Sign vs. Goal Tracking in Alcohol Use Disorder: Predicting Problem Alcohol Use Using A Neurophysiological Endophenotype of Reward-Based Incentive Salience Attribution

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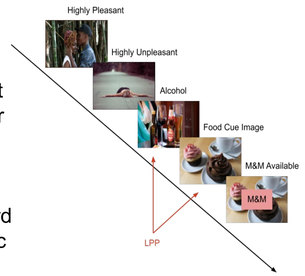
BACKGROUND

- Between 2020-21, alcohol use disorder (AUD) claimed the lives of almost 200,000 Americans (Centers for Disease Control and Prevention, 2024).
- Evidence-based treatments exist but are not effective for many, with heterogeneity of AUD likely a key contributor (Litten et al., 2016).
- Identifying individual predictors of potential treatment response could be one key to improving outcomes. One promising candidate predictor could be ***incentive salience attribution (ISA):***

  In cued reinforcement paradigms, the degree to which value (i.e., incentive salience) is associated with the cue that predicts the desired outcome (the *sign*) and/ or with the outcome itself (the *goal*).
- Work with non-AUD samples finds reliable individual ISA differences (whether individuals respond to signs as salient stimuli or not; Versace et al., 2019) As a first step to study ISA as a candidate treatment predictor in AUD, this study tested if ISA differences are also measurable in individuals with AUD.

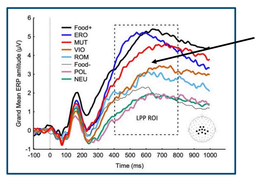
METHODS

- 24 participants with AUD have completed this ongoing observational study.
- **ISA task**: Participants see images varying in inherent hedonic content (pleasant, unpleasant, or neutral) and intensity. One low-intensity image type is consistently followed by a food reward (M&M candy) 2s after pic onset.



CAPTURING ISA DIFFERENCES

- **Measurement Modality:** 32-channel brain electro-encephalography (BrainVision active EEG system)
- **Salience Index:** An event-related brain response to pictures whose amplitude scales with image salience – the late positive potential (LPP).



CLASSIFYING ISA DIFFERENCES

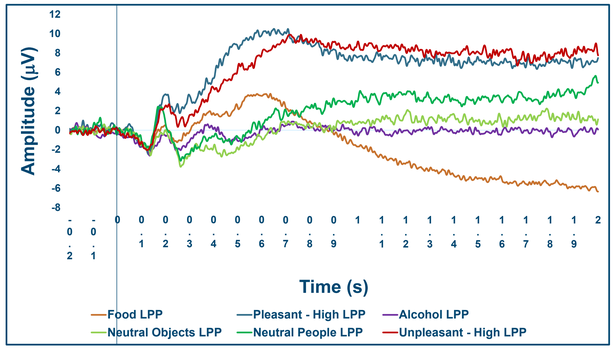
- Sign Trackers: individuals with >3μV larger LPP for pleasant *and* food-predicting images vs. neutral
- Goal Trackers: Individuals with >3μV larger LPP for pleasant than food and <3μV food vs. neutral diff.

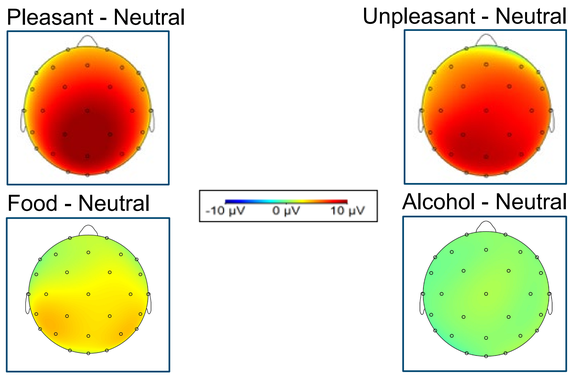
RESULTS

- Paired t-test results convey that all participants showed consistent LPP amplitude enhancement for highly unpleasant, $t(23)=9.4$, $p<.001$, and highly pleasant, $t(23)=8.6$, $p<.001$, pictures compared to neutral pictures, shown in **Figure 1**.
- Applying our classification scheme revealed half (n=12) of participants who also showed LPP enhancement for low-intensity food-predicting pictures (i.e., signs) compared to neutral images, $t(11)=7.6$, $p<.001$, and another half who showed no difference between food-predicting and neutral pictures, $t(11)=-0.3$, $p=.744$ **(Figures 2 and 3).**
- On average, sign trackers consumed less M&Ms than goal trackers **(Figure 4)**, but there were no statistical differences comparing their AUD symptoms **(Figure 5)** or past-month alcohol consumption **(Figure 6).**

LATE POSITIVE POTENTIAL RESPONSE IN TASK

Figure 1: LPP Response All Participants





INCENTIVE SALIENCE ATTRIBUTION DIFFERENCES IN RESPONSE TO TASK

Figure 2: LPP Response for Goal vs. Sign Trackers

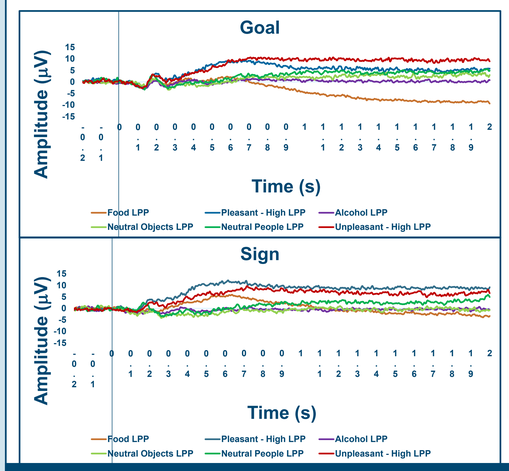
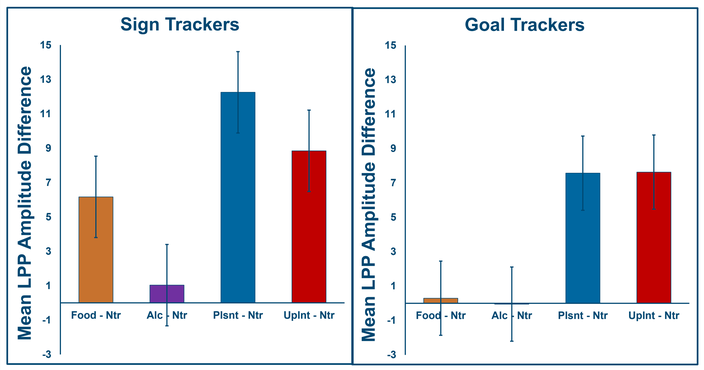


Figure 3: LPP Response Differences for Goal vs. Sign Trackers



INCENTIVE SALIENCE ATTRIBUTION BEHAVIOR DIFFERENCES

Figure 4: M&Ms Eaten in Task

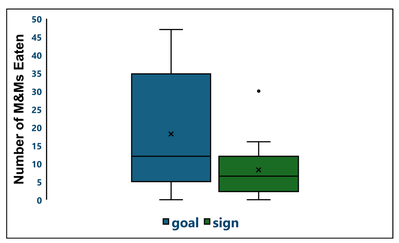


Figure 5: AUDIT Questionnaire Score

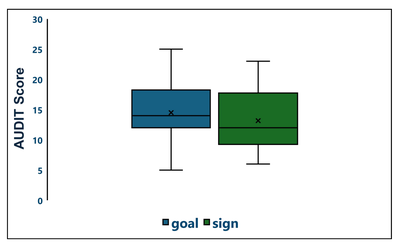
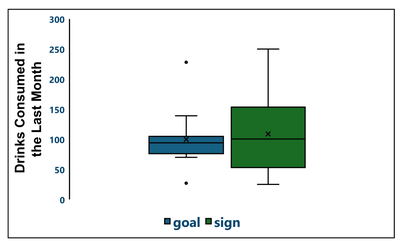


Figure 6:TLFB Total Alcohol, past mo.



CONCLUSIONS

- Key Finding: ISA Differences were readily detectable in individuals with AUD:
  - Sign trackers showed robust LPP enhancement for images that were not inherently salient but did predict a general reward (candy)
  - Goal trackers showed minimal LPP for reward-predicting low-intensity images
  - All participants showed LPP enhancement to inherently emotional images (*goals*)
- Of note: ISA differences were apparent in a task using *general rewards*, rather than *disorder-specific reward* (i.e., alcohol).
- In this study, ISA distinctions also predicted task behavior such that M&M consumption was greater for goal trackers than sign trackers - opposite to prior findings (Versace et al., 2019).
  - More work is needed to determine if different patterns arise with alcohol-related rewards
- ISA also did not predict alcohol use severity but this is consistent with findings from other samples (e.g., cigarette smokers; Versace et al., 2023). At the same time, ISA differences might still predict *treatment outcome variables* (response to treatment, relapse risk) like in that study
- Findings support a biological index of ISA (LPP response to reward-predicting images) for further study as a treatment predictor candidate in AUD.

FUTURE DIRECTIONS

- Future studies should compare results from an alcohol-non-specific task with results from a version that uses alcohol rewards - to determine if similar or different patterns arise with different rewards
- Also, future investigations should determine if classifying individuals with AUD based on ISA accurately predicts standardized AUD treatment outcomes – including treatment response and treatment response durability

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