In the visual system, geniculocortical projection neurons in the visual thalamus, the dorsal lateral geniculate nucleus (LGN), convey distinct visual information coming from the retina mainly to the primary visual cortex (V1) (Callaway 2005, Kaplan 2004, Sherman & Guillery 2006). From V1, visual information is passed on to extrastriate cortical areas along the visual cortical hierarchy (Felleman & Van Essen 1991). However, there are sparse V1-bypassing projections from the LGN to extrastriate visual cortical areas which are thought to originate primarily from cells within the koniocellular and C layers of the LGN (Dell et al 2018, Lyon & Rabideau 2012, Lysakowski et al 1988, Sherk 1986, Sincich et al 2004, Tong et al 1982). Visual perception likely involves reciprocal feedback circuits connecting the cortex with the LGN, which complement the feedforward geniculocortical projections. Using virus-mediated retrograde tracing techniques, we have identified and characterized multiple morphologically distinct corticogeniculate subtypes, predominantly in area 17 (V1) and area 18 (V2) (Briggs et al 2016, Hasse et al 2019), as well as in extrastriate visual cortical areas V4, MT and MST in macaques, and area 21a, PMLS, and PLLS, in ferrets. Physiological evidence based on axon conduction latencies and visual responses properties suggests that distinct V1 corticogeniculate subtypes align with the feedforward parallel processing streams (Briggs & Usrey 2005, Briggs & Usrey 2007, Briggs & Usrey 2009). Whether extrastriate corticogeniculate neurons are similarly functionally distinct and stream-specific is not known. Importantly, the presence of complementary, reciprocal, V1-independent connections between the LGN and extrastriate visual cortex, in ferrets and macaques, could provide a substrate for residual vision following V1 damage.

We will explore physiological changes among LGN, PMLS, PLLS, and area 21a neurons over time following V1 lesions. We will train ferrets to discriminate contrast, temporal frequency, spatial frequency, and direction changes among moving visual stimuli. We hypothesize that physiological changes in each area may depend on the type of visual discrimination tasks performed by the animals. Furthermore, we predict that changes in physiological properties of extrastriate corticogeniculate neurons following V1 lesions (observed in Aim 1) may dictate the changes we observe in the LGN and extrastriate areas. Altogether, these results will help us assess the functional significance of sparse extrastriate corticogeniculate projections, and whether extrastriate corticogeniculate feedback circuits are critical for maintaining residual vision following V1 damage, as in blindsight.