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Independent Small Group Discussion Write-up

1. What was the motivation for this study? (e.g. big picture questions motivating experiments, prior work motivating experiments, etc)

The process of mapping of auditory stimuli onto the cortex is largely unknown (or at least was when this study was performed). The rate-level function shows that the fibers may not respond to particular sounds that are within the range of hearing- in fact the function reach a limit at around 50-55dB. This shows that sound is processed in complex ways- not just determined by the number of spikes. The superior temporal gyrus shows cochleotopic preference. Specific sound frequencies map precisely onto the primary auditory cortex, but more complex sounds may be processed in higher level cortical regions. In other studies the superior temporal gyrus was found to be an important structure in the pathway consisting of the amygdala and prefrontal cortex, which are all involved in social cognition processes. This study may suggest it's role in decoding speech and social specific (complex, natural speech) calls.

2. List the key methodological details (species, preparation, recording/ anatomical techniques, data analysis methods)

Stimuli consisted of bandpassed noise (BPN) juxtaposed around a certain frequency and Pure Tones (PT). Glass electrodes were used to record the specific activities of certain neurons in STG and STP in theft hemisphere- in humans this corresponds to the lateral STG (implied in studies to affect speech perception). A control electrode was

placed in AI and R to record from primary auditory cortices. Neuron burst were then measured in response to PT and BPN, tested over 81 neurons.

3. For each figure, describe the important points including how the authors interpret the findings and what the findings may actually show.

Figure 1)

a & b) Harmonic responses (area AL) in spike burst activity corresponding to the stimuli given. Figure A shows the PSTHs for BPN and PT spikes, correspondingly B shows PSTHs for rate-frequency curves for PT and BPN, showing the clear effect BPN had for increased firing around the frequency of speech.

c) Proportion of neurons that responded to each stimuli, more responded to BPN (around 90%, show firing with the stimuli)

Figure 2)

The best center frequencies were measured along the axis of the lateral sulcus for the STG. They show consistent (progressive) tonotopic mapping in the anterolateral(AL), mid-lateral(ML), and caudal lateral(CL) areas.

Figure 3)

This shows directional selectivity for individual cells

a) The neuron responded best to BPN in certain bandwidths (1/3 to 2 octaves) and was unaffected by sound level expected in top right (for monotonic responses). PT and White noise showed very little responsiveness for neurons tested.

b) The best center frequencies correspond direct to their position relative to the lateral sulcus.

Figure 4)

a) 87 neurons responded better to certain calls- in areas anterolateral(AL), mid-lateral(ML), and caudal lateral(CL). There was clear preference for a complex noisy call over a harmonic one.

b) Neurons in all areas did respond directly to increases in the PT stimuli, the article suggests these are energy matched responses.

c) First top panel shows a significant response to harmonic components. Below it low-pass filtering shows a lesser response and same with the high-pass filtering below that one. The bottom row shows total response from many repetitions of the stimuli.

d) Neurons tested with tone bursts show a preference for speech frequencies and harmonics as well as differences for filtered “coo” signal.

e) The response of PT shows a clear cutoff around 5 Hz, limiting responsiveness.

4. What is your assessment of the overall findings? Did the experimental data support the authors’ interpretation? Why or why not?

The BPN stimuli had a remarkable effect (in 90% of neurons) whereas the PT stimuli showed little change. The effects of filtering and not allowing for the full signal had clear implications in the structures of the lateral sulcus. There is clear tonotopic mapping and speech specific mapping found here.

5. Describe new insights that you gained from the small group discussion of this paper.

I learned that tonotopic mapping is significantly altered by the amplication that feedback from brainstem may produce. I also found that many nuclei in thalamus and midbrain could’ve been implicated in perception of the “coo” signals or speech sounds.

6. List all of your questions and/or points in the paper that you did not understand.

I don’t understand how the low pass and high pass filtering figure 4 effected the perception of the holistic sound differently than the pure tone.