB): be attracted to a photo of junk food

Alcohol and VDAB:

- Stronger AB towards reward-associated stimuli
- Decreased flexibility

Alcohol Binge Drinking (ABD):

- Consuming ≥ 5 (male) or ≥ 4 (female) standard drinks in 2 hours

Adolescent binge drinking:

- Prevalence
 - 29% reported drinking alcohol in the past 30 days, 32% in female
 - 48% of teenage drinkers had binge drank experience
- Vulnerability
 - More impulsive behaviors, e.g. risky decision-making
 - Worse memory and reversal learning
 - Shrinking of gray and white matter volumes in multiple brain regions

Region of Interest: Caudate

- High sensitivity to the value of visual stimulus
- Functions in the dopaminergic pathways of reward processing and learning

Knowledge Gaps:

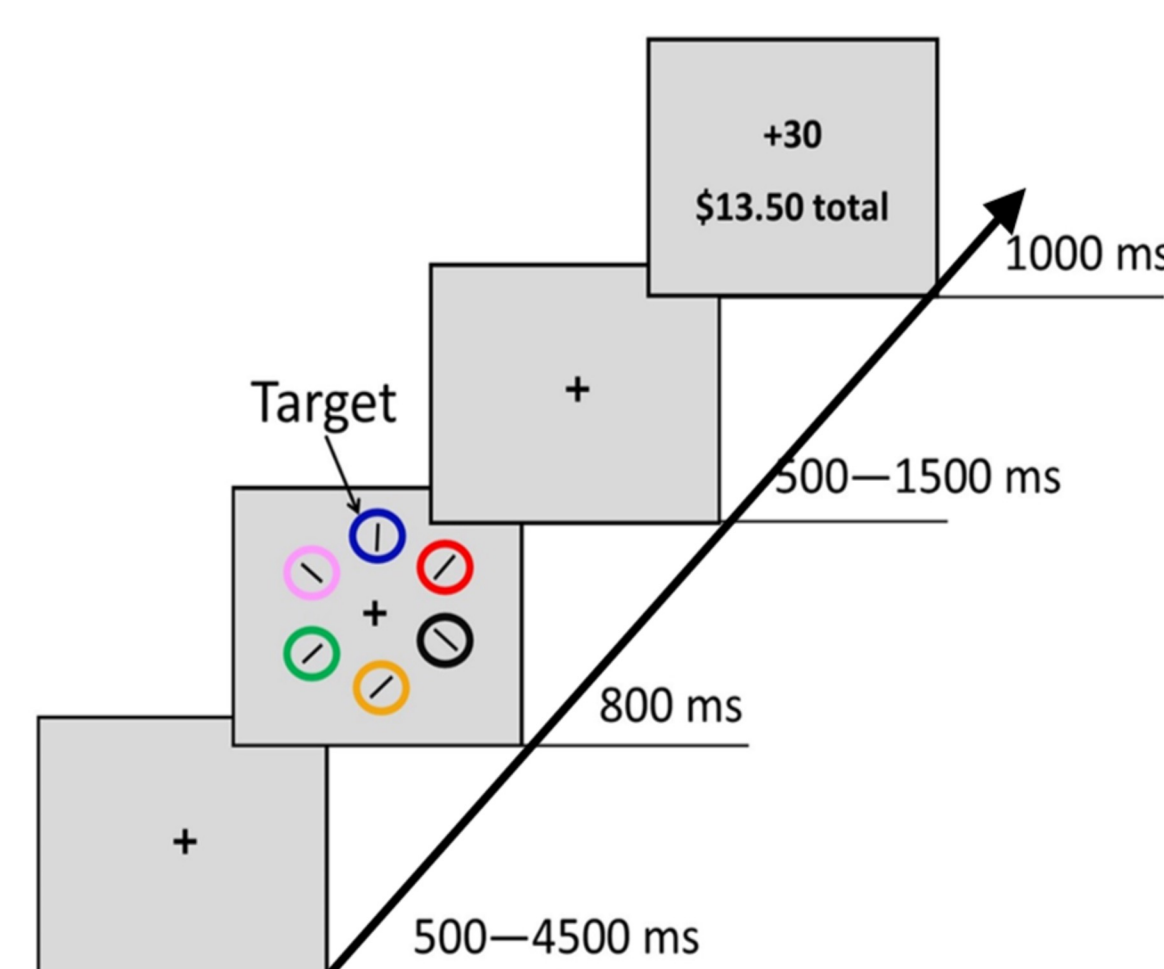
1. Reward conditioning process vs. developed attentional bias
2. Alcohol vs. non-alcohol cues
3. AUD/SUD vs. adolescent alcohol misuse

METHODS

TRAINING PHASE

stimulus (target) + reward

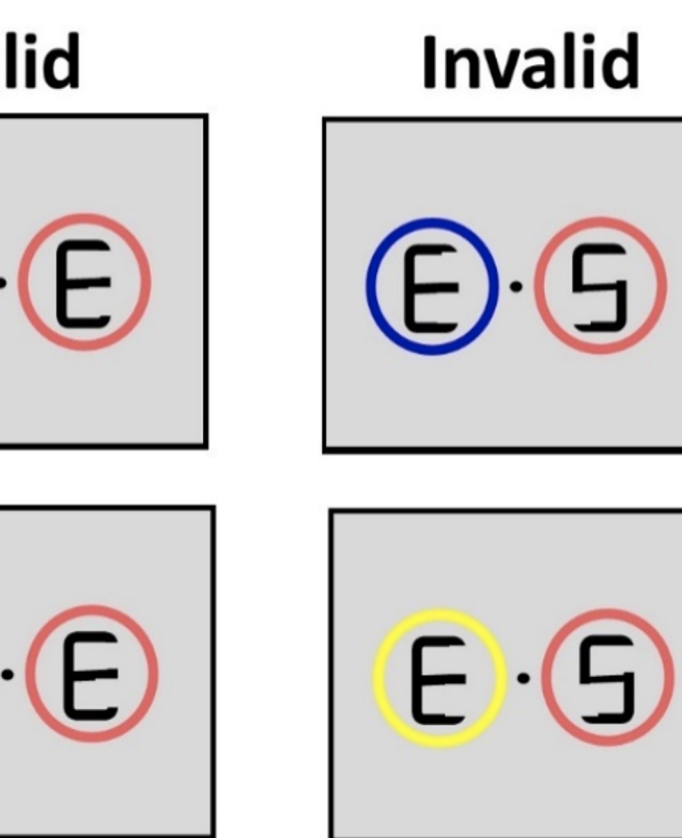
Condition the target with reward (money, food, alcohol, etc.)



- Find the target color (blue/yellow)
- Select the direction of the inside line
- Earn money for correct answer if the color is rewarded
- Performance measured by reaction time, accuracy, IES=RT/accuracy

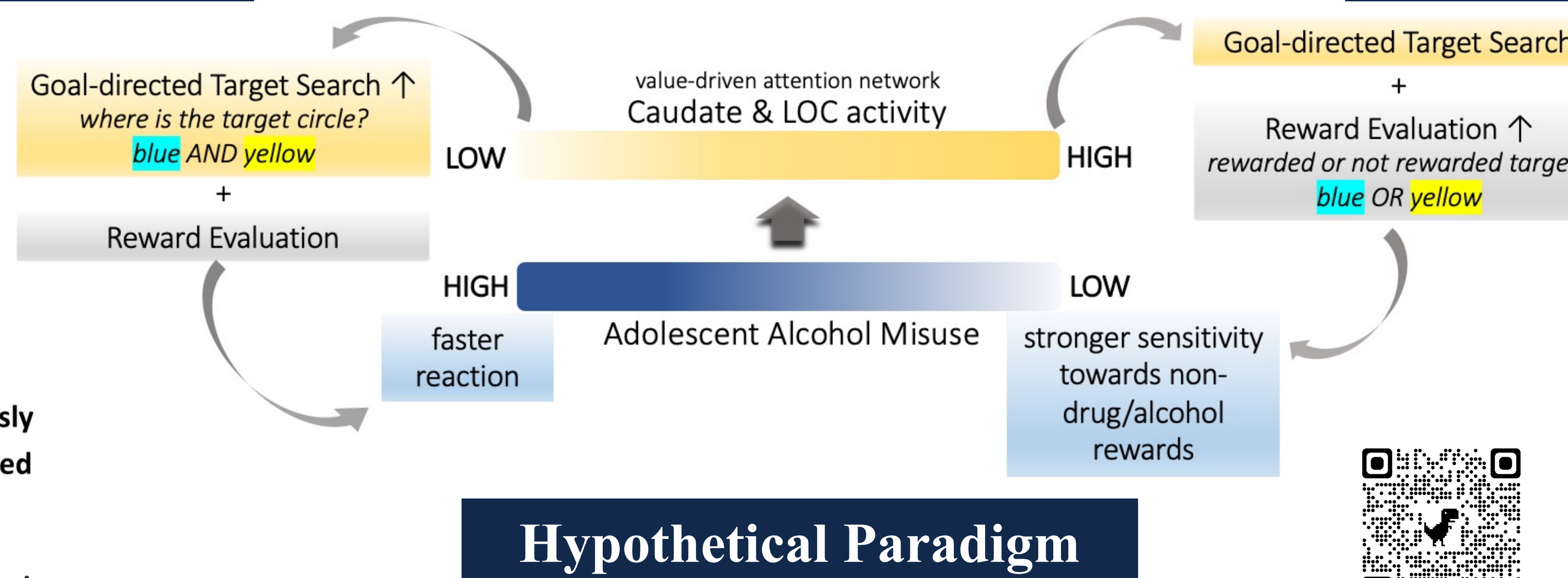
TESTING PHASE

new target + stimulus (distractor) or stimulus (facilitator)

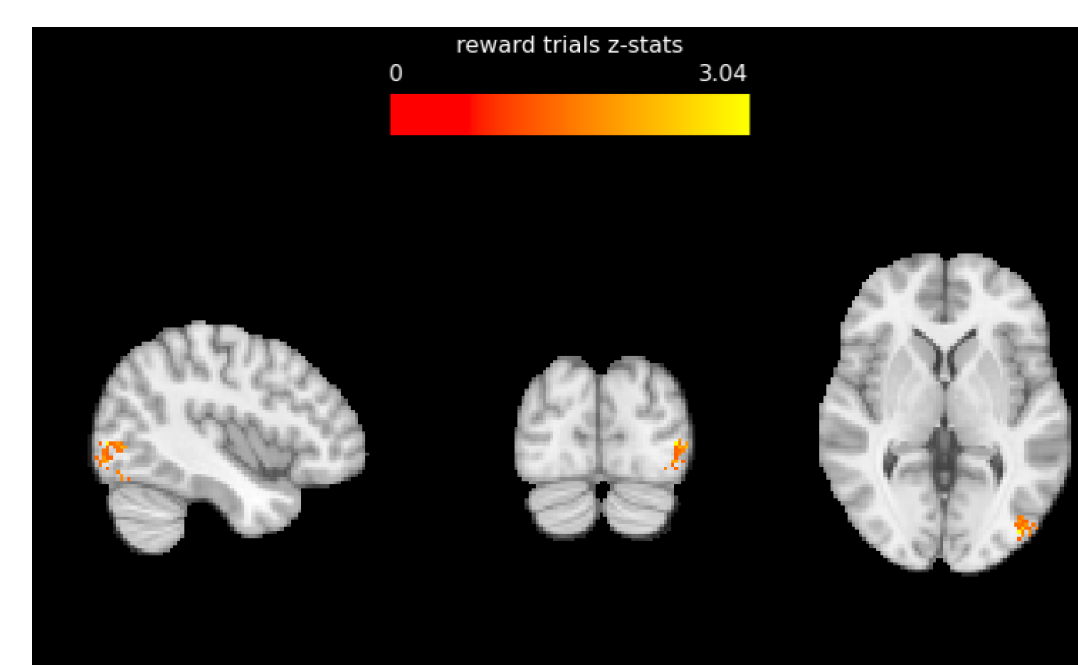


S = Target

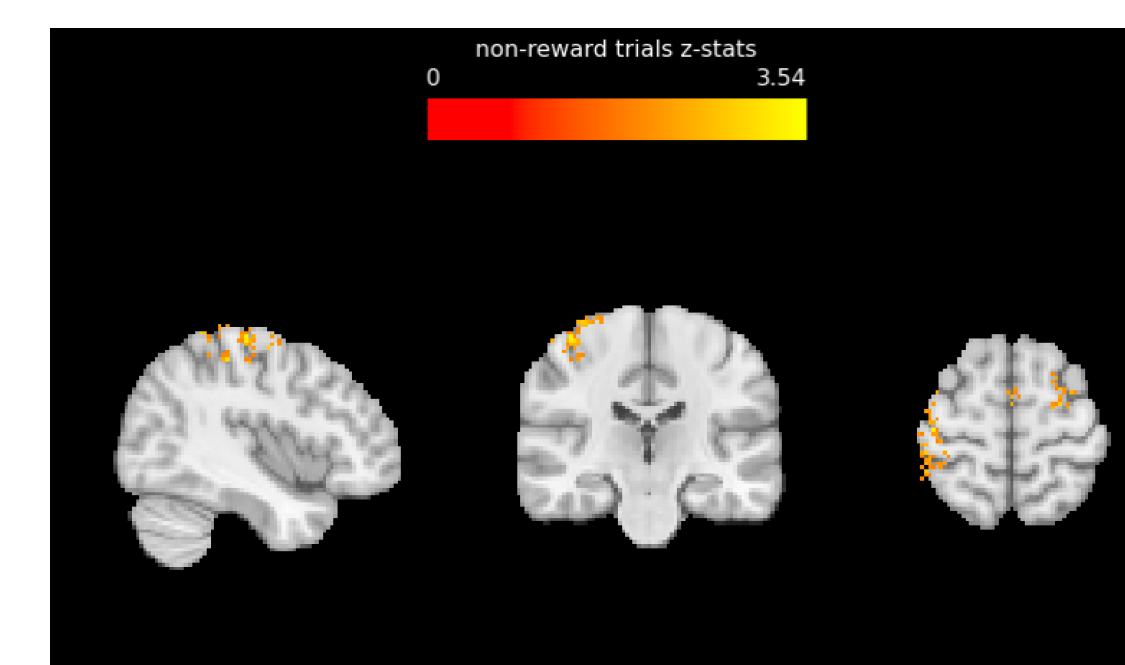
- Find the target letter (S/P)
- Color of the circle can be blue/yellow or neutral
- Valid=target inside the blue/yellow circle
- Invalid=target in the opposite circle of the blue/yellow circle
- No monetary reward



Hypothetical Paradigm

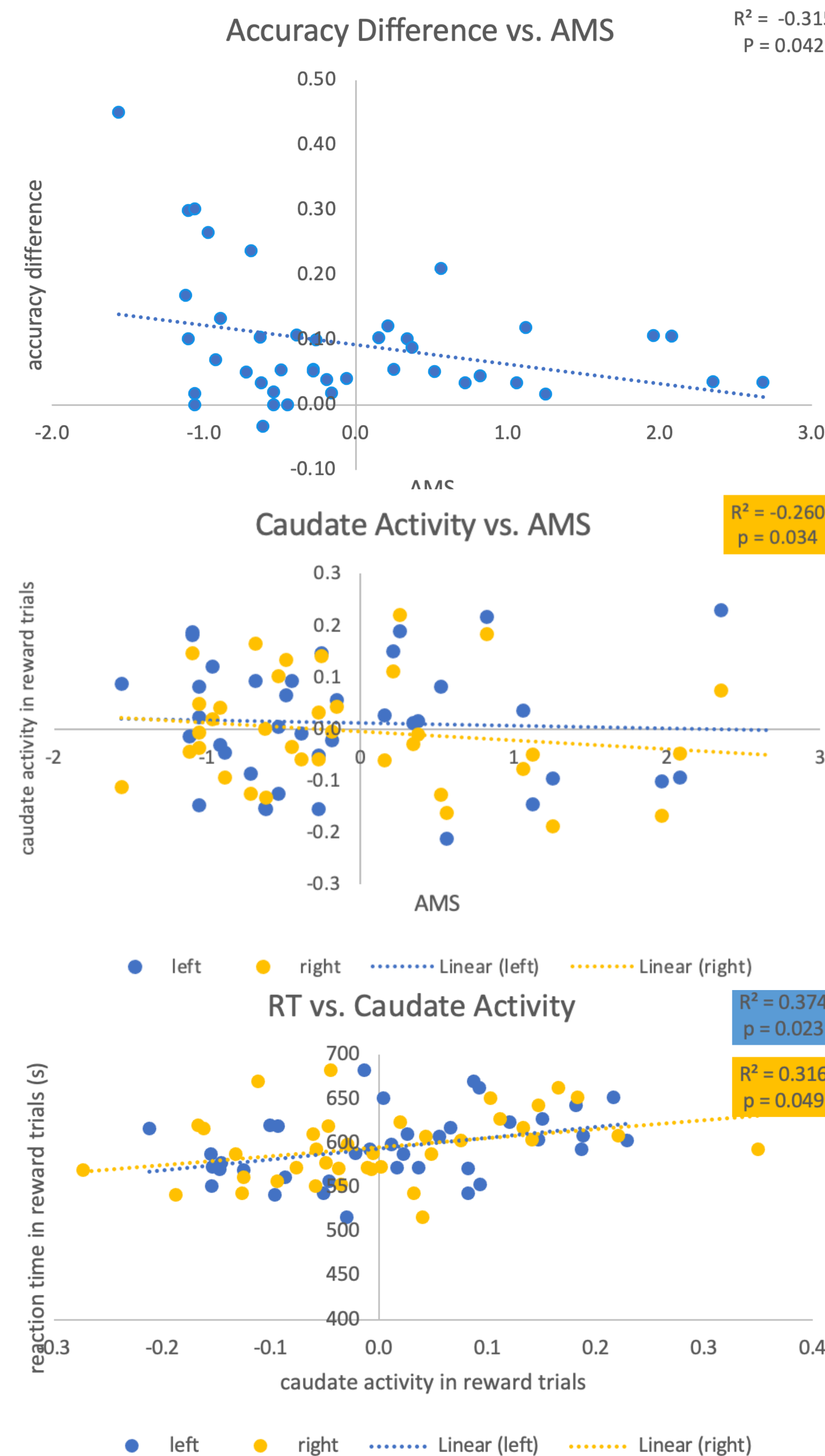


Significant main effect of non-reward stimulus on ABD group in the supplemental motor cortex (SMC)



Significant main effect of reward stimulus on CTRL group in the lateral occipital cortex (LOC)

RESULTS



1. The difference in accuracy between rewarded and non-reward trials is negatively correlated with AMS
 2. Neural activity in the caudate and lateral occipital cortex (LOC) is negatively associated with AMS
 3. The reaction time during the rewarding trials is positively related with neural activity in the caudate and LOC
- ROI analysis:
 - A main effect of rewarding stimuli in the lateral occipital cortex in the control group
 - A main effect of non-rewarding stimuli in the supplementary motor cortex and precentral and postcentral gyrus in the adolescent binge drinking group
 - Sex difference:
 - Females showed a trend of stronger AB or AB development
 - In the training phase, only females showed a strong correlation between AMS and sensitivity towards reward; whereas in the testing phase, only males' AB was significantly affected by AMS.
 - Hypothetical paradigm:
 - As more binge drinking can predict the lower ROI neural activity - for which binge drank more before 18 and have weaker activity in the value-driven attention network, they tend to focus more on the goal-directed search and perform with faster reaction but less sensitivity towards reward during associative learning.

FUTURE DIRECTION

- The effect of current alcohol binge drinking on the performance in reward learning
- The contract of caudate neural activity between rewarded and non-reward trials vs. disengagement effect in the testing phase
- Neural activity in vmPFC and ACC and its correlation with the disengagement effect in the testing phase
- Performance (RT, acc, IES) change across the three blocks in the testing phase
- Caudate activity changes across smaller blocks and the difference between drinking groups (adolescent binge drinking group, control group; or higher than average, average level, and lower than average)
- The impact of attention impulsivity, motor impulsivity, and non-planning impulsivity on the performance
- The effect of drinking history on the disengagement effect in the testing phase