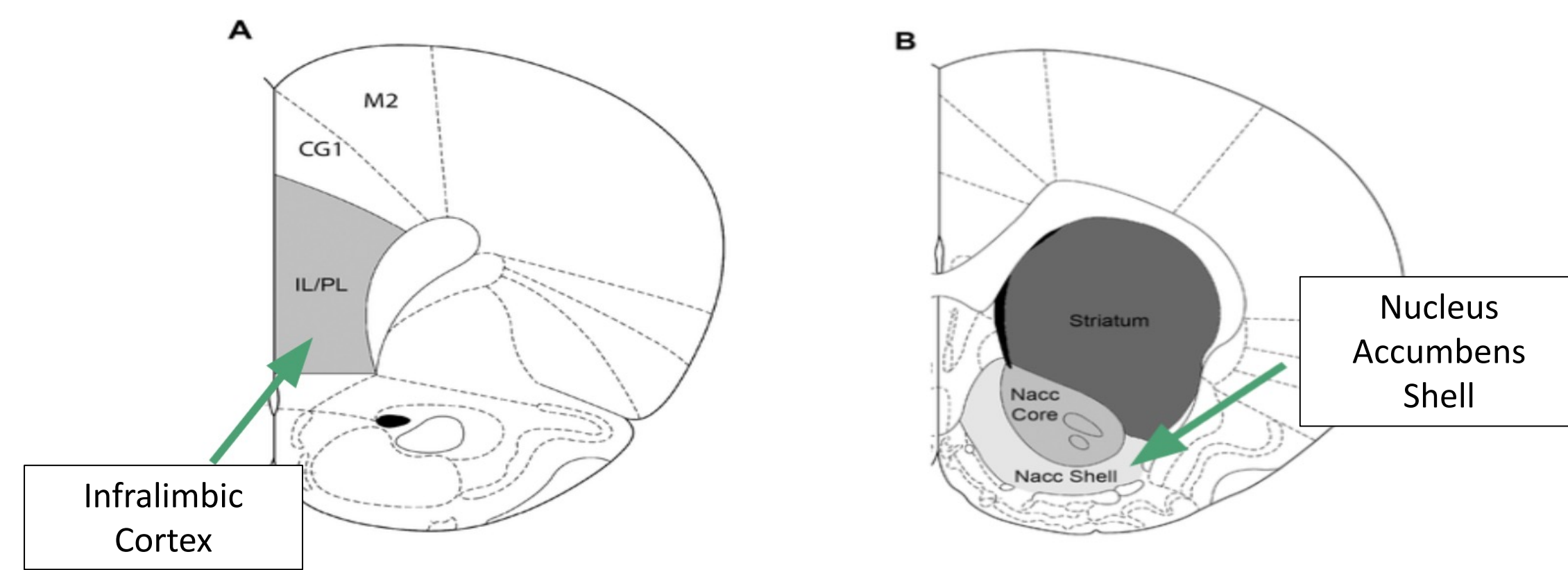


Introduction

- Disruption in hedonic processing that leads to negative affective states is associated with several psychiatric disorders such as substance use disorders (SUD), depression, and anxiety.
- The infralimbic cortex to nucleus accumbens shell (IL-NAcSh) pathway is key in coding for negative affect.
- Prior research showed that optogenetics stimulation at 20 Hz of the IL-NAcSh pathway restored behavioral effects associated with negative affective states.
- Coherence represents a functional connectivity of IL and NAcSh and has shown to be disrupted by CTA.
- tACS is a non-invasive brain stimulation that allows for tailoring of the stimulation at specific frequencies associated with certain behaviors.

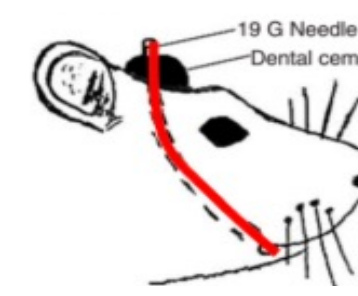
Hypothesis: tACS at 20 Hz will revert the aversive effect elicited by LiCl on saccharin solution.



Methods

Taste Reactivity (TR)

- Insertion of intraoral canula (IO) allows tastant infusion directly into the oral cavity
- TR occurs during intraoral infusion of different types of taste stimuli and recording the facial expressions of rats
- Tongue protrusions for pleasant tastes (appetitive TR) and gapes (triangle shaped mouth; Aversive TR) for unpleasant tastes

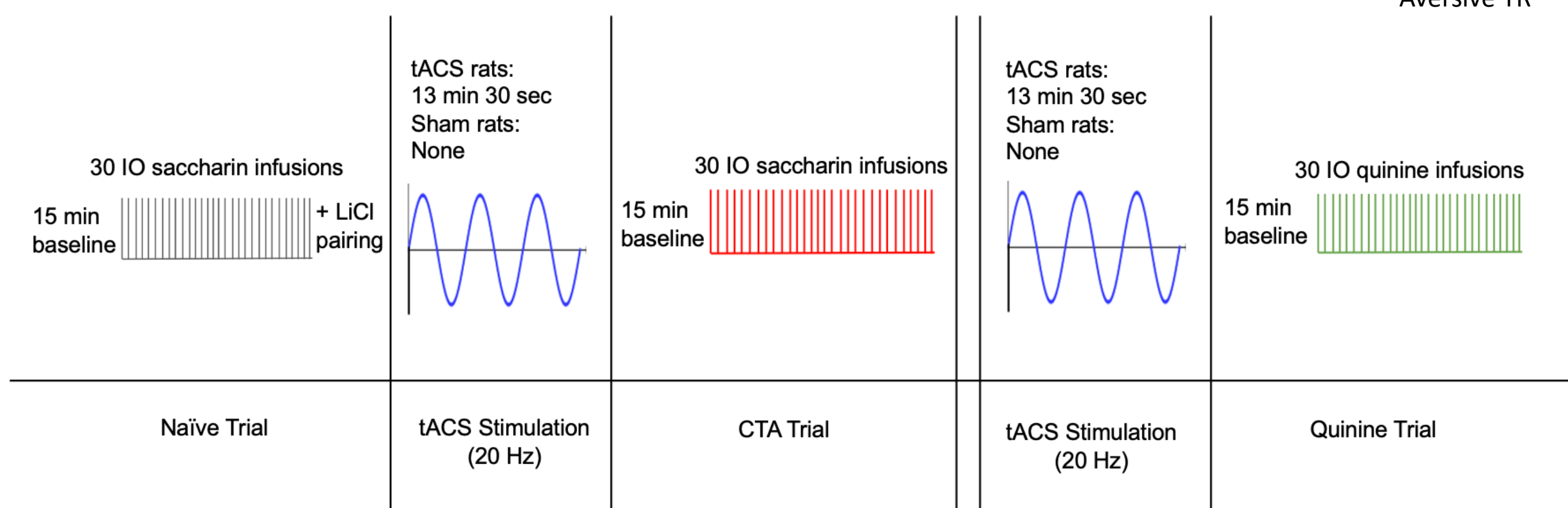


Conditioned Taste Aversion (CTA)

- Rewarding saccharin solution is paired with the injection of malaise producing lithium chloride (LiCl)
- Rats show conditioned aversion (Aversive TR) to saccharin after the pairing

Experimental Design

- 15 Sprague Dawley male rats, 9 tACS treated rats (20 Hz) and 6 Sham
- Rats were mildly water restricted throughout the experiment
- Analysis performed via t-test and one-way ANOVA



Results

Naïve Trial

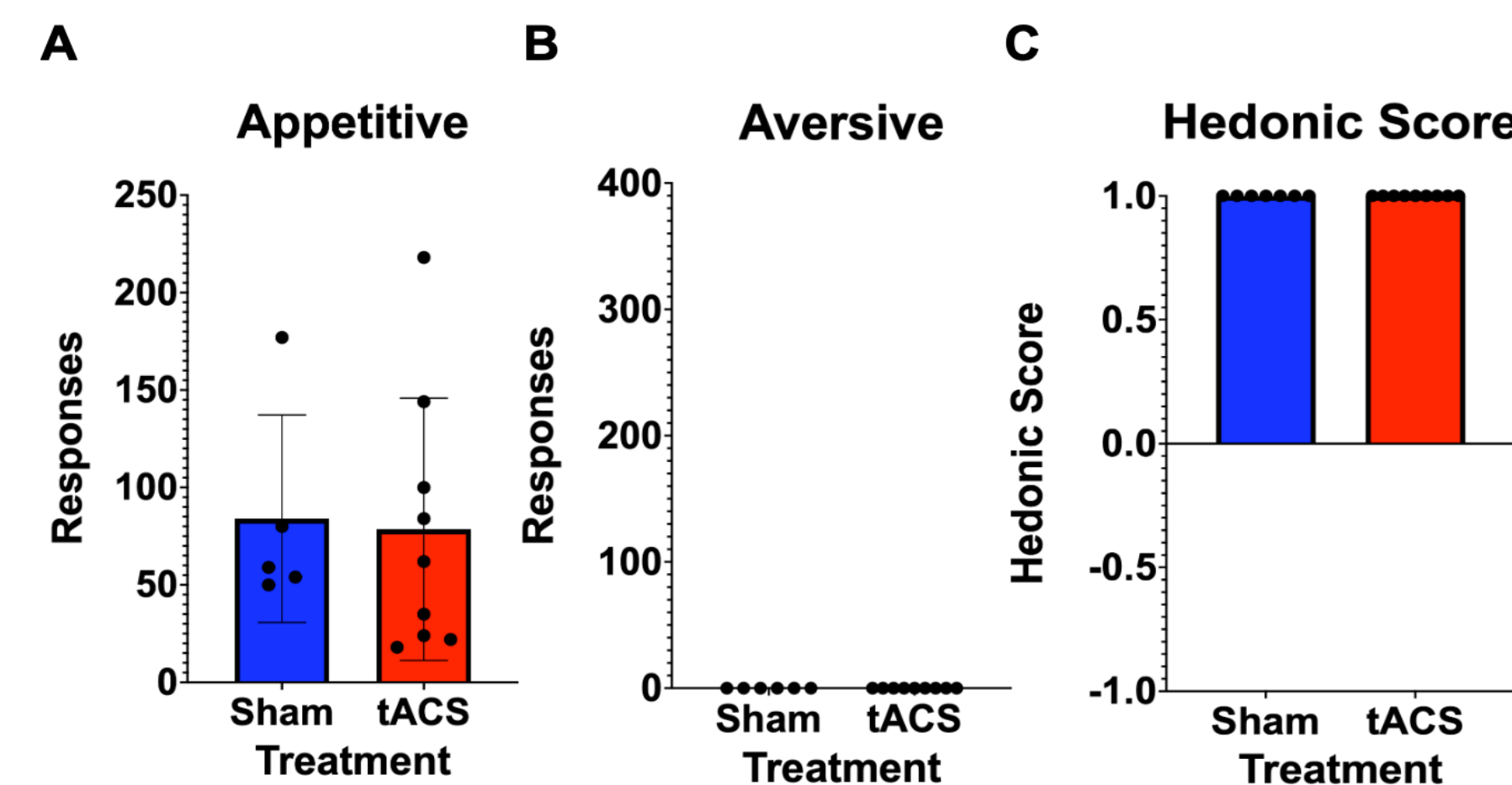


Figure 1. Appetitive and aversive taste reactivity responses and hedonic scores before treatment.

Tongue protrusions (including lateral) were counted as appetitive, and gapes were counted as aversive response. Both groups showed similar number of appetitive

responses without any aversive responses. Hedonic score of 1 shows the presence of appetitive responses only.

CTA Trial

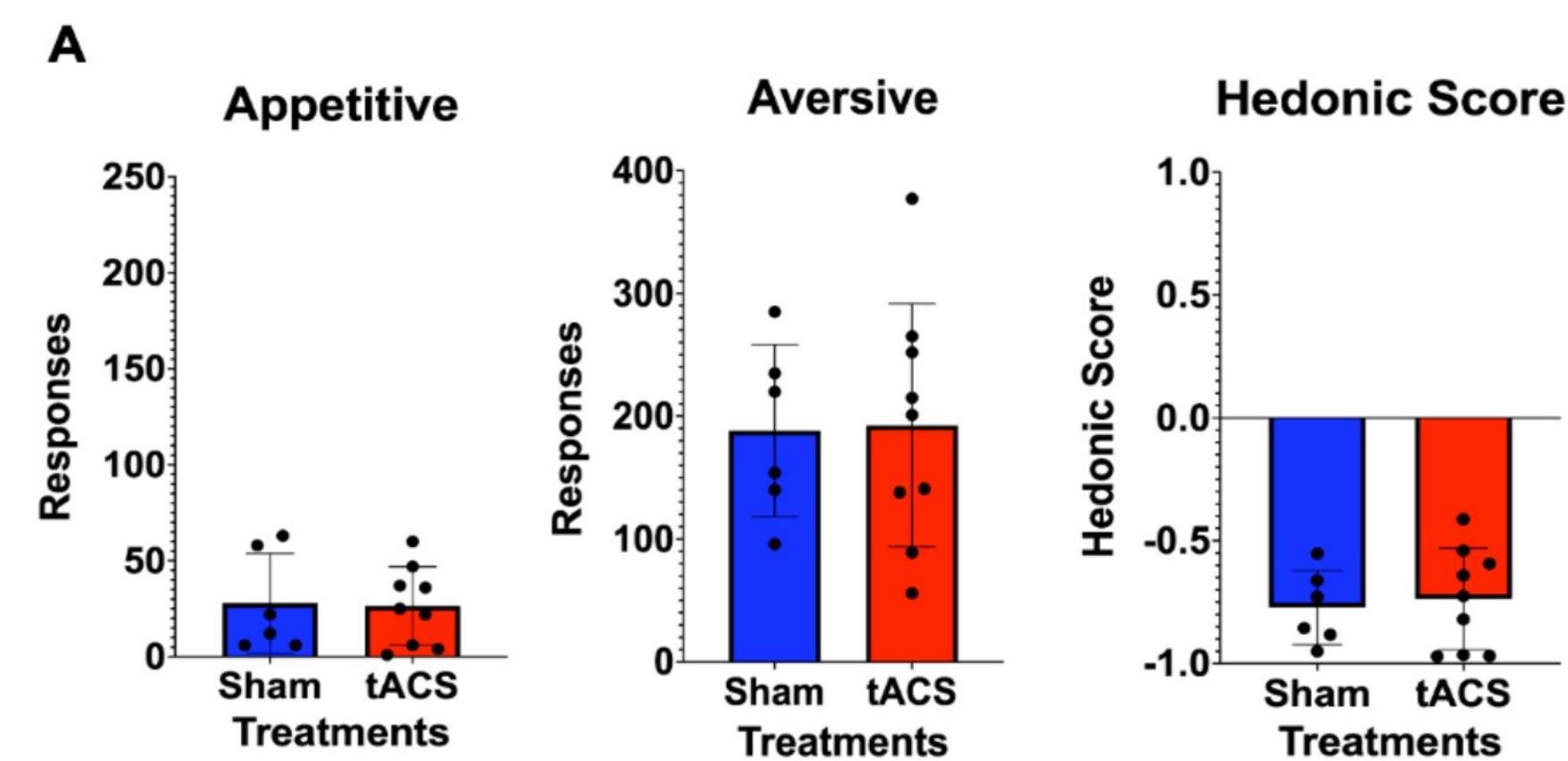


Figure 2. Appetitive and aversive taste reactivity responses and hedonic score for each group during CTA test.

Sham and tACS rats showed similar number of appetitive and aversive responses. Both groups recorded higher number of aversive responses as shown

in hedonic scores in the negative range. Three rats in tACS group showed lower hedonic score compared to the rest of the group.

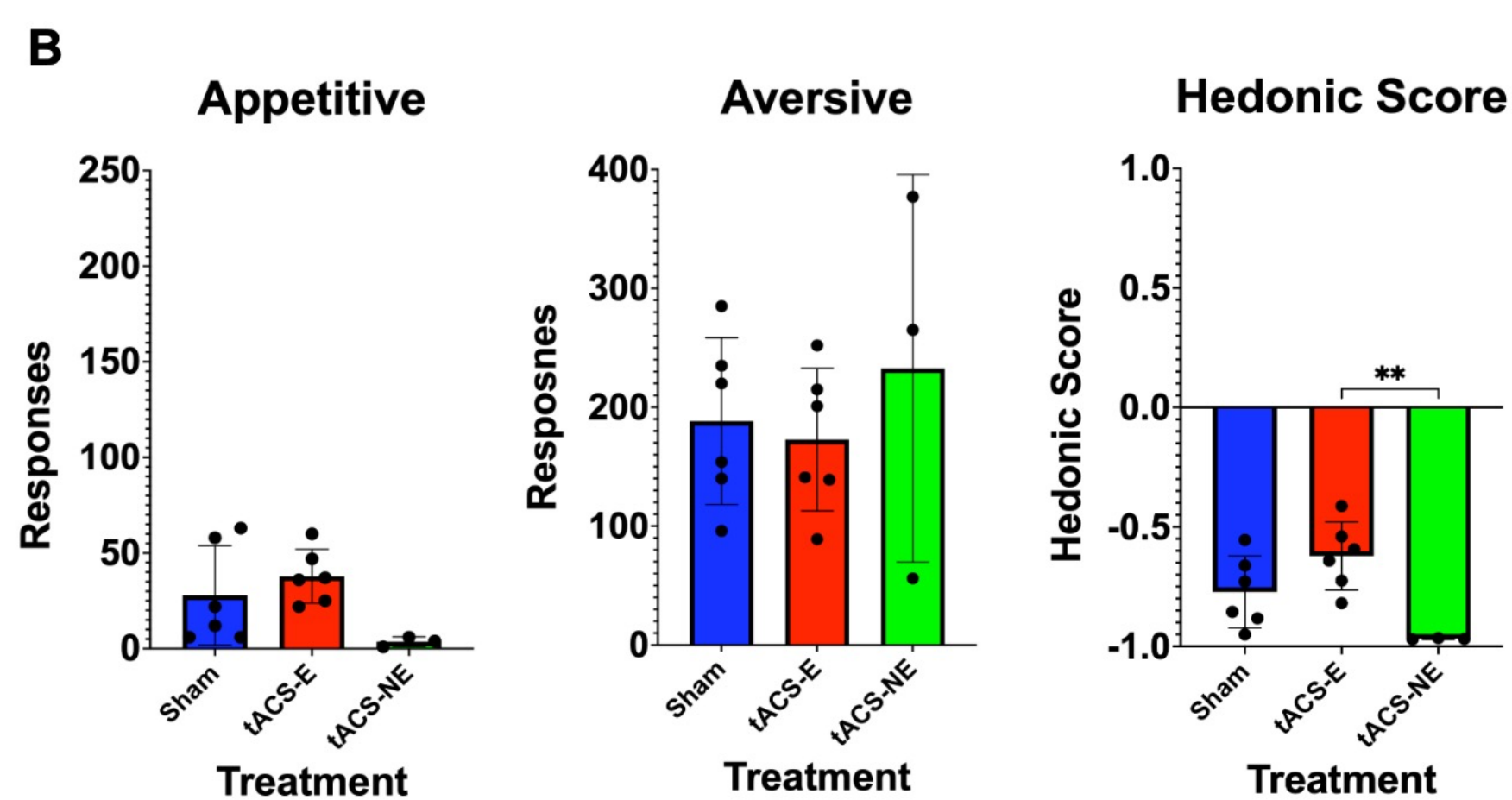


Figure 3. tACS group was divided into two groups where the three rats that showed hedonic score of -1 were labeled tACS-Non-Effective (tACS-NE) and the rest as tACS-Effective (tACS-E).

A significant difference in tACS-NE and tACS-E was observed in hedonic score.

tACS treatment was effective in improving hedonic score in some individuals.

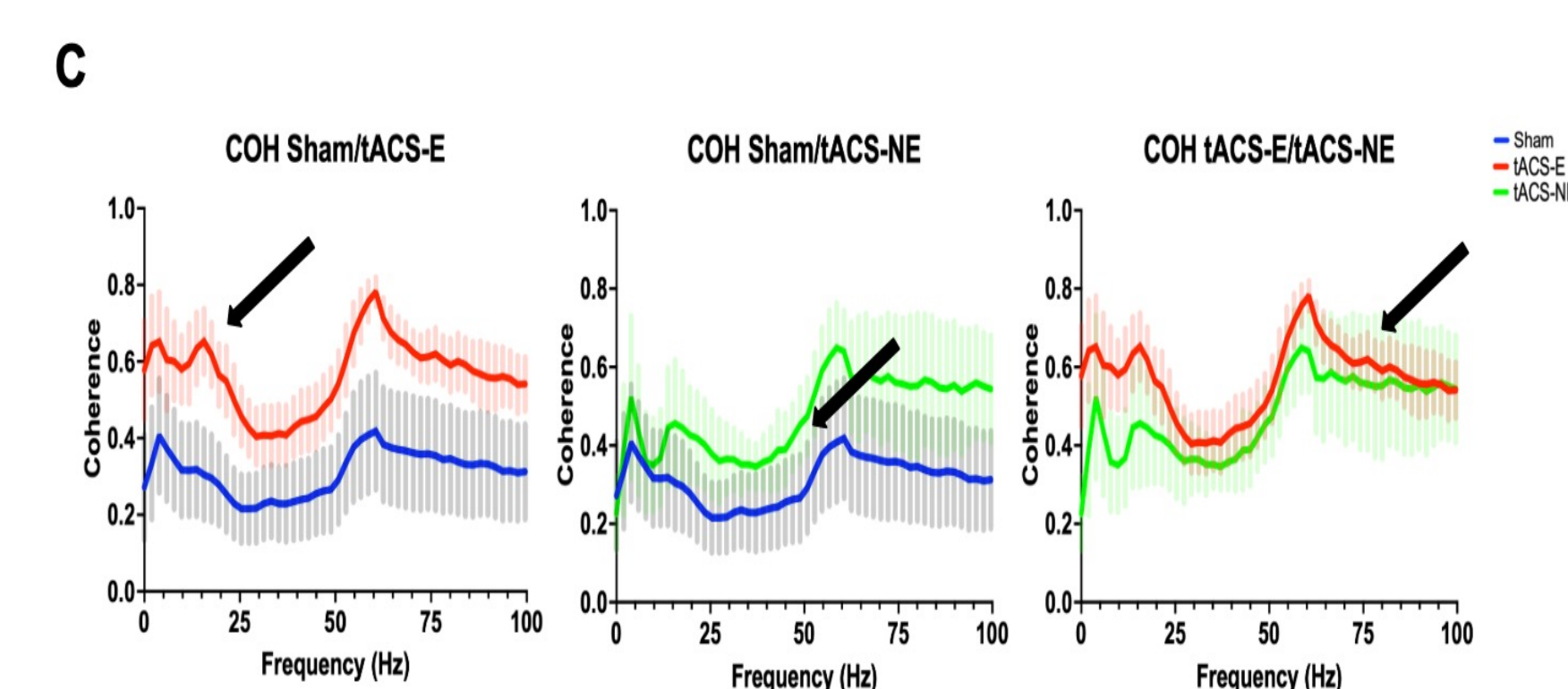
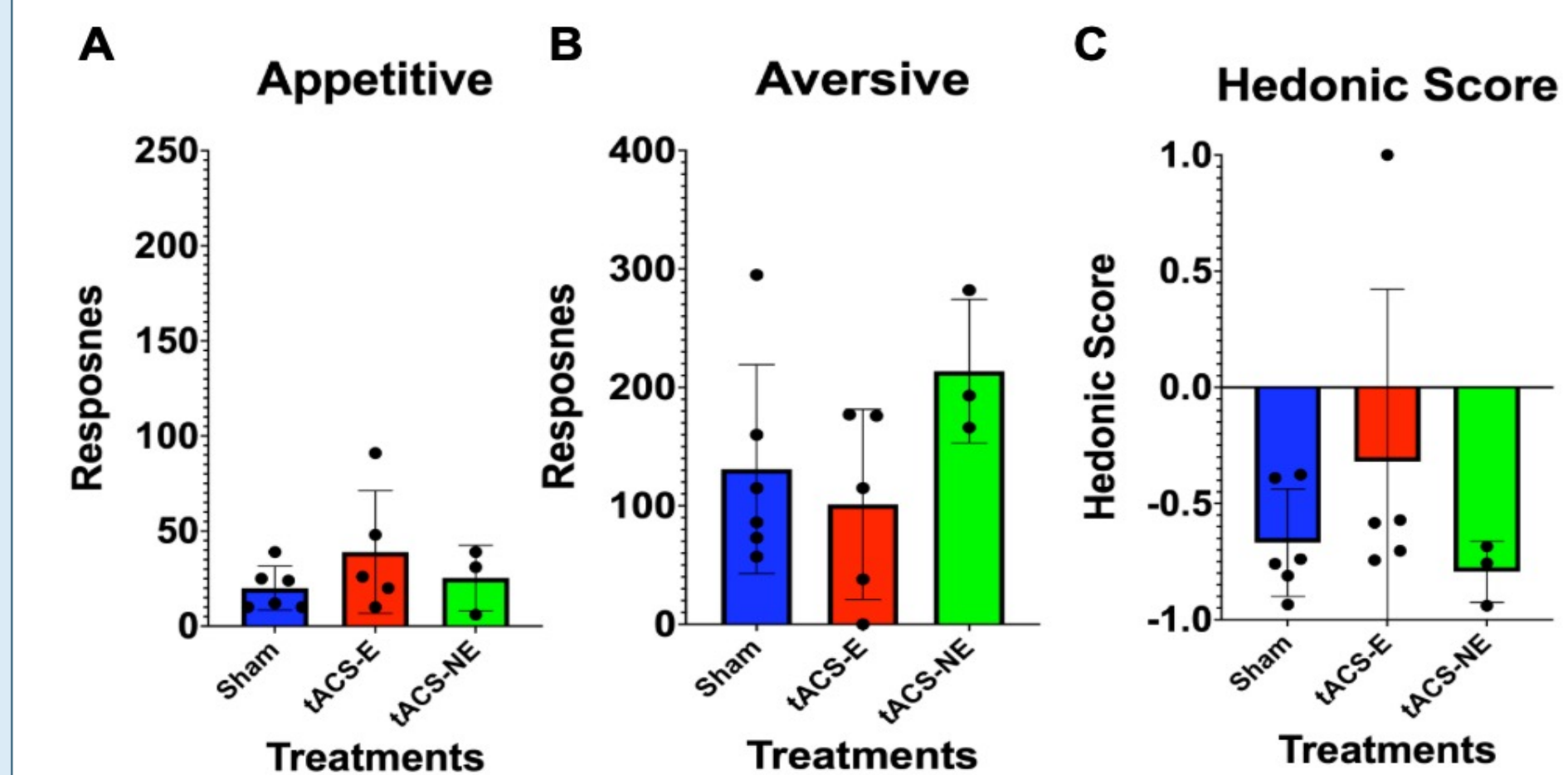


Figure 4. Coherence analysis across each group pair.

tACS-E recovered coherence at a higher degree than sham across the entire frequency range. Sham showed lower coherence and no oscillation at 20 Hz. tACS-NE showed similar coherence to sham at

0-25 Hz but recovered coherence at higher frequencies. Greatest difference between tACS-E and tACS-NE was observed at 0-25 Hz.

Quinine Trial



Appetitive and aversive taste reactivity responses and hedonic score for each group during quinine test.

No differences were observed during the quinine trial between Sham, tACS-E and tACS-NE in either appetitive TR, aversive TR nor hedonic score.

Conclusion

CTA Trial

- tACS was only effective in sub-group of rats.
- tACS recovers IL-NAcSh functional connectivity in the effective group
- tACS-NE recovers IL-NAcSh functional connectivity at higher frequencies.

Quinine Trial

- No clear effect of tACS on innate negative affect was observed.

Implications and Context

- Individual differences in susceptibility to tACS treatment exist and it may be due to underlying biological factors.

Limitations

- Small sample size (tACS-NE; n = 3)
- High variability within sham rats

Future Directions

- Modulate parameters such as amplitude and/or frequency stimulation to increase the effectiveness population.
- Replication of the experiment in female rats.
- Exploring underlying neurological and biological factors that makes tACS effective in certain individuals.

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