CS294-164 Report - Week 3

Medhini G Narasimhan (medhini@berkeley.edu)

September 11, 2019

1 Gene therapy for red–green colour blindness in adult primates

1.1 Main Idea

This paper discusses the possibility of using gene therapy to cure red-green color blindness in adult monkeys which were color blind from birth. Their results show, contrary to the prior belief that vision disorders can only be treated in the young, the addition of a third opsin in adult red–green color deficient primates was sufficient to produce trichromatic color vision behaviour.

1. Main cause of red-green color blindness is the absence of L or M cone cells.
2. Two dichromat squirrel monkeys, which were missing the L-opsin gene, were chosen for the experiment.
3. For trichromacy, spectral sensitivity needs to be shifted to respond to long wavelength light, thus producing two distinct cone types absorbing in the middle-to-long wavelengths.
4. A virus containing L-opsin gene under the control of the L/M-opsin enhancer and promoter was delivered to the photoreceptor layer by subretinal injections. After about 20 weeks, the monkey's perception of blue-green and red-violet improved, indicating they had achieved trichromatic vision.
5. Their experiments also revealed that colour vision requires a shift in spectral sensitivity that results from expression of an L pigment in a subset of M cones.
6. **In conclusion, gene therapy, without any rewiring of neural circuitry, can cure color blindness in adult primates which have all photoreceptors intact and healthy. Also they show that trichromatic colour vision behaviour requires nothing more than a third cone type.**

1.2 New idea based on readings

1. The key takeaway from the experiments in this paper is that no rewiring of neural circuitry is necessary for treating red-green color blindness. Thus, trichromacy can arise from a single addition of a third cone class and it does not require an early developmental process. It would be interesting to investigate other similar congenital disorders (eg. Achromatopsia) which could be treated the same way.

2. **Mf-ERG Analysis:** Analysis of periodic Mf-ERG tests of color blind primates being treated with gene therapy can lead to interesting insights on how the retina responses change gradually during this process. It makes it easier to replicate these patterns and reproduce similar changes using other corrective procedures like Oz-Vision.

2 The elementary representation of spatial and color vision in the human retina

2.1 Main Idea

This work talks about the findings from stimulating sensitive cone cells with light. There are two main challenges in performing an experiment like this: (1) The retina is situated inside the eyeball and thus can be neither visualized nor stimulated at cellular resolution due to the eye's aberrated optics. (2) Even while steadily fixating, the retina moves over spatial scales far greater than the size of a single cone, impeding the repeated and reliable stimulation of the same cell. Main conclusions of the experiments were as follows: (1) Two distinct populations of cones were observed: a smaller group predominantly associated with signaling chromatic sensations and a second, more numerous population linked to achromatic percepts. (2) Spectrally opponent neighborhoods do not produce chromatic sensations

2.2 New idea based on readings

1.