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NSCI 1230

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**Homework 6: Reading Scientific Papers**

**1: What are the main research questions?**

Throughout the article the authors figure out if rats can differentiate between different types of whisker stimuli, and the mean speed/ intensity of this stimuli by monitoring its behavior (seeing which drink port it choses). They also wonder if slow positive units had any stimuli or firing rate change.

**2: Who are the authors and what are their backgrounds?**

**Leah M. McGuire:** Leah completed a PhD and Postdoctoral fellowship in computational neuroscience at University of California, San Francisco, and at University of California, Berkeley. She studied neural encoding and integration of sensory signals. She was also a lead data scientist for LinkedIn. She is currently a machine learning engineer as well. (2)

**Gregory Telian:** There is not much information publicly posted about this author, but he is a postdoctoral scholar in Psychiatry and received his PhD from University of California Berkeley. He now studies how hippocampal networks represent and distribute information across its network of interconnected brain regions. (3)

**Keven J. Laboy-Juárez:** Keven completed his PhD at university of California Berkeley and studied neurons in the somatosensory cortex and how they represent tactile and vibrotactile sequences. He is now a postdoc in a lab that studies how subcortical structures mediate learning and motor sequences. (4)

**3: What experiments were run and what data did they collect?**

They collected neuron output from female Long-Evan rats > 3 months of age. These rat whiskers were trimmed to 15mm. They were trained to discriminate whiskers “Vibrotactile sequences”. These had a range of different rise/fall velocities. S meaning slow, M Meaning, and F being Fast. They then put lab rats into a small contraption where they had a “whisker stimulus panel” that stimulated their right whiskers with different patterns of rise/fall velocities. The ones mostly mentioned included SSS, SMF, FMS, and FFF. Mean speed was taken into account with these sequences. Fastest mean speed was greatest for FFF and lowest for SSS and equal for both SMF and FMS. When a certain sequence was given the rat was trained to go to a certain water port. For example in these trials SMF and SSS were rewarded left and FFF and FMS were rewarded right. The drink port dispensed a “water reward”. They ensured that the whiskers constantly were on the whisker stimulus panel as a constant, and it was their right whisker set that felt stimulus. Overall through the experiment they gathered behavioral feedback (drink port choosing) and neuron stimulus data such as spike trains from the rats somatosensory cortex through four tetrodes.

**4: Choose a figure from the paper and explain it.**

Calendar

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**Graphical user interface, text, application, email

Description automatically generated**

I chose this graph because it shows us not only a raster plot of spike train data, but it also shows us a line graph that helps us understand the change of frequency compared to a stimulus. This figure shows a **spike raster plot** and **population peri-stimulus time histograms (PSTHs)** which are histograms that show the rate and timing of neuronal spikes in relation to a stimulus being elicited. The blue vertical lines in this instance represent the stimulus, the black dots represent the spikes, and the multicolored graph lines represent the firing rate. The researchers split this up to be across multiple trials for the FFF, FMS, SMF and SSS firing patterns. The researchers observed from this graph that individual units showed a phasic response to individual impulses/stimuli. They also found that the units showed an increasing firing rate when the stimulus was being recorded. What the authors learned from this information is that the S1 neurons rarely spike with individual whisker deflections.

**5: Brainstorm a couple of things you want to do once you start looking through the data.**

Throughout the paper it mentions rats weren’t able to distinguish between SMF and FMS whisker stimulation. I think it would be interesting to plot this data and see whether the rats were able to distinguish between these different stimuli because of the mean speed and or intensity of the stimulation. It would also be interesting to plot the firing rate graphs and the “on/ off'' sections of when a stimulus occurred and compare them to when a rat can distinguish between the stimulus to see if there is a vast difference in interval differences and concentration of spikes during these on/off periods. I think it would also be interesting to see the interval difference between the FFF and the SSS and how they differ as both were distinguishable by the rats.

**6: Look through the readme file and explain how the data is set up.**

The data was collected through extracellular spike recordings in the primary somatosensory cortex (S1) whisker area of rats when they were performing whisker discrimination tasks. The recordings are the spike times and they are clustered into single and multiunit arrays after sorting the data. The stimulus of the data was based on whisker impulses of different speed, labeled by fast (F), Medium (M), and slow (S) velocity. The researchers tried different variations of these impulses as stimuli when the data was collected. Each trial has one stimulus. There were 5 rats and over 8- recording sessions. The data is formatted in a 80 x 1 array in the code, where each recording session is a row of the structure. All the neurons in one session were recorded simultaneously. The spike times were recorded in columns, each column of the trial location has data from a different tetrode. This information was from the ReadMe file, but we have not been able to take a deeper look at the data set right now because it is in Mat for when we need it in R form.

**Sources:**

1. **THE PAPER:** <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5004814/>
2. <https://databricks.com/speaker/leah-mcguire>
3. <https://neuroscience.berkeley.edu/qa-with-the-2021-neuroscience-phd-program-graduates/>
4. <https://olveczkylab.oeb.harvard.edu/people/keven-laboy-juarez>