



Neuronal Activity in Olfactory Processing: A Meta-Analysis and Experimental Study

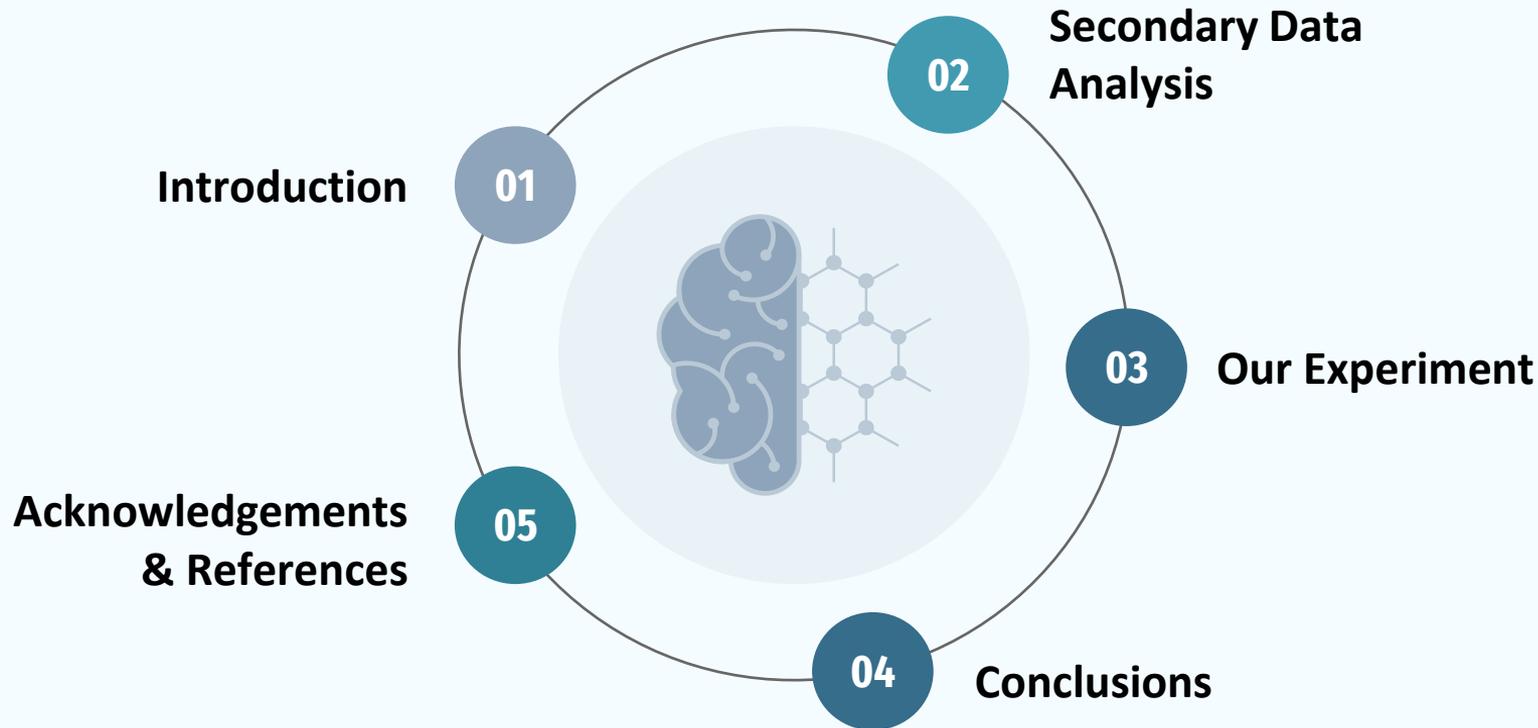
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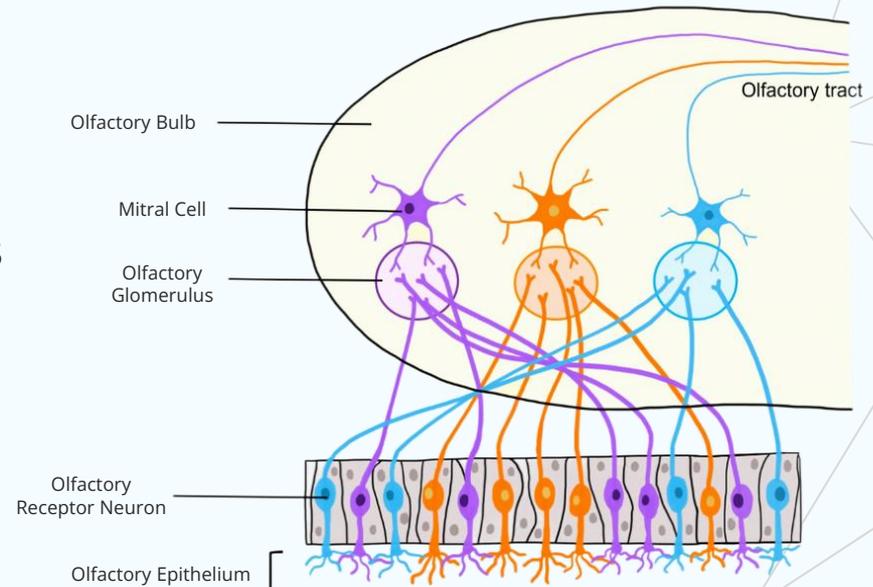


01

Introduction

Olfactory System

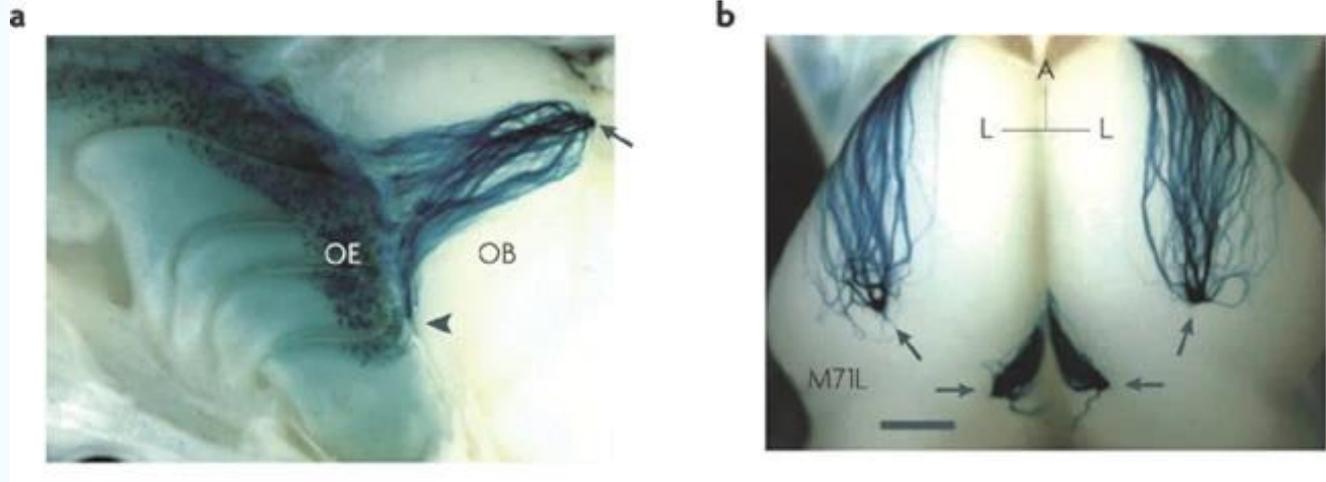
- 1) ORNs sense odorant molecules
- 1) Molecules bind to the ORNs and relay action potentials
- 1) Olfactory tract projects to various regions



Hedges, 2022

Hedges, 2022

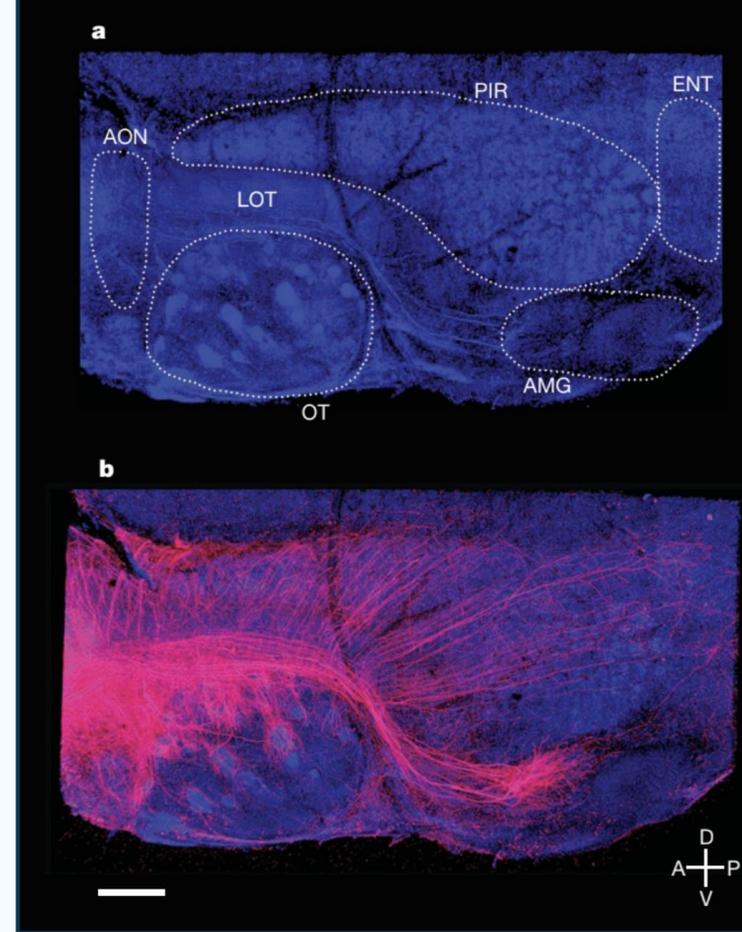
Main Olfactory Bulb



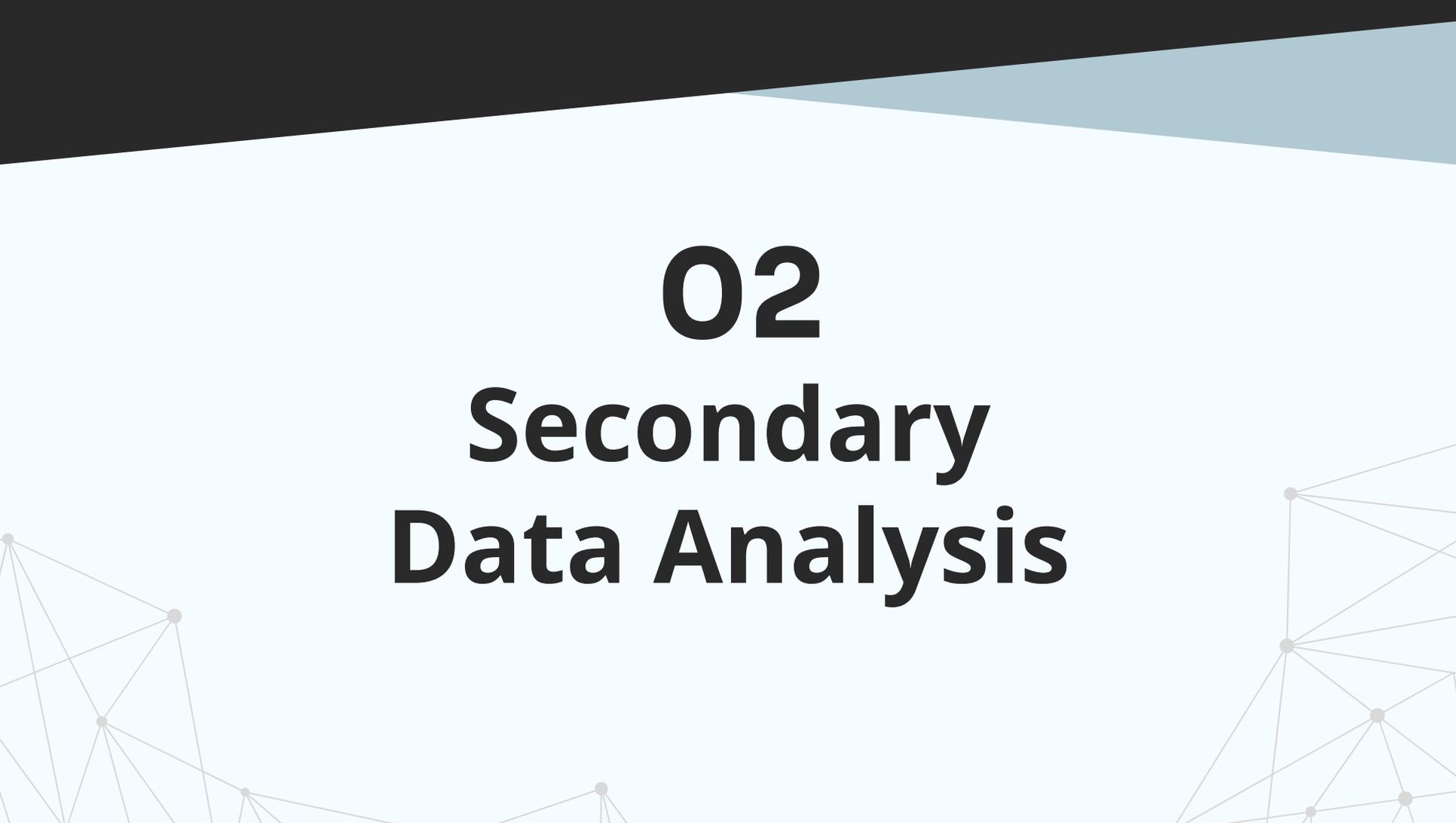
Cell Press, 2004

Primary Olfactory Areas

- Lateral Olfactory Tract (LOT)
- Anterior Olfactory Nucleus (AON)
- Piriform Cortex (PC)
- Tenia Tecta (TT)
- Posterolateral Cortical Amygdala (plCoA)
- Entorhinal Cortex (EC)



Sosulski, Bloom, Cutforth, et. al, 2011



02

Secondary Data Analysis

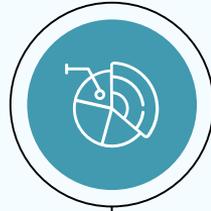
Methods



Literature Review



Data Formatting



Generate Figures



Analyze Figures

Literature Descriptions

#1

“Characterization of odor-evoked neural activity in the olfactory peduncle”

Graham A. Cousins

**Dorsal Tenia Tecta,
Ventral Tenia Tecta, &
Anterior Olfactory
Nucleus**

#2

“Recurrent cortical circuits implement concentration-invariant odor coding”

**Kevin A. Bolding and
Kevin M. Franks**

**Olfactory Bulb & Piriform
Cortex**

#3

“Population Coding in an Innately Relevant Olfactory Area”
**Giuliano Iurilli and
Sandeep Robert Datta**

**Piriform Cortex
& Posterolateral
Cortical Amygdala**

Meta-Analysis Research Topics

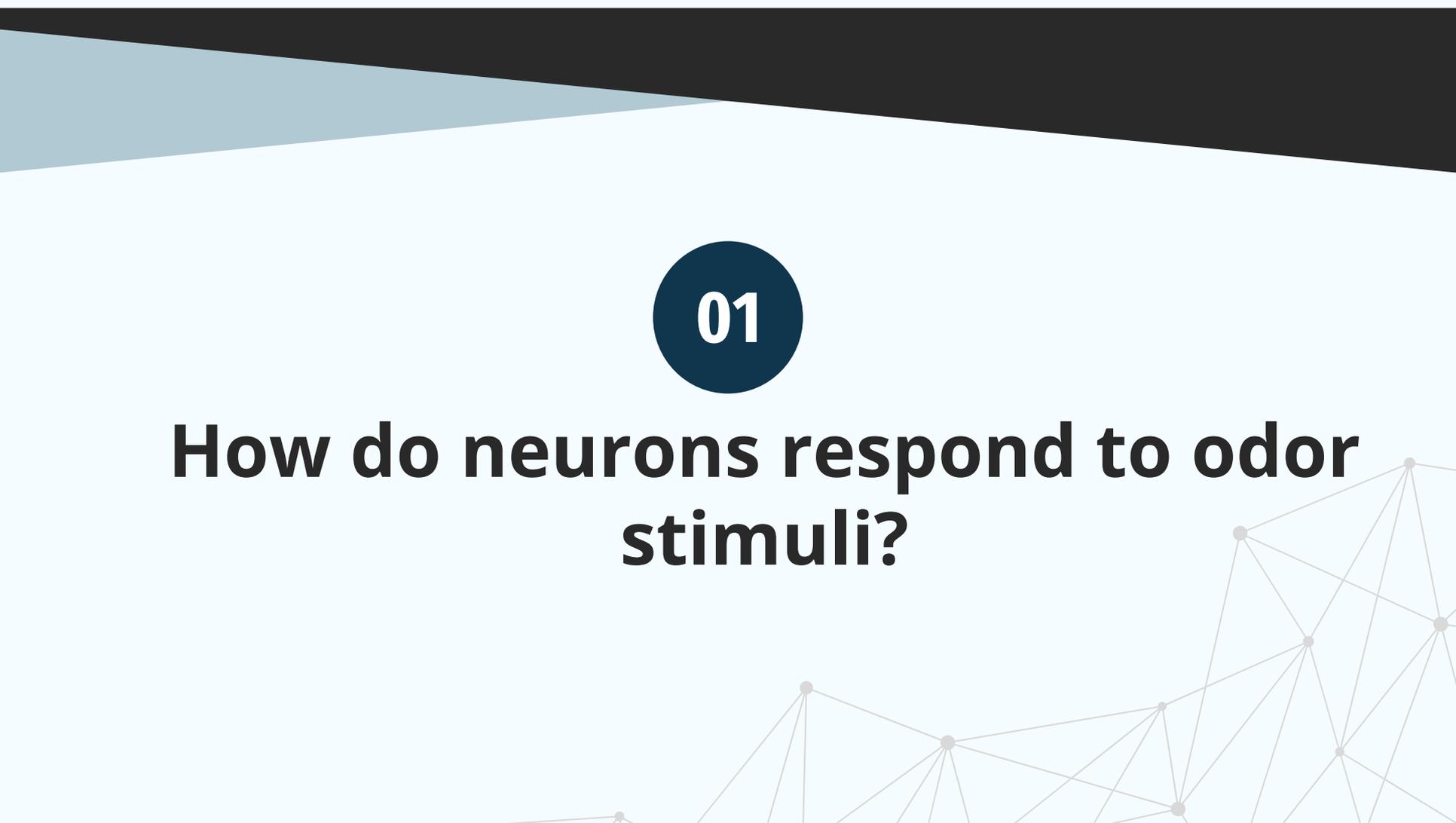
01

**Spike Firing
Rates**

02

Oscillations



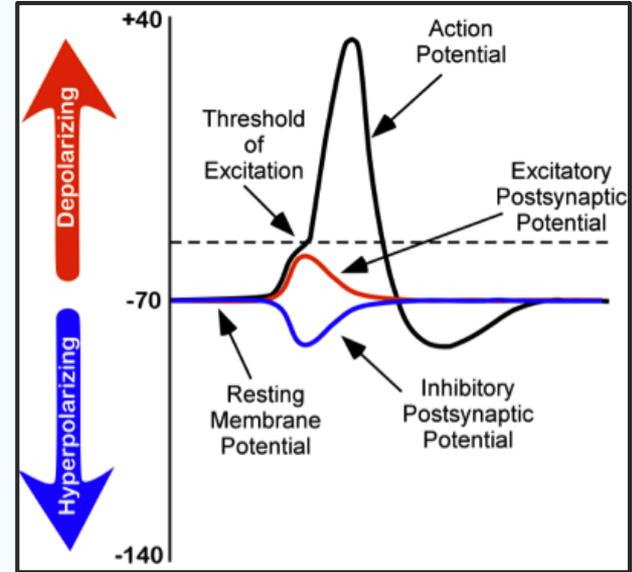


01

How do neurons respond to odor stimuli?

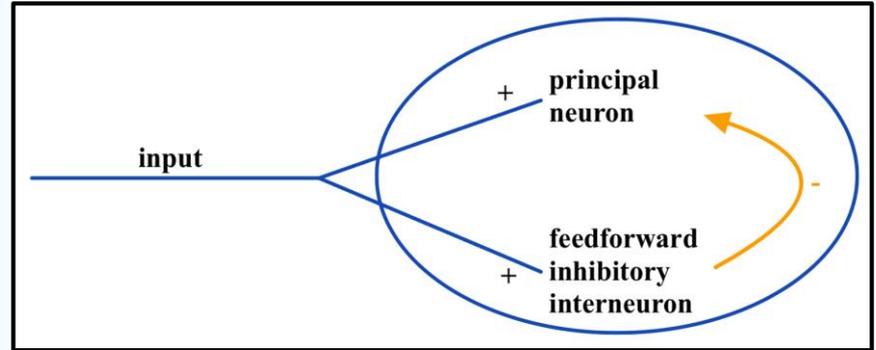
Excitation

Excitatory neurons enhance postsynaptic activation

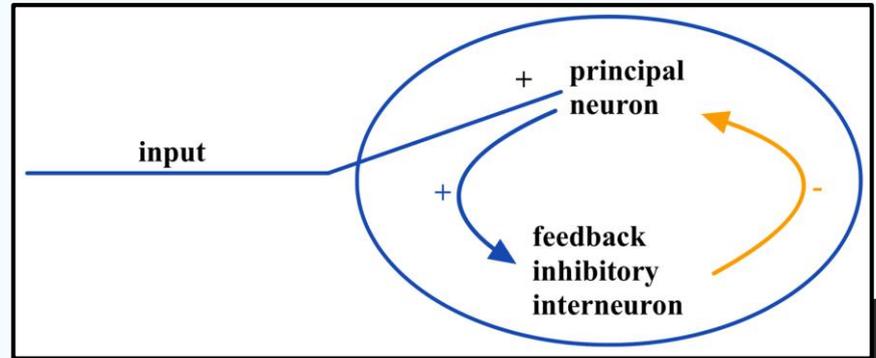


Inhibition

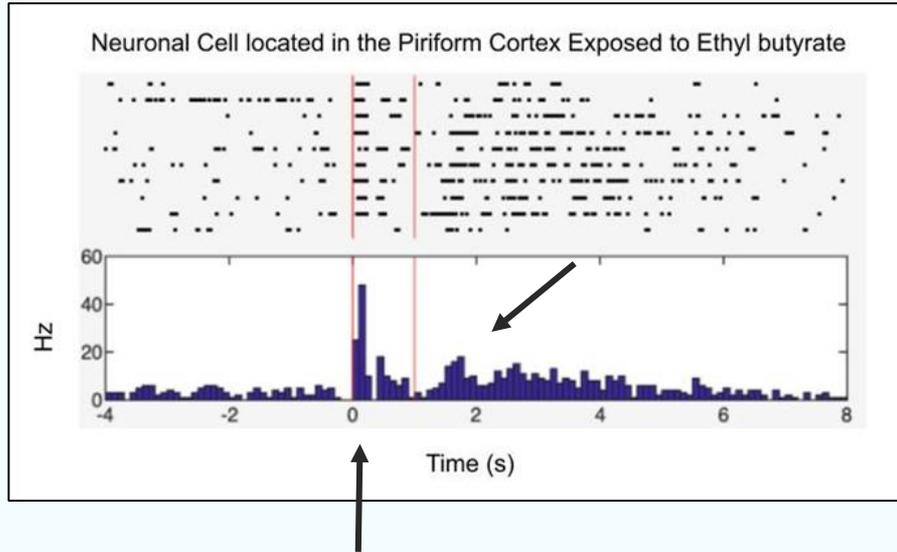
Feedforward



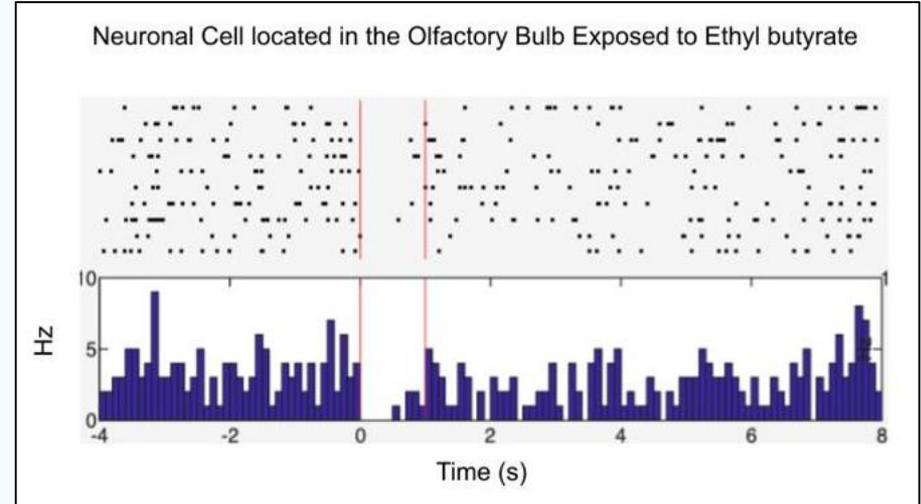
Feedback



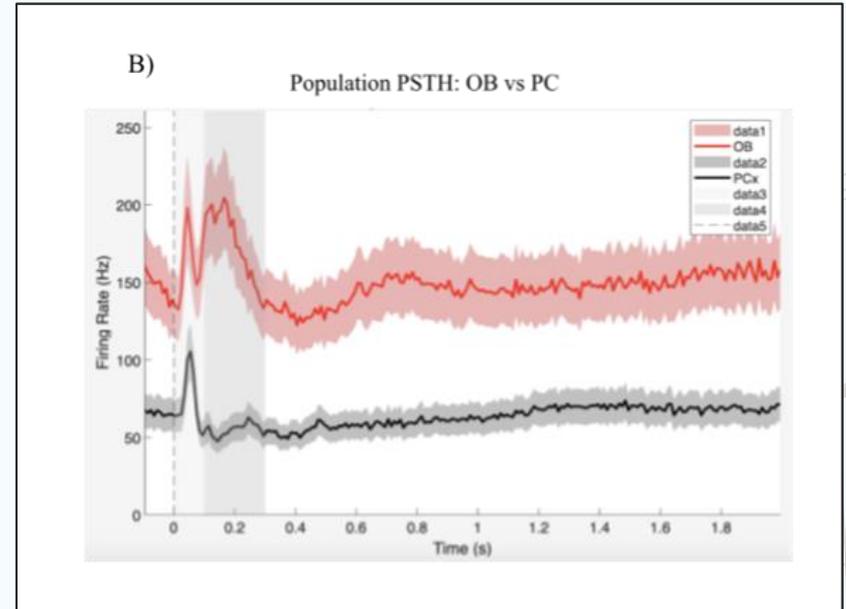
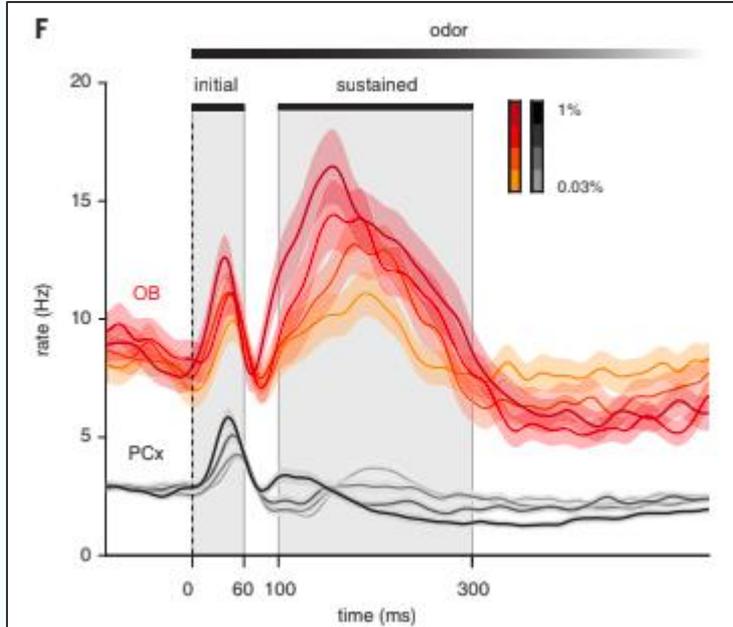
Being Excited



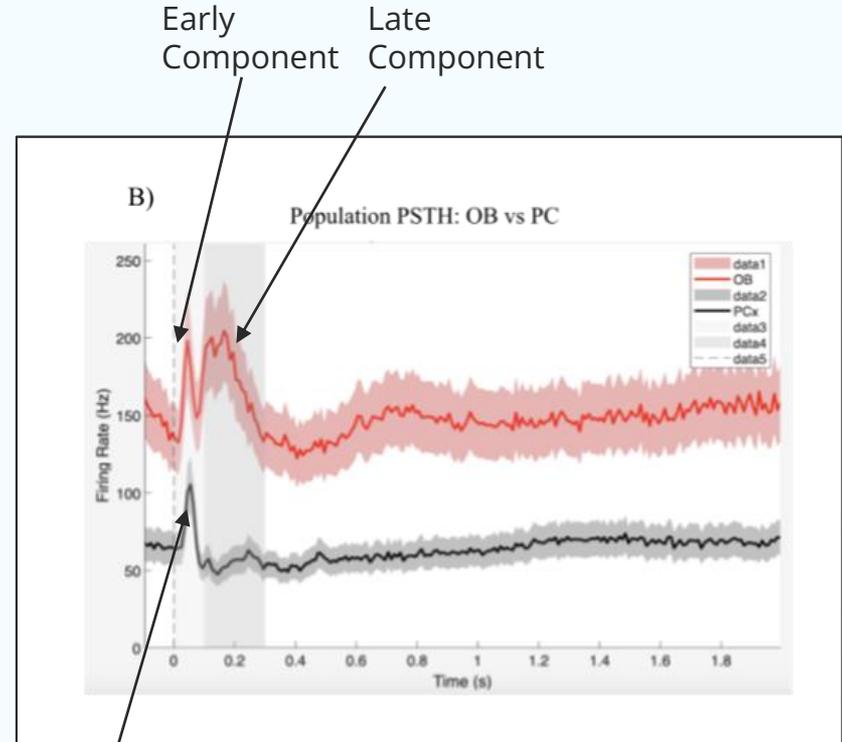
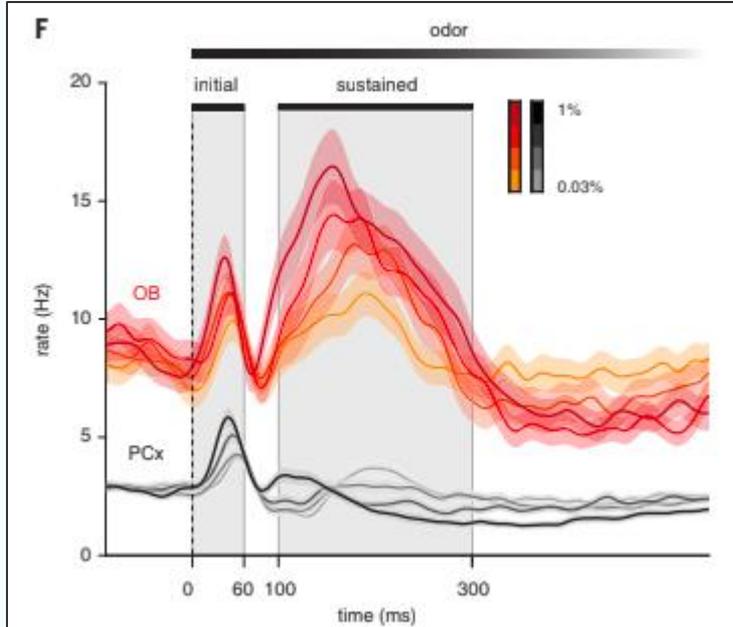
Being Inhibited



Responses in Bolding & Franks



Responses in Bolding & Franks

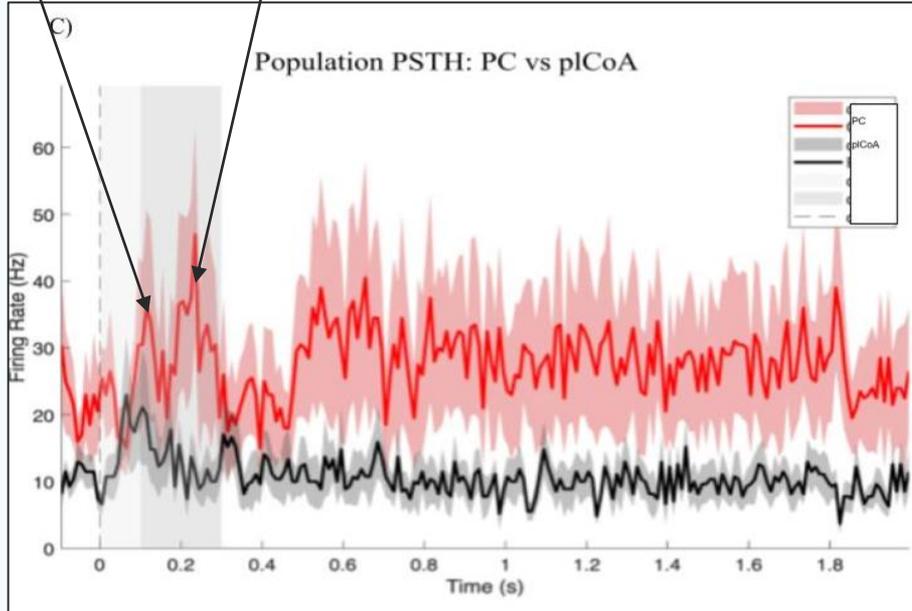


Early Component

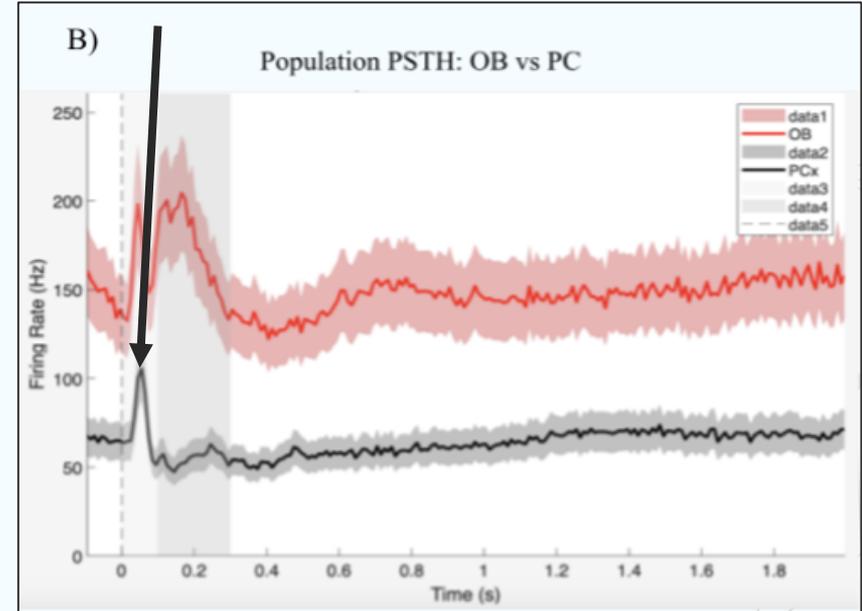
Responses in Various Olfactory Regions

Early Component

Late Component



Early Component





02

**What rhythmic patterns can we see in
different olfactory areas?**

Oscillations

- Gamma: 30-120 Hz
- Beta: 15-30 Hz
- Theta: 1-12 Hz

Human Brainwaves

Gamma



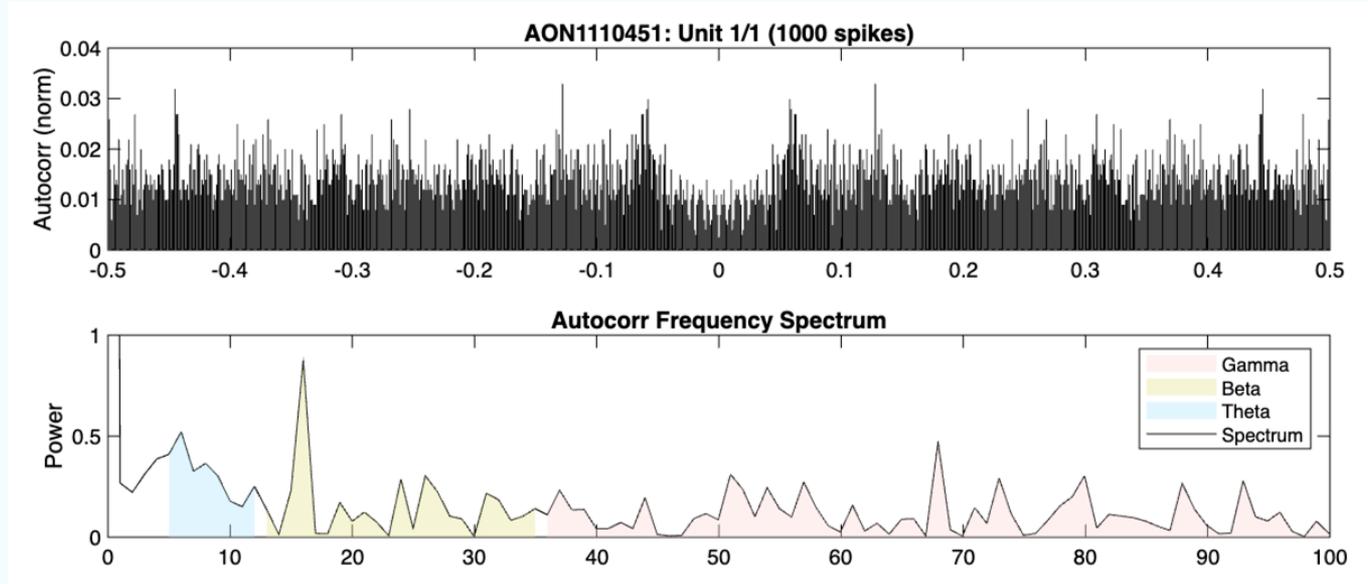
Beta



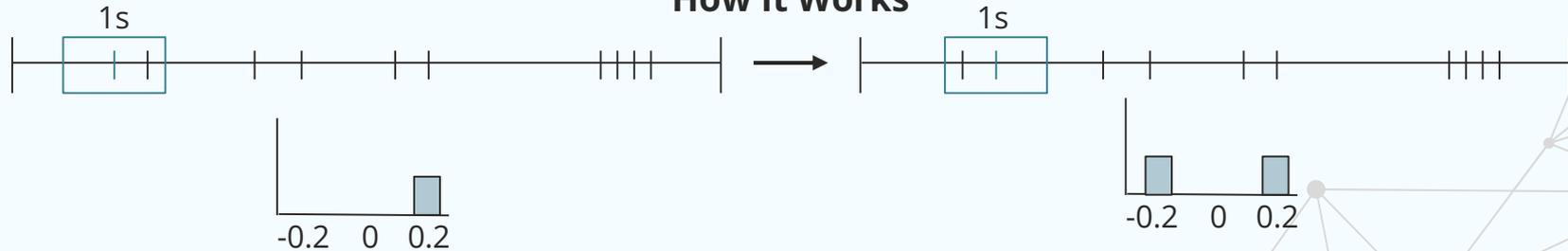
Theta



Oscillations Graph

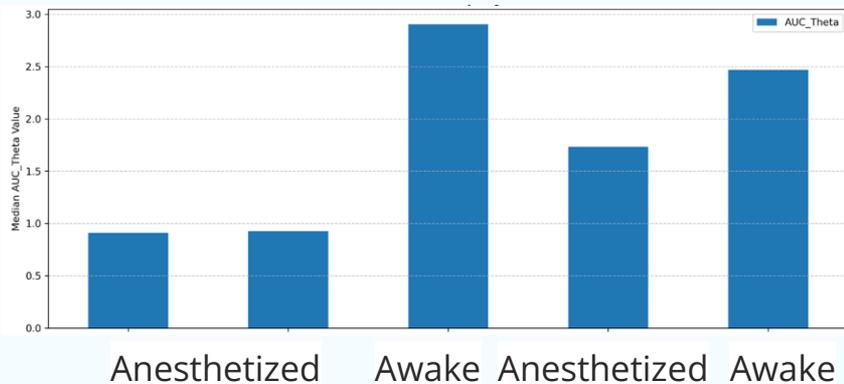


How It Works

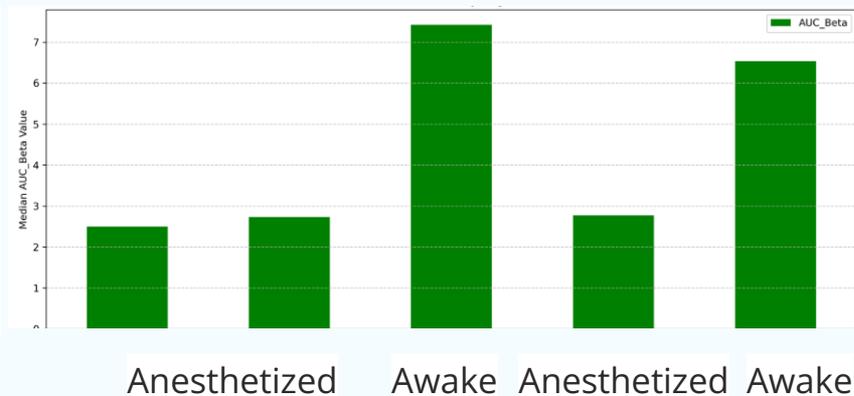


Oscillations Graph

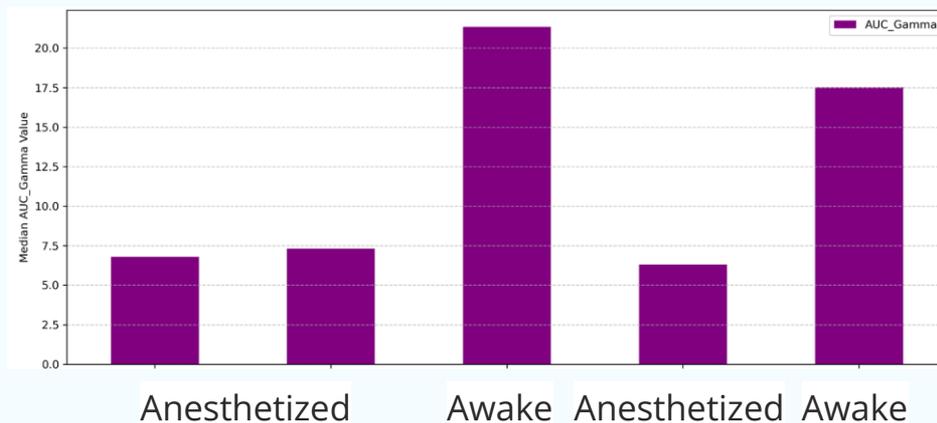
Theta

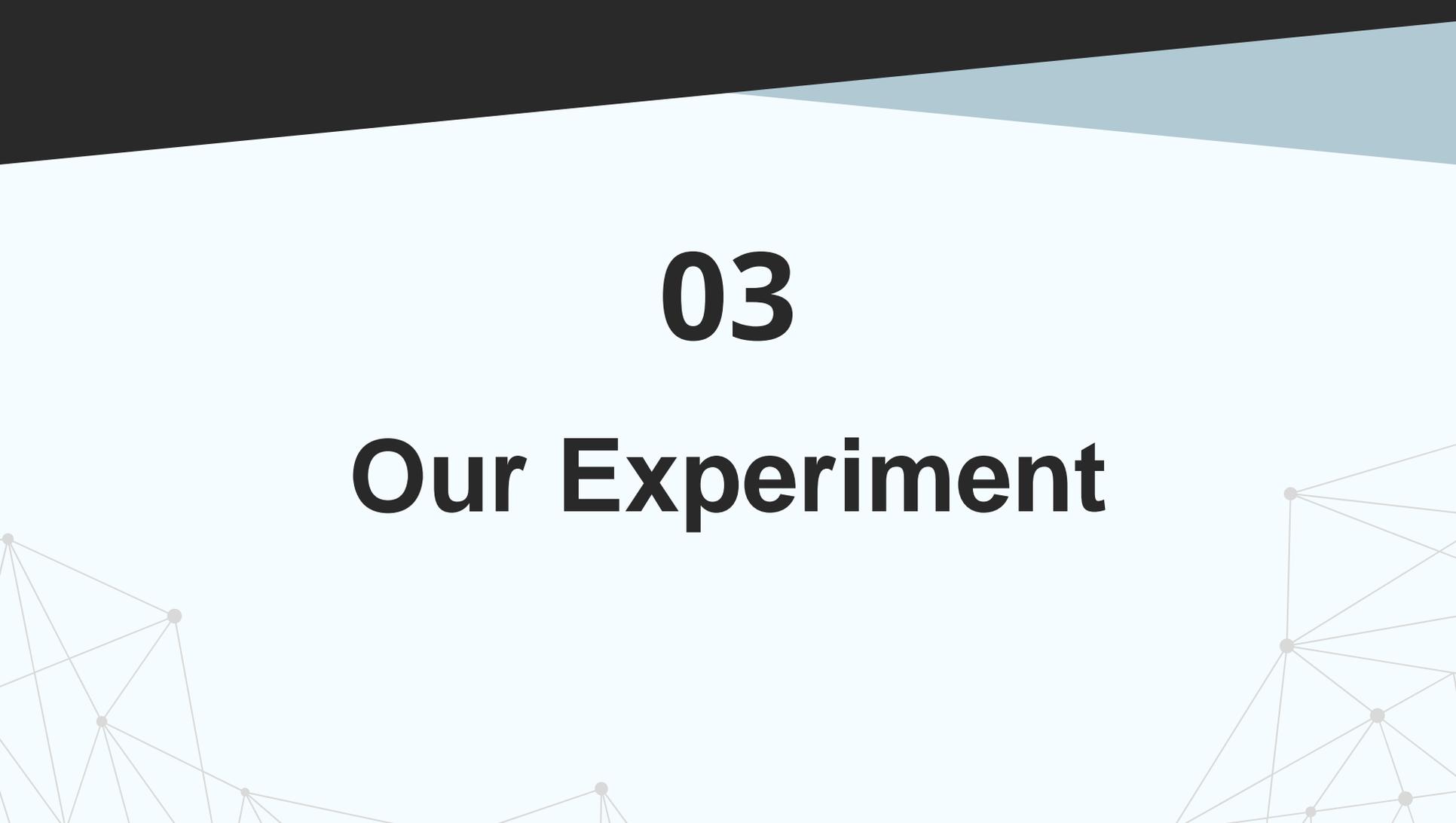


Beta



Gamma





03

Our Experiment



Mixture Suppression

- Odor mixing from the same functional groups reduces neuron firing
 - Prevents overactivation from combinations
- 

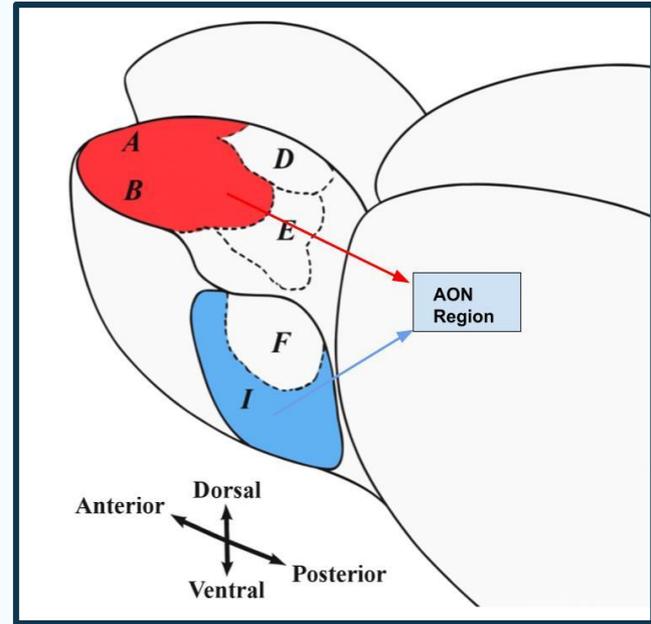
Our Model and Hypothesis

Red region → Part of the OB that responds to Ethyl Esters

Blue region → Part of the OB that responds to Terpenes

We predict:

- Ester + Ester → **Greater Mixture Suppression**
- Terpene + Terpene → **Greater Mixture Suppression**
- Ester + Terpene → **No Mixture Suppression**



Experiment Method

Subjects:

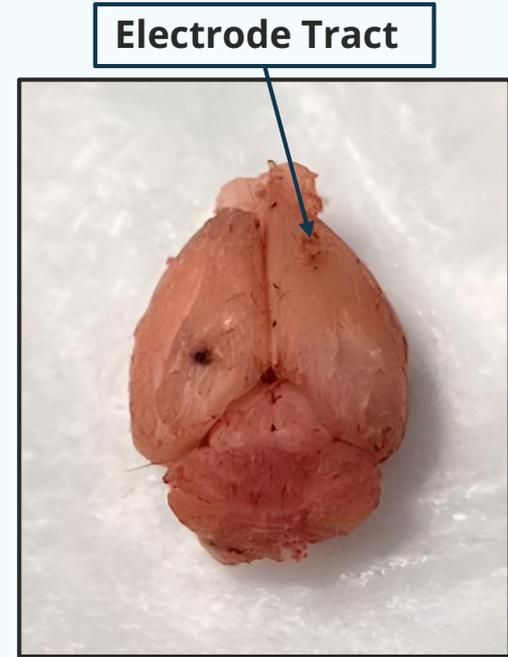
- Mice: adult C57BL/6, bred at Drew University

Surgery:

- Anesthesia: urethane (1.5 mg/kg)
- Supplement: atropine (25 mg/kg)
- Additional anesthesia: Isoflurane

Identifying Recording Sites:

- Electrode targeted AON (2.5 AP, 1.0 ML, 2.0 DV)

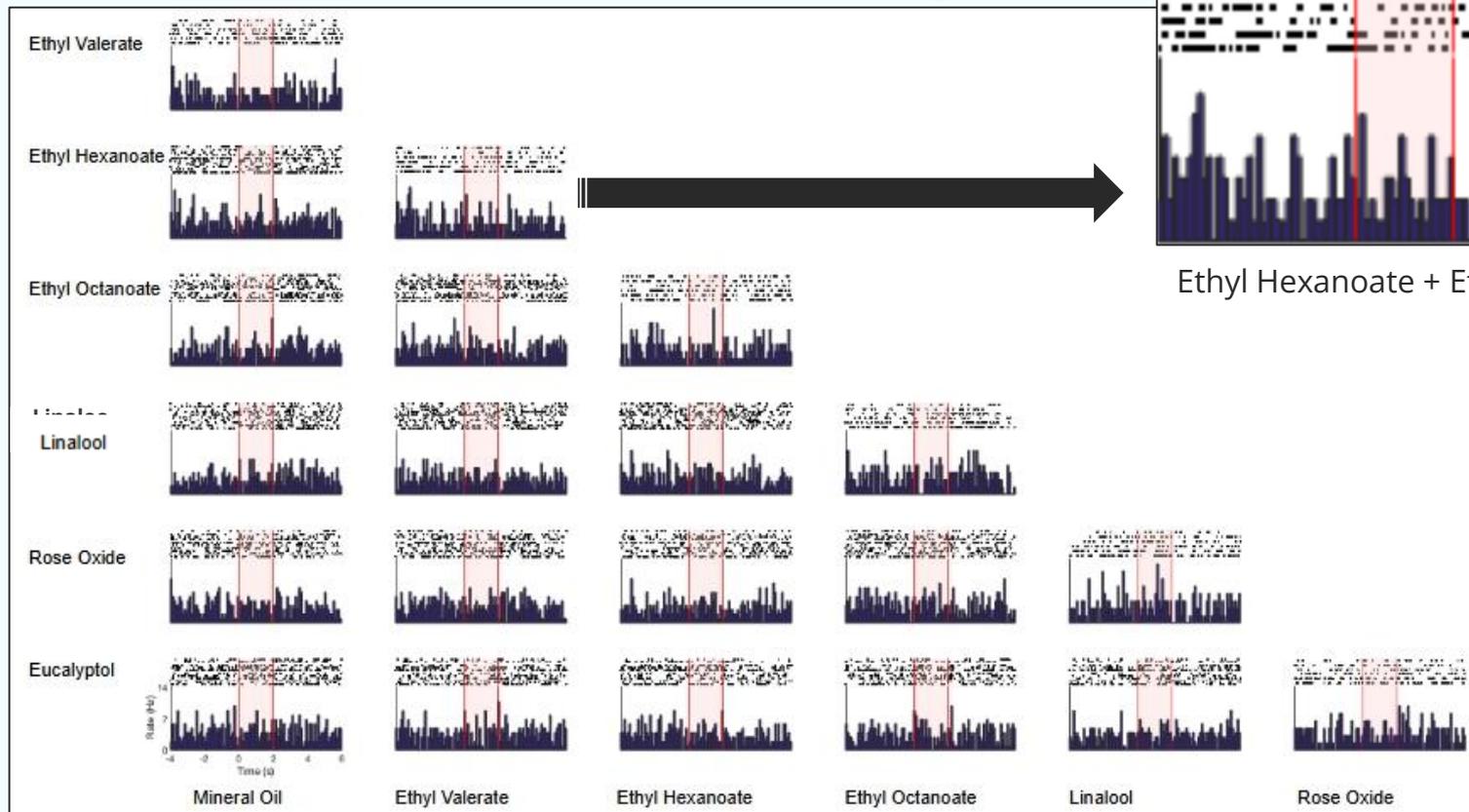


Stimulus Presentation

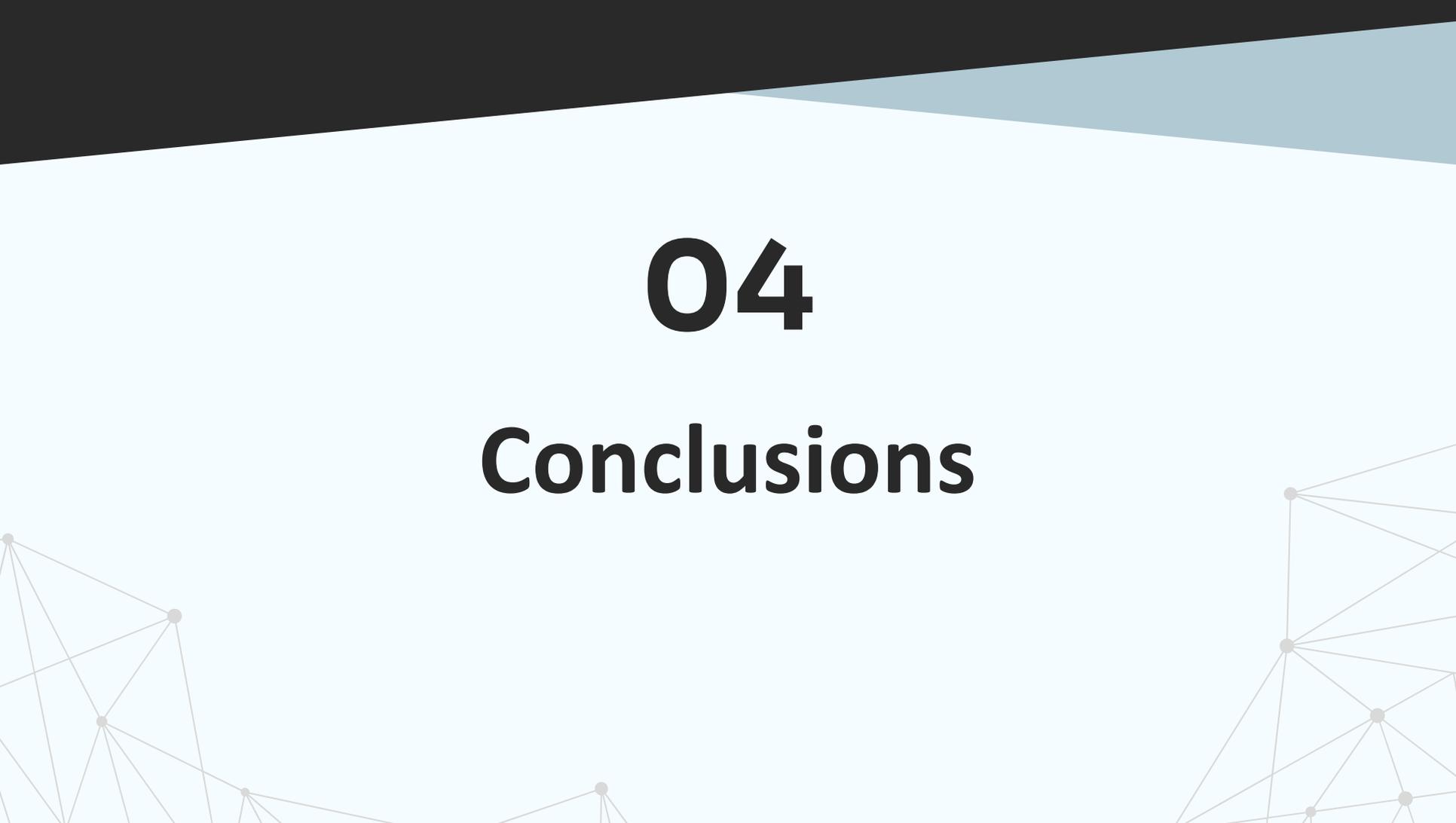
2nd recording: 15 mixtures, 6 odorants

- Recorded 4 cells
- 15 mixtures, 6 odorants
- 15s/2s
 - Terpene - Terpene Mixtures (3)
 - Ester - Ester Mixtures (3)
 - Terpenes - Ester (9)

Mixture Histogram



Ethyl Hexanoate + Ethyl Valerate



04

Conclusions

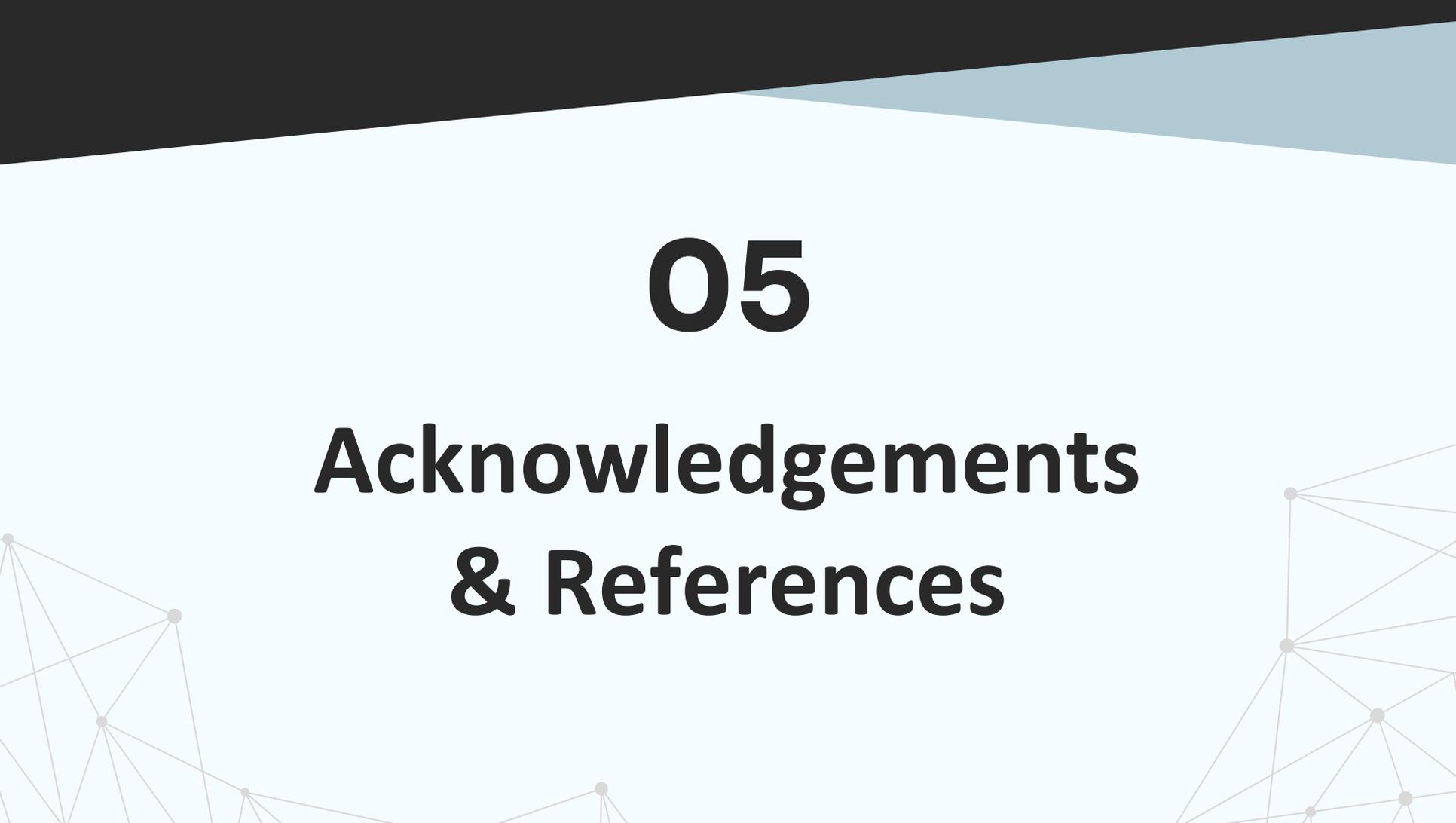
Conclusions

- I. The presence of late component from the Datta spike data indicates that feedback inhibition may not be occurring in the piriform cortex, contrary to findings of Bolding and Franks.
- II. Oscillatory rhythms decrease with mice are anesthetized versus non-anesthetized mice.
- III. (Theorize) That mixtures with similar functional groups prompt inhibition in the Anterior Olfactory Nucleus.

Potential Applications

- Development of artificial olfactory systems
 - E-Noses for commercial industries
 - Disease biomarkers for neurodegenerative conditions
- Restoring olfactory abilities inhibited by viral infections (COVID-19) and neurodegenerative disorders (Alzheimer's, Parkinson's)



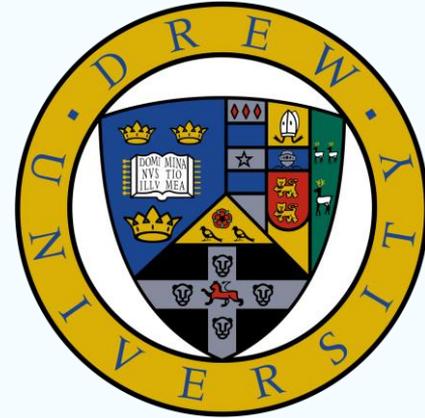


05

**Acknowledgements
& References**

Acknowledgements

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- Dr. Graham Cousens
- Harris Naqvi





**Thank
You!**

Questions?

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