The effect of optogenetic suppression of gap detection in mice

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Introduction

To combat the speech processing deficits that impact people who are aging and people with diseases like Alzheimer's, we need to learn more about the pathways involved with speech processing.

In between syllables and phonemes, there are gaps in sound that allow you to distinguish between these syllables and phonemes. Processing these gaps is crucial to perceiving speech. The ability to process short gaps in constant background white noise is known as gap detection.

Gap detection is a simplified model for speech processing.

Research Question

How can we use optogenetics to manipulate gap detection ability?

Methods- Behavioral Task

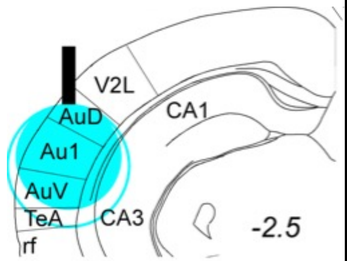
We use 2-Alternative Forced Choice tasks to test gap detection ability. This task requires the mice to make a choice based on a stimulus. In this case, the mice hear a gap or hear no gap and must respond based on what they perceive.

Middle Port = Initiate Trial (no reward)
Left Port= Reward when gap in background sound
Right Port= Reward when NO gap in background sound

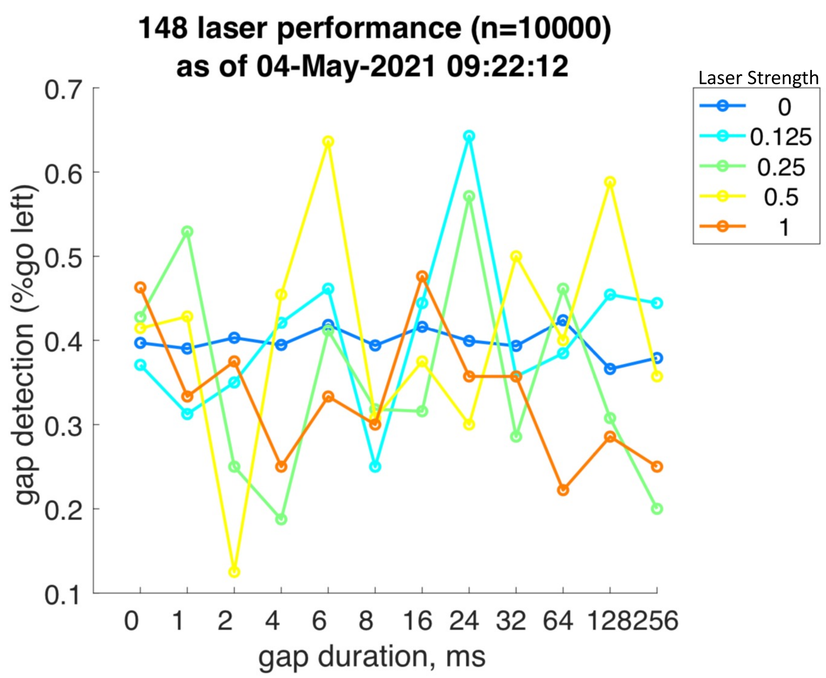
Methods- Optogenetic Manipulation

Optogenetics are a genetic tool that allow us to control gene expression and neuronal activity with light. In mice who have inhibitory optogenetic genes, neuron activity is shut off when the cells are exposed to light.

These mice have optogenetic fibers implanted into their brains that illuminate the neurons in auditory cortex. Lasers are attached to these fibers while the mice perform the choice task to see how the light effects their gap detection ability.



Preliminary Data



Expected Conclusions

The data show inconclusive results because instead of performing the behavior as expected, all the mice with inhibitory optogenetic genes show a strong bias towards one port.

This bias is most likely due to a technical problem with the software used in the experiment. To get conclusive results, the experiment needs to be redone.

We expected to see the gap detection deteriorate by using light to suppress the optogenetic genes in the auditory cortex of mice.

Shifting the gap detection threshold, would confirm that the neurons in auditory cortex are responsible for gap detection, which confirms a step in the pathway of speech processing.

References

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Acknowledgments

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