Visual perception is thought to occur via different processing pathways in the brain. The dorsal pathway is involved in motion processing, while the ventral pathway is involved in processing the form of objects (Ungerleider & Mishkin, 1982; Fig. 1). Primary visual cortex (V1) is the first cortical area that receives information from the eye. Neurons in V1 project to area V2, which then distributes information into either the dorsal or ventral processing streams. By understanding how V1 and V2 are wired together, we can understand what kinds of information from the eye are flowing into each of the visual pathways, thus allowing us to investigate how the brain constructs our visual perception of the world.

In this project, we are looking at the kinds of cells in V1 that provide information to different functional areas in V2 (known as stripes: thick, thin, pale-medial, pale-lateral; Fig 2). We are specifically looking at two kinds of neurons (spiny stellates, pyramids) in layer 4B (L4B) of V1 (Fig 3). These L4B cells have been shown to receive different kinds of input; stellates receive input useful for motion processing, while pyramids receive input useful for processing the form of objects. Surprisingly, it was recently shown that a motion area of the brain, MT, receives about ~80% stellate and ~20% pyramidal input from L4B. It was also shown that area V2 received ~80% input from pyramids, and ~20% from stellates (Nassi & Callaway, 2009). In that study, the investigators did not look at the
input from V1 to the specific stripe areas of V2, which is the goal of this project.

To label L4B neurons that project to specific V2 stripes, a modified rabies-GFP virus is injected in vivo into a V2 stripe in an anesthetized macaque monkey. After ~5 days post injection, animals are euthanized, brains are sectioned at 40µm, and then processed immunohistochemically to reveal labelled neurons. Neurons are digitally reconstructed across serial sections using light microscopy and Neurolucida software.

The percentage of spiny stellate and pyramidal cells going to thick stripes in V2 was found to be ~50% stellate and ~50% pyramidal. This differs from the previous findings and is important because it shows that one function of thick stripes is to integrate equal amounts of form (pyramidal neurons) and motion (stellate neurons) information, which was previously unknown. Additionally, thick stripes project into the dorsal stream, and our data show an unexpected contribution of ‘form’ information to this pathway. Currently, we are studying the proportion of each neuron type projecting to thin stripes. We hypothesize that there will be a higher percentage of pyramidal neurons projecting to thin stripes because thin stripes are known to project into the form processing ventral pathway.

References


Federer et al. 2009