

# Optogenetic enhancement of the motivation to consume alcohol by the central nucleus of the amygdala

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## Introduction

The central amygdala has been implicated in the promotion of alcohol consumption primarily following dependence through processes associated with the generation of a prolonged negative affective state that is alleviated by alcohol consumption.

It has remained unclear, however, how the central amygdala is involved in the initial motivation to consume alcohol prior to the onset of physical dependence.

If the central amygdala contributes to alcohol consumption produced by appetitive motivational processes, then it is possible that prolonged alcohol consumption can co-opt these appetitive mechanisms and provide a mechanism for the transition to compulsive alcohol consumption and alcohol abuse.

The central amygdala is an ideal site for such hypothesized alcohol-induced plasticity as it receives direct input from brainstem, thalamic and cortical gustatory regions and projects to affective processing structures like the bed nucleus of the stria terminalis, homeostatic control centers like the lateral hypothalamus, and brainstem taste centers such as the parabrachial nucleus and nucleus of the solitary tract.

We investigated the involvement of the central amygdala in the control of alcohol consumption by making use of optogenetics to tease apart mechanisms by which the central amygdala may promote the consumption of alcohol despite the availability of more preferred options.

## Methods

For optogenetic experiments male Long-Evans rats ( $n=14$ ) first received bilateral infusions of  $0.5 \mu\text{L}$  AAV5-hsyn-ChR2-eYFP or AAV5-hsyn-GFP into the central amygdala and then subsequent implantation of an optic implant above the central amygdala. Rats were then allowed to drink 15% ethanol on an every other day intermittent access schedule for 5 weeks. They were then extensively handled and accustomed to tethering needed for the optogenetic stimulation. During testing rats had access to two bottles for 30 minutes in a modified homecage. Licks were recorded from each bottle using a custom, low-cost lickometer and one bottle triggered stimulation on the first lick made each second.

In a follow-up experiment, Long-Evans rats ( $n=11$ ) were infused bilaterally with  $0.5 \mu\text{L}$  AAV5-hsyn-ChR2-eYFP or AAV5-hsyn-GFP into the central amygdala and received bilateral optic fiber implants. After 4 weeks of recovery these rats were tested for optogenetic self-stimulation of the central amygdala.

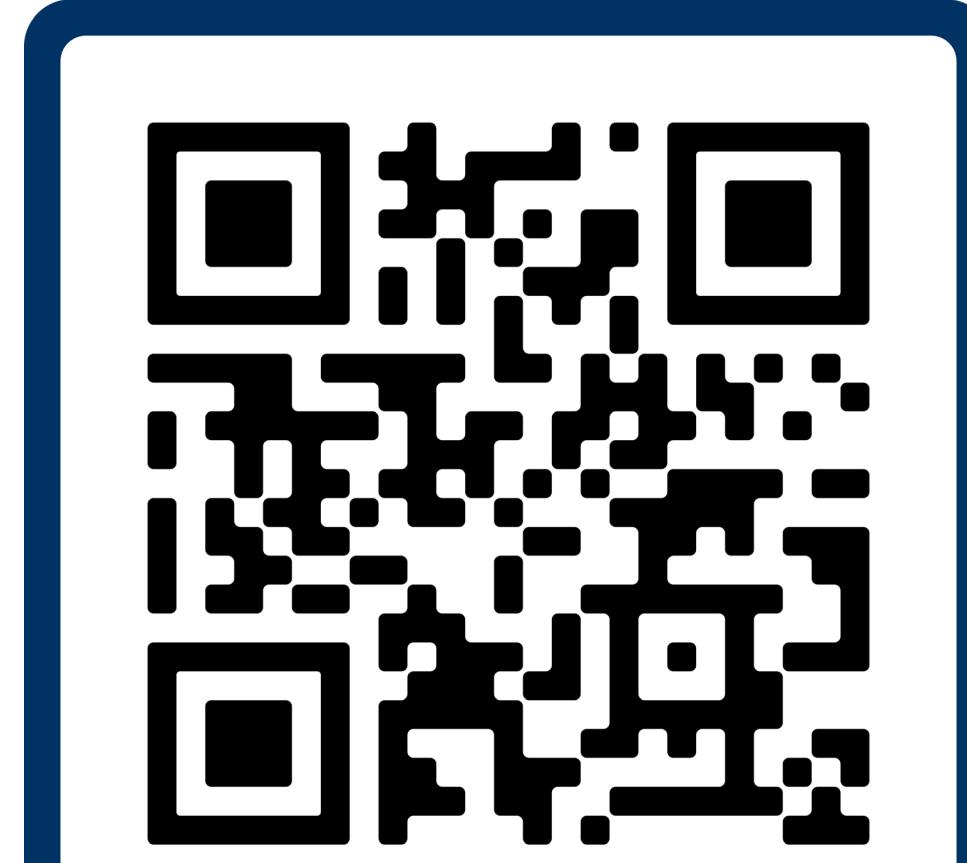
Do you want the code and instructions for the lickometer?

A reprint of this poster?

How-to guide, arduino code, and MATLAB analysis code for lickometer generated data all available at : [github.com/kmfraser/lickometer](https://github.com/kmfraser/lickometer)

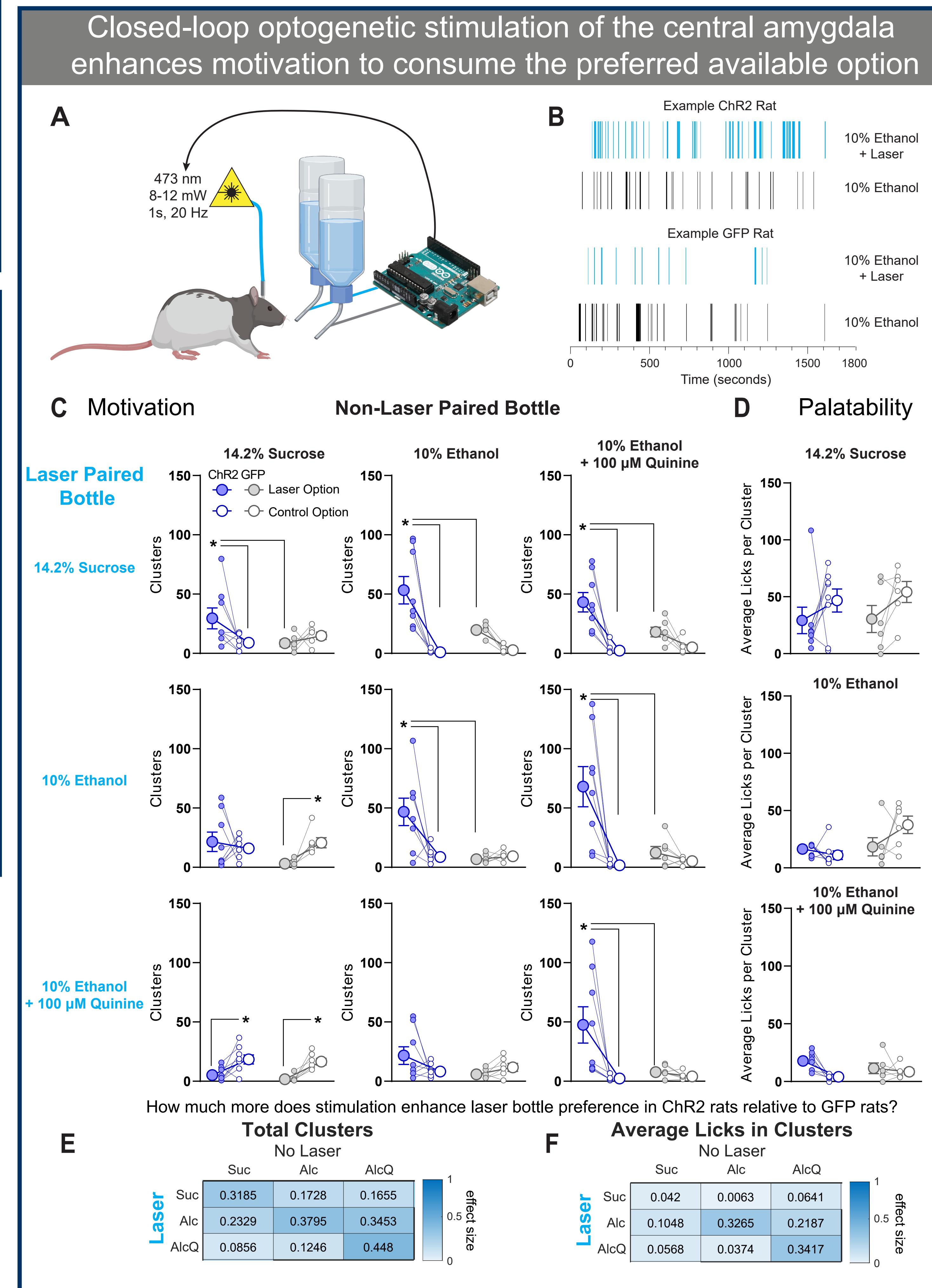
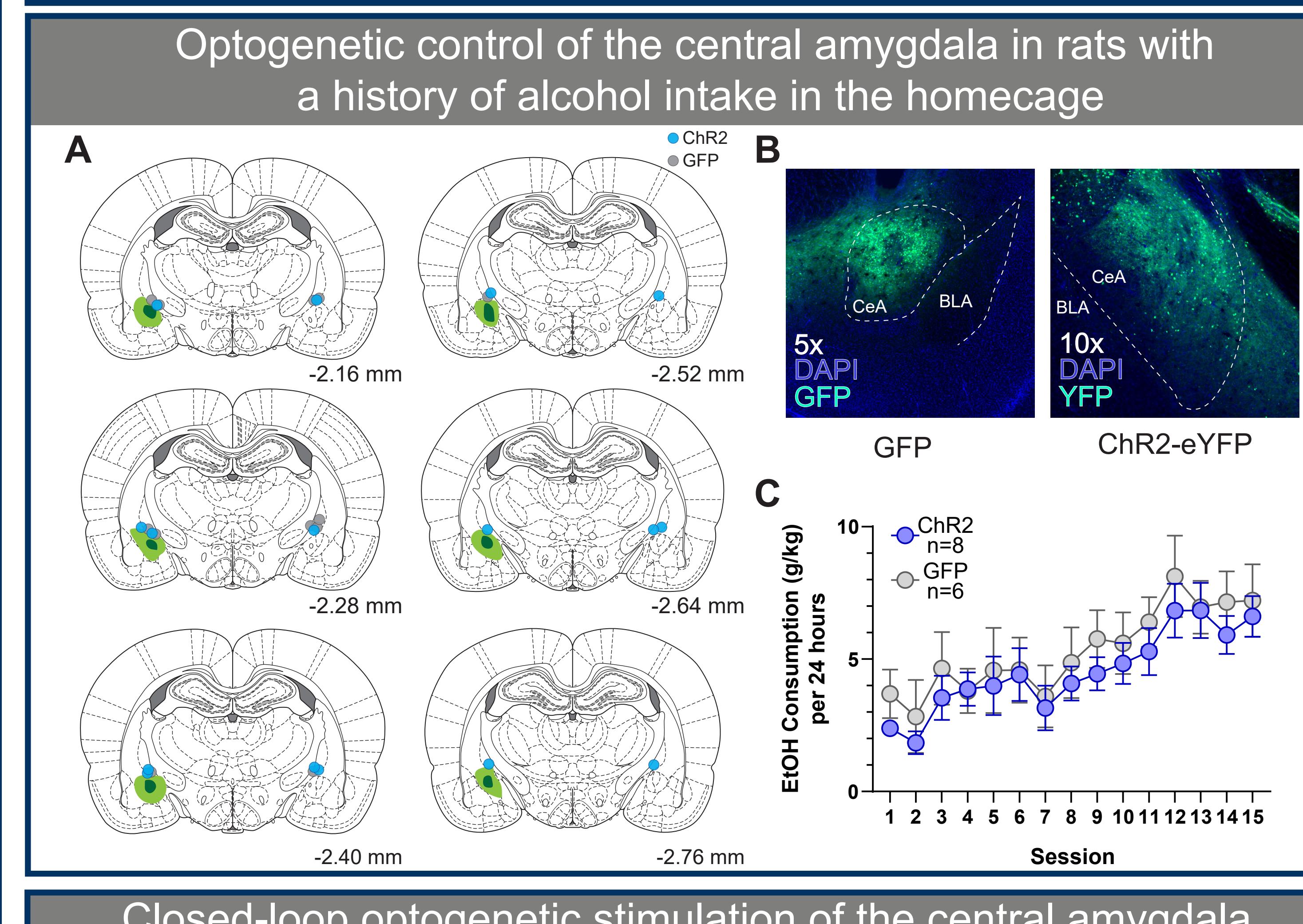
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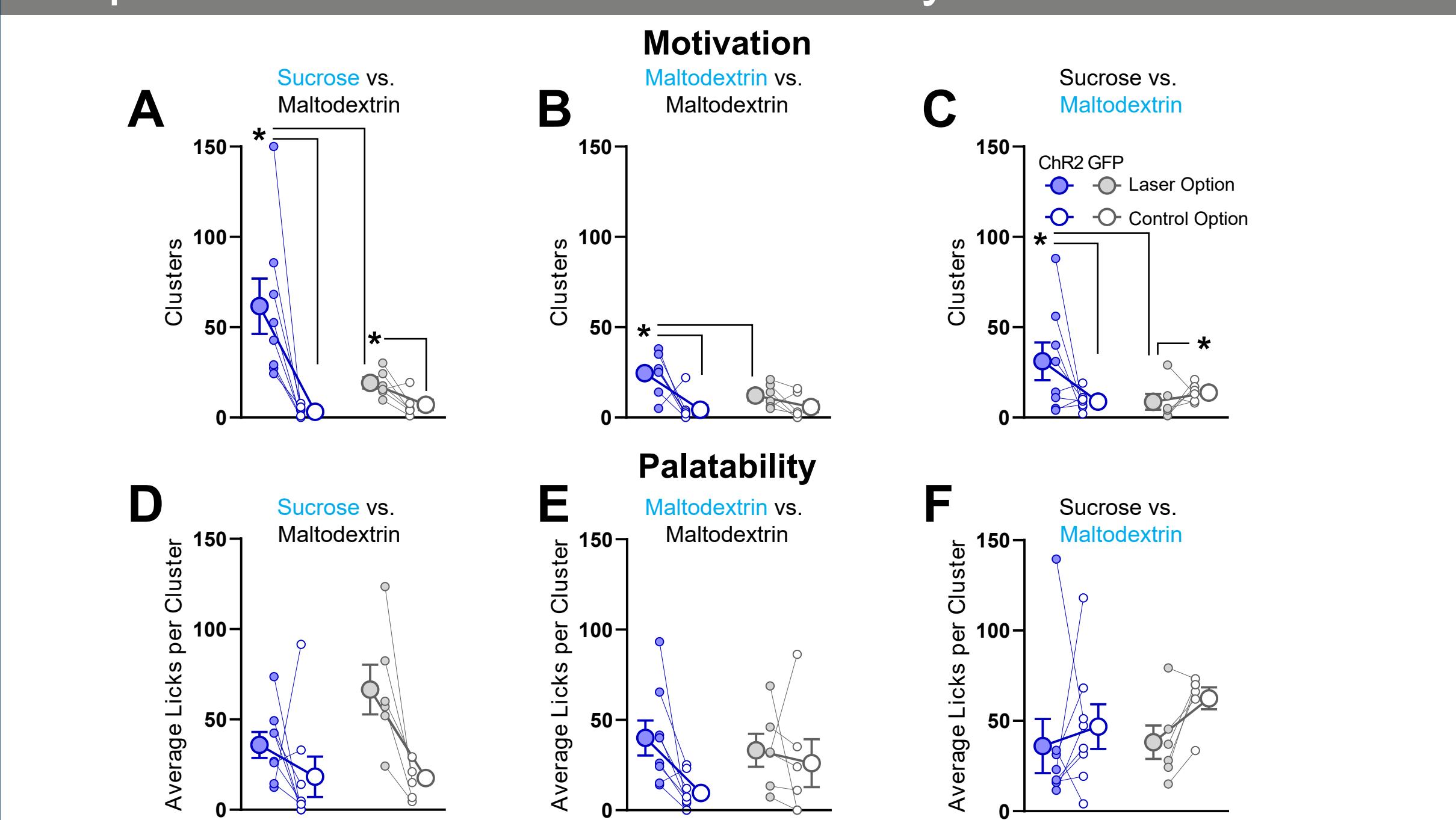


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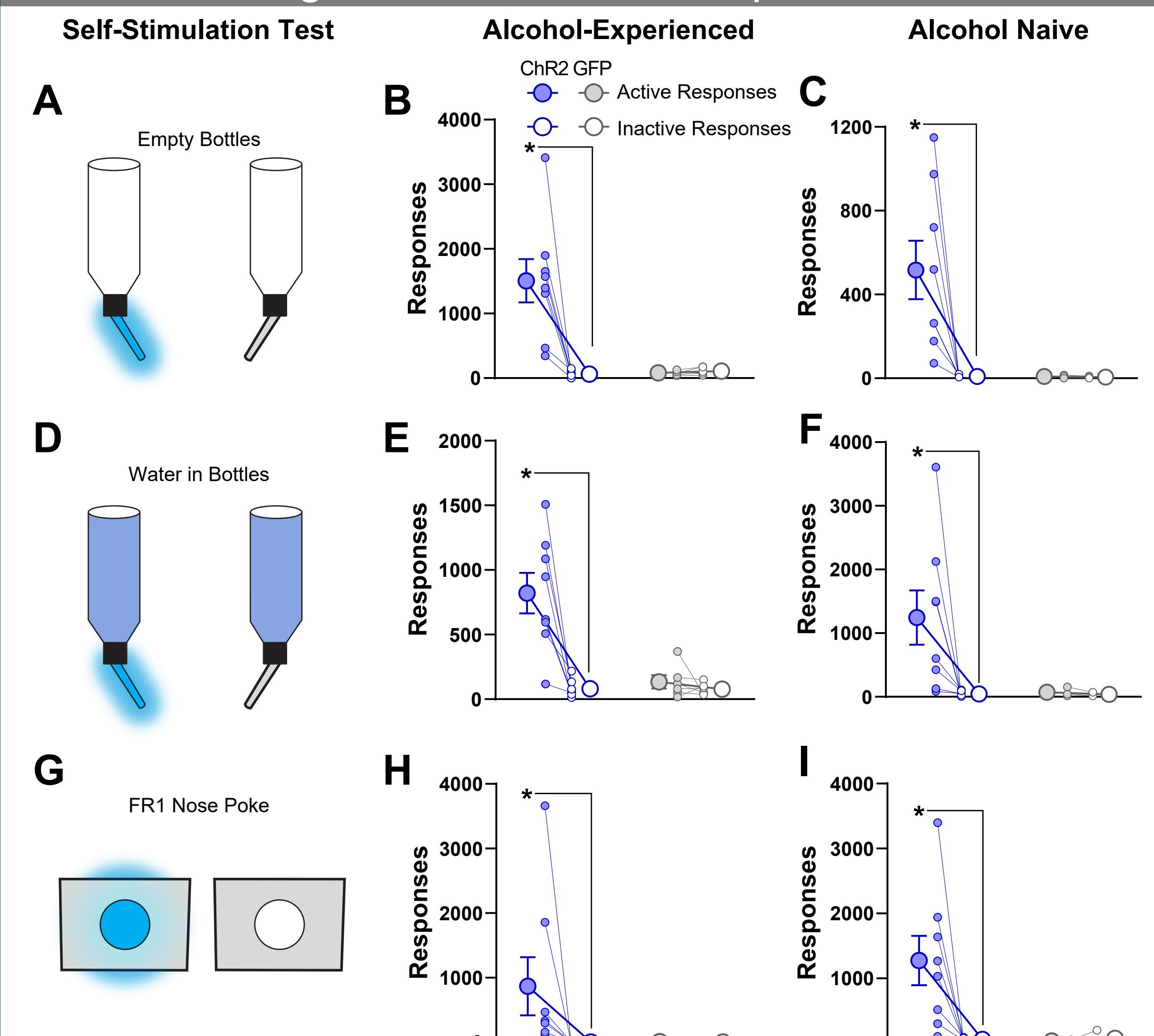
## Results



Optogenetic stimulation of the central amygdala alters preference between two similarly valued rewards



Optogenetic self-stimulation of the central amygdala regardless of alcohol experience



## Summary

- Closed-loop optogenetic excitation of the central amygdala promoted consumption of the laser-paired option when the other option was equivalent.
- Stimulation did not alter perceived palatability or alter the preference of the available offers, but enhanced the motivation to consume the preferred option.
- Optogenetic self-stimulation of the central amygdala occurs independent of alcohol experience.
- Despite this primary reinforcement, in choice tests rats would not self-stimulate if a more desirable option was available.
- The central amygdala appears to be critical in enhancing the motivation to consume the most desirable reward available.

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