WHAT'S THE BIOBUZZ?
A journal for students by students

Cortex Conundrum!

Key Terms

Cortex: The outer layer of the brain

Primary Somatosensory Cortex: A part of the cortex that is responsible for processing sensations

Perception: The process where you brain takes information from all your senses to make sense of what is going on around you

Stimuli: A change you experience that causes or inspires a reaction

Model Organism: An non-human species used for studying a specific scientific phenomenon

Barrel Cortex: A part of the primary somatosensory cortex that receives inputs from a rats whiskers

Neurons: Specialized cells that make up the brain and other parts of the nervous system

Optogenetic silencing: A technique where a laser is shined on a group of neurons to stop them from sending messages to the barrel cortex

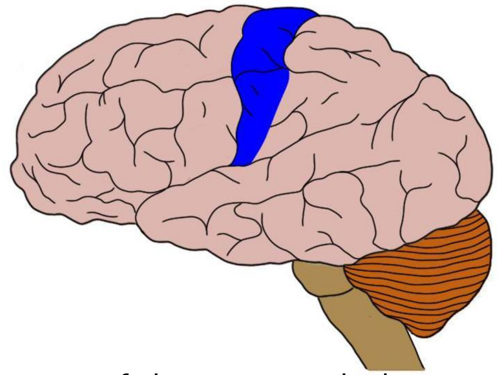

Figure 1: Image of the Brain with the primary somatorsensory cortex highlighted in blue

ABSTRACT

Ever wonder how the sense of touch works? Your body is filled with nerves, which are made up of **neurons**. These nerves get excited when they receive a stimulus- like when you touch something hot. When these cells get excited they release a message which travels from cell to cell all the way to your brain. Then what? Your brain has to process this message, it might say "Ouch that's hot!" and trigger movement away from the hot object.

What parts of the brain are involved in this? Scientists are still trying to figure out if parts of the brain like the **cortex** play a role in perception. To test this, researchers at Columbia University inactivated a particular part of the mouse cortex called the **primary somatosensory cortex**. After doing this, they put the mice through a detection test using their whiskers, which mice use to feel their away around. Researchers found that the somatosensory cortex may not be necessary for organisms to actively detect objects around them!

INTRODUCTION

Our brains are what allow us to perform numerous functions like think, pay attention, walk and talk! Brains have several different sections that often play key roles in certain tasks. One such part is the cortex. It plays a role in a variety of tasks like **perception**, movement and attention.

While we do know somethings about the brain we don't know everything. Neuroscientists are still trying to find out more! Researchers at Columbia wanted to find out what role the cortex plays in detecting **stimuli.**

To do this, they used mice as a **model organism**. Researchers inactivated the primary somatosensory cortex, some for a short amount of time and others for longer, of these mice and tested how they did in a detection task using their whiskers.

Why whiskers? Studies have shown that each whisker is controlled by a specific spot on a part of the somatosensory cortex called the **barrel cortex.**

METHODS

Scientists tested short-term inactivation. They shined a laser on the brain to control neurons in charge of sending messages to the barrel cortex This technique is called **optogenetic silencing**. The light from the laser blocked neurons from communicating with the barrel cortex, which usually happens when whiskers came into contact with anything. They used this technique on one group of mice while the other group was not affected by the laser. All mice were then trained to perform a GO/NOGO task with their whisker.

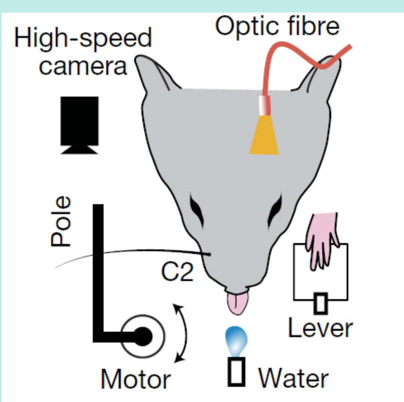

FIGURE 2 GO/NOGO trial set up

GO TRIAL!!!

- Mice start by holding down lever
- Pole moves near whiskers
- ***Mice need to let go of lever***
- Water reward is given if completed

NOGO TRIAL!!!

- Mice start by holding down lever
- Pole moves away from whiskers
- ***Mice need to hold down lever***
- Punishment if lever is let go: No water reward and timeout

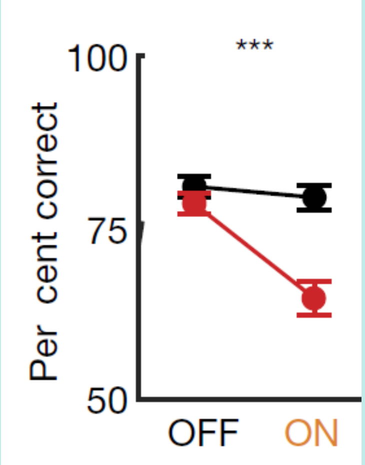

FIGURE 3: The line in red shows performance of the group that had parts of their cortex inactivated when the laser was on. The black line shows a group that did not experience this effect when the laser was on.

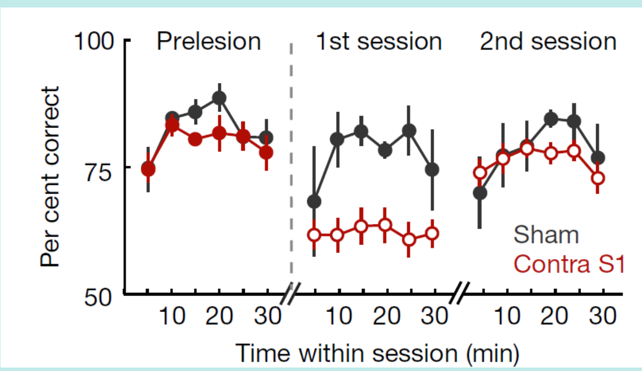

FIGURE 4: The line in black (SHAM) shows performance of the mice group with a fake surgery. The line in red (CONTRA) shows performance of the mouse group with a real surgery.

METHODS CONTINUED

Scientists also tested long-term inactivation. They created two mice groups one with a fake surgery and one with a real surgery. The fake surgery did not affect the cortex so neurons were able to send messages. Scientists used this to see if any changes were actually from the part of the brain in question and not from the process of the surgery itself. The real surgery permanently inactivated the cortex so there was no communication. Then they made the mice perform the same GO/NOGO task twice. These results were compared with a test done before the surgery- this was labeled pre-lesion in figure 4.

RESULTS

- Optogenic silencing efficiently stopped all neurons from sending messages to the barrel cortex
- The group that didn't experience the effects of the laser, meaning they had their barrel cortex inactivated, performed well on GO/NOGO trials
- The group that experienced the effects of the laser had a poor performance on the GO/NOGO trials
- Mice with the real surgery performed the tasks worse than the mice with the fake surgery but over time the performance in both groups went back to normal levels found before the surgery

DISCUSSION / CONCLUSION / SO WHAT?

- The barrel cortex isn't necessary for active detection of the environment, which leaves scientists questioning what the role of this part of the brain is in detecting objects in the environment.

- This study brings up an interesting result in the debate regarding the role of this part of the brain in perception.

- Simply because short-term inactivation of the cortex decreased performance did not mean the region was absolutely necessary for the task.

- Future research could look into whether recovery of performance was due to experience or if sensory and motor systems are so different that one doesn't impact another in this task.

- Why is it important for us to use model organisms like rats in these types of studies?

- Why do researchers test things using several different approaches and conditions? Why isn't one enough?

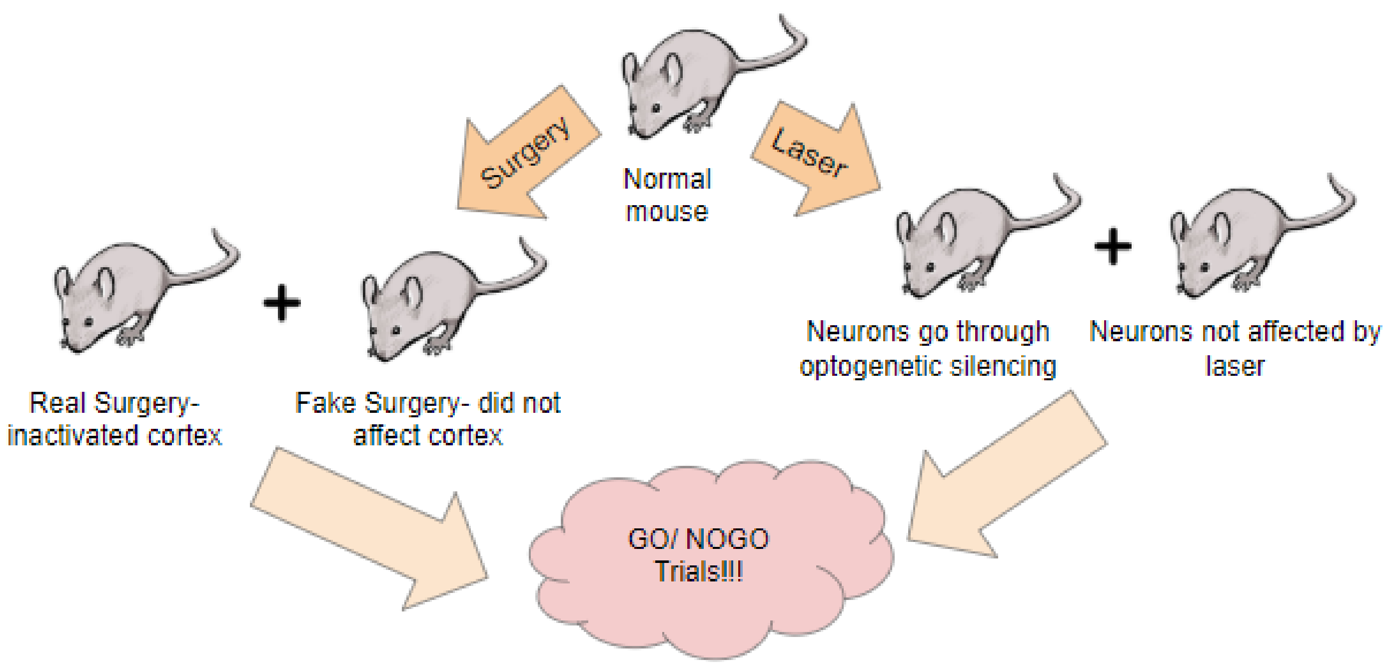

FIGURE 5: Summary of short term inactivation (right) and long term inactivation (right)

Adapted by Joseph Parziale and Dhara Salazar from *Sensation, movement and learning in the absence of barrel cortex* by Randy M. Bruno *et al.*, Nature 2020.