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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)

A team of researchers funded by the Salk Institute for Biological Studies had discovered mapping among the connections between photoreceptors in the eye with retinal ganglion cells; neurons that dispatch visual information (from cones and bipolar cells) to the brain. The study was performed on a macaque monkey and it helped to demystify the code used to relay color information to the brain. These researchers revealed "computations in a neural circuit at the elementary resolution of individual neurons." with amazingly fine grained techniques to parse out the true nature of retinal ganglion cells. This article presents a different prospective to color opponent processes in M cells, showing that previous methods may have overlooked details of these visual pathways, precluding the diversity of RGC inputs.

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

Multi-electrode technology was used to record retinal ganglion types in the Macque eye. One of the essential elements that made the experiments possible was the unique neural recording system developed by these scientists. This system is able to record simultaneously the tiny electrical signals generated by hundreds of the retinal output neurons that transmit information about the outside visual world to the brain. These

recordings are made at high-speed (over ten million samples each second) and with fine spatial detail, sufficient to detect even a locally complete population of the tiny and densely spaced output cells known as “midget” retinal ganglion cells.
This helps with more accurately calculating purity score for the data. Photomicrograph of horizontal cells in the flat-mounted macaque monkey retinal periphery was also used and cells were stained with the Golgi method. Functional connectivity between RCG and cones was summarized with assigning an input strength to each cone.

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

The time course and radius helps distinguish between the five cell types in the retina- the image B overlays cones on to each image, showing the different RGC types
The first figure can help us classify the cells based on the time course and receptive field radius. The center graph of the first figure shows receptive-field radius versus first principal component of response time course, showing if they are sustained or transient neurons.

The second figure figures out which of those cones is communicating to which retinal ganglion cells, also it shows the spectral sensitivity. Being able to record from hundreds of retinal ganglion cells, they could trace the connections of individual photoreceptors (red, green and blue dots) to individual retinal ganglion cells. In figure 2 A, it shows concentration of red, green, blue inputs. Figure 2 B shows the proportions of spectral sensitivity on three axises, giving a different prospective on distribution of color sensitivity. D and C shows the cone mosaic of all RGC in region,

as similarly shown in E. Figure 3 shows the distinction between each cell type, displaying receptive-field centers of RGC with white lines representing the center and black lines representing the surround cell area. OFF midget cells continually relayed a clear S-cone input, but ON midget, ON parasol and OFF parasol cells had sporadically received this. In figure 4, subset i shows the purity index and the graphs in j shows the distribution in OFF and ON midget cells.

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

It shows that despite conflicting data in the past, a significant amount of peripheral cells have color opponent processes. These researchers found all cone cells, and responses from retinal ganglion cells. Then created connectionist models about how these retinal networks- how each cone reacted to ganglion cell. The prior work that inspired this was the red-green opponent theories that had conflicted with each other. Chichilnisky et. al discovered that populations of ON and OFF midget and parasol cells each sampled the complete population of cones sensitive to red or green light, with midget cells sampling these cones in a surprisingly non-random fashion. Only OFF midget cells frequently received strong input from cones sensitive to blue light.

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

When combined with information on spectral sensitivities of individual cones, maps of these punctate islands not only allowed the researchers to recreate the full cone mosaic found in the retina, but also to conclude which cone fed information to which retinal ganglion cell. With my group, I reviewed the analysis of these findings, the paper claims that "smooth Gaussian approximation" lead to flawed results in most papers and that their more fine grained methods provide a more detailed and accurate understanding of color opponent processes.

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

The permutation mechanism that they use to conclude connectivity between cones and RGCs is not clear in the paper. The role of the connectivity is not clear in the paper and the calculation of the purity index is also very confusing. I also found some of the graph/figures hard to interpret, like the three axis model in figure 2b. I hope to discuss this more in class.