Sophie Sackstein

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 V2 area is rarely studied, and it's function is largely unknown still -as we discussed in class. V2 is one of the largest structures in the cortical area and it has strong connections to V1. To show fruitful responses to stimuli, controlled naturalistic texture stimuli were used- and discussed at length in the article.

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

Gaussian noise was used to create images that were similar to the original. The matched images for V1 and V2 had the same orientation and spatial frequencies, but using methods like a Fourier transform, they were able to generate a "texture" for the image. Responses were taken using a modularity index to differentiate firing in V1 and V2. The methods are further discussed below in the figures. The cells recording were taken from macaque monkeys. Later, (BOLD) fMRI responses were used to test the same concepts in humans. They also used a forced choice discrimination task to discern texture family.

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

Figure 1) This shows how they generated the images to stimulate areas V1 and V2 separately.

1A) Original Photographs

1B) Spectrally matched noise (same orientation & spatial frequency)

1C) Naturalistic texture images (average image)

1D) Gaussian white noise

Figure 2) Distinguishes V1 and V2 cells from firing in response to images mentioned above

2A) V1 and V2 cells show different firing patterns in response to the image- V1 seems almost matched to the image while firing in V2 seems very different from the naturalistic texture

2B) This shows the same results in 2A but more dramatically over a neuron population- the noise and naturalistic stimuli is even more separated, indicating there isn't the same one-to-one response that exists in V1.

2C) Thickness of the lines show a case where the modulation may due to chance- the blue seems much thicker at points and shows a steadier pattern that V1 cells.

2D) Firing rates are shown for different texture "families" in V2. In V2 there is a large difference for naturalistic stimuli and noise- indicating this texture specificity.

2E) Shows the amount that cells in V2 change in response to textured stimuli is greater than V1.

2F) This shows a distribution in spikes for the average single neurons in V1 and V2, this shows that the modulation is more consistent for V2 and more cells show positive modulations.

Figure 3) While receptive fields are larger in V2 than V1, there is correlation between that and modulation.

3a & 3b) When accounting for receptive field size, their seemed to be a random pattern for that plotted against the modulation index.

3c & 3d) Each data point shows a neuron for V1 and V2, classical receptive field–matched had a greater modulation index than smaller stimuli as shown by the points clustered above the line. There was less modulation in V2 for the smaller size.

Figure 4) This shows human responses to naturalistic textures in V1 and V2

4A) There was strong differential firing rates in V2, and a large coherence of cells communicate to V3.

4B) Modulation V3 is in this figure and V4 - although V4 is weakly connected.

4C) This shows responses to different texture families- showing some coherence in V2 and V3. The modulation in each is also clear from this figure.

4D) This shows much no modulations in the V1 corresponding to V2. V2 shows strong modulation for both indices.

Figure 5) Neuronal responses to naturalistic textures should show that there is a difference in firing between those and the spectrally matched noise.

5A) Stimuli used for discrimination task

5B) A three-alternative forced choice discrimination task was used so subjects could choice between images that varied in "naturalness".

5C) This shows that spectrally matched have a smoother threshold, which quickly becomes recognizable, whereas images that don't preserve orientation and spacing have a more sinusoidal curve.

5D & 5E) This shows that perceptual sensitivity is more strongly correlated with V2 activity than V1.

Figure 6) Mturk participants estimates generated a psychophysical function for texture families.

6A) Psychometric functions for texture families.

6B) Perceptual sensitivity was lower than sensitivity measured in fMRI data.

6C) 20 texture families were used, crowd-sourced from Mturk. There is an outlier spike at 1 from lower sensitivity.

6D & 6E) Single-unit modulation and sensitivity was measured for V1 and V2. These were matched with fMRI results.

Figure 7) Crowd-sourced psychophysical is strongly correlated to perceptual sensitivity

7A & 7B) Stimuli were made to match the V1 neural responses. Linear filters and energy response increased the selectivity for V1 at various orientations.

7C) Linear regression shows that there is a strong correlation between predicted sensitivity and measured sensitivity.

7D) Correlations for energy filters were more important than linear and spectral statistics for texture images.

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

Perception of shapes and texture may occur in V2 but not in V1. Border ownership and relative binocular disparity were also found to occur in V2. V2 responses were dramatically changed by the naturalistic structure, as was clear through figure 2. Some populations of V2 respond to different textures than others. While V2 cells have strong responses to V1, they are not completely modulated by it. 15% of V1 neurons and 63% of V2 neurons show specific response to textures. Although V2 fields are larger- this doesn't explain their selectivity for firing. They also testing if naturalistic textures are different from spectrally matched noise, then V2 is responding to more than just the orientation and size. Textures in the left graph of 4C show a sinusoidal difference in discriminability, whereas orientation is a smoother perceptual scale. A three-alternative forced choice discrimination task was used to measure discrimination for textures. This was tested on a larger sample with MTurk participants, this determined the "naturalness" of a stimuli in the other study. Energy filtration was more important in predicting the discriminability of a stimulus for texture discrimination than other variables. The data collected for Mturk supported the data found in the lab and MRI studies, confirming the hypothesis that V2 plays a strong role in perception of natural structures.

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

I found that the texture stimuli and other stimuli were produced through crowd-sourcing (MTurk) and that was how images were determined for the naturalness scale in the fMRI study. I also found that the responses in the macaque monkey supported those found in humans. The texture sensitivity- as determine by the image is also

shown in the human fMRI scan. The receptive field size in humans, is presumably similar to that in primates and thus it would not explain the difference in response to textures,

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

Why is the middle bottom figure in 2A so drastically different for V2 for spectrally matched noise? Why is there only weak activity in some areas for the MRI analysis?