Interarea communication during visual processing

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Perception of our environment relies on sensory processing, which takes place in hierarchical pathways involving cortical areas. These cortical areas are also interconnected with the thalamus, which comprises most of the input to the cortex. Visual processing relies on communication across groups of retinotopically aligned neurons, including groups that have been defined primarily through anatomical connections. However, our understanding of the functional connectivity and specializations between these aligned groups is not well understood. Much of the current body of literature examining interactions between groups of cells does not capture spiking interactions at the population level – the level of interaction which is thought to be critical for visual processing. To approach these questions, we set to record and modulate subnetworks of communication to visual cortex to study specific inter-area interactions. These findings would bring us towards answering a foundational question in neuroscience regarding how populations of neurons selectively communicate with one another. Furthermore, understanding how the brain uses population activity to build representations of the world will help us understand sensory, psychiatric, and other disorders.

Using a Neuropixels platform built by the Denman lab, we recorded multiple brain areas simultaneously using high-density electrodes in awake mice. Furthermore, with spike sorting techniques, we identified individual units that responded to specific visual stimuli, showing different degrees of response to visual stimuli in the different levels of the visual processing hierarchy (V1, LM, LP). Next, we used mice injected with the eOPN3 rhodopsin to examine the effects of transient modulation of visually responsive areas. In aggregated, we find that the inhibition of V1 can lead to corresponding suppressed activity in LM and LP. These data are a first exciting look at how we might uncover the dynamics of communication between populations of neurons.