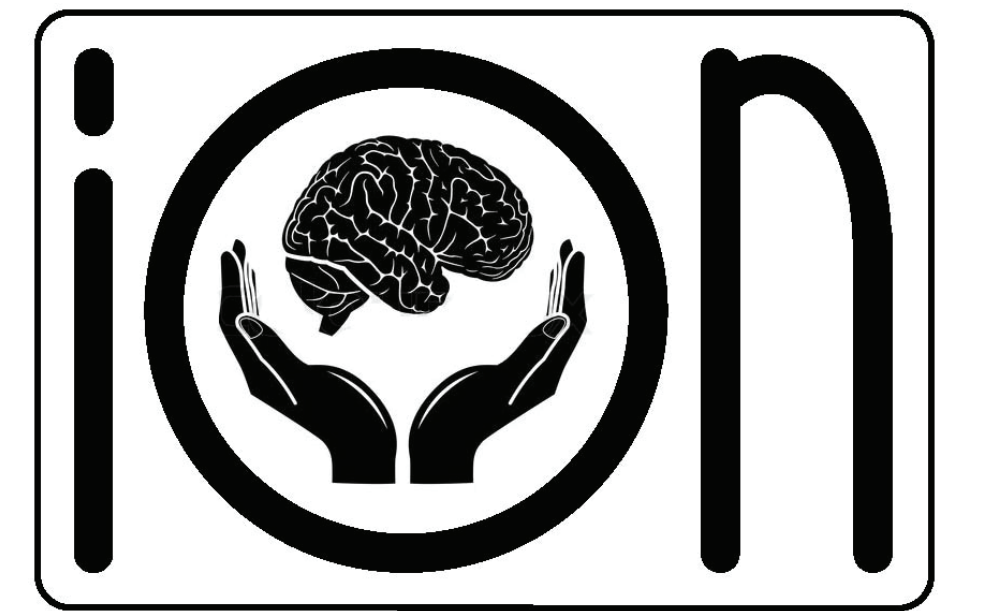




Determining the role of the pulvinar in visual attentional control



Emmalyn SP Leonard, Cristopher M Niell

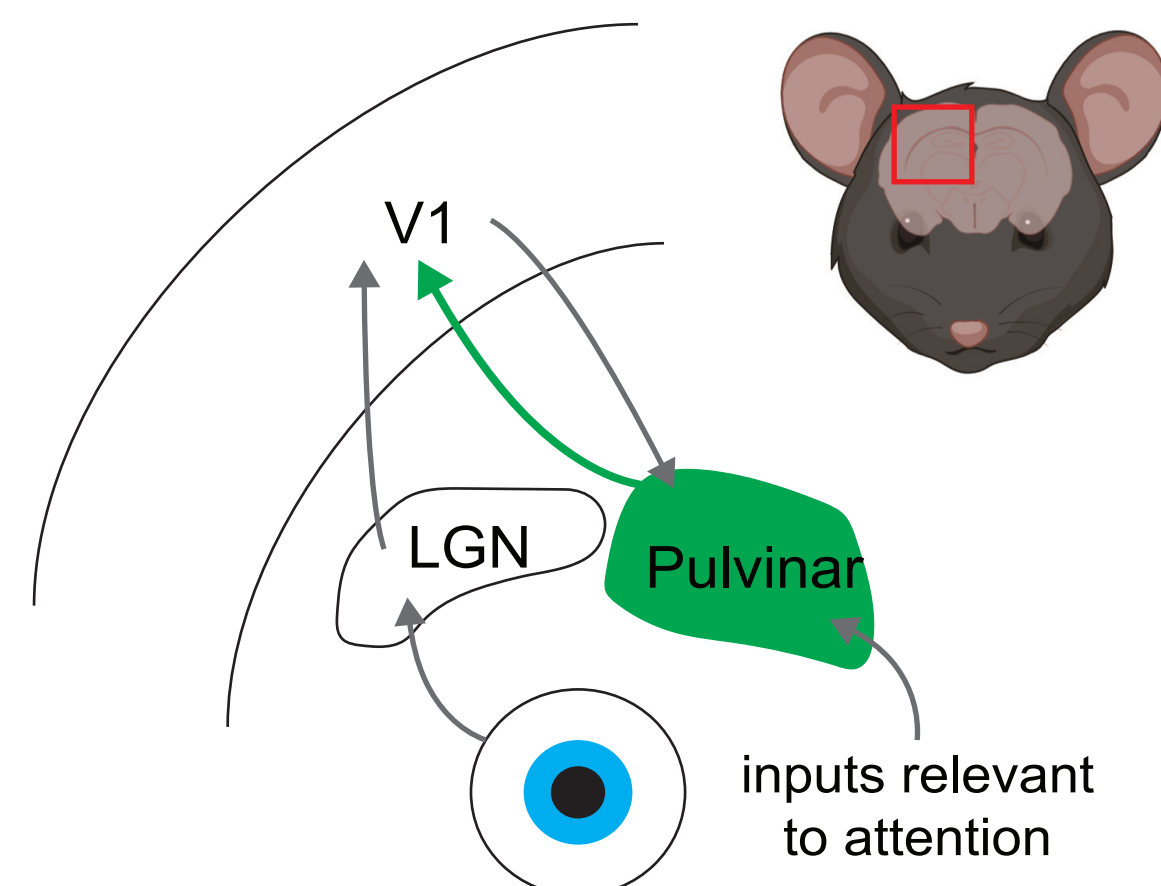
Institute of Neuroscience & Department of Biology, University of Oregon

INTRODUCTION

- Safe navigation of the world requires selective attention to relevant visual stimuli
- A key aspect of selective visual attention is quick and accurate judgement of what visual information must be attended to in order to survive
- The pulvinar thalamic nucleus is proposed to play a vital role in the filtering of visual stimuli to determine which information is most important
- We aim to determine the role of the pulvinar in a visual discrimination task with distractors requiring active viewing of a stimulus

BACKGROUND

- The primary visual cortex (V1) is involved in the initial construction of a basic visual image
- Much of the information processed in V1 is first processed in the LGN then routed through the pulvinar



- Human patients with pulvinar lesions show deficits in their ability to filter out and ignore distracting information (Snow et. al., 2009)



We use our ability to filter out distracting information to safely navigate the complex world.

METHODS

Behavioral task: Mice are placed on a running wheel and will receive a water reward if they correctly reports (licks) a change in the orientation or direction of the stimulus. Mice are head-fixed over the running wheel to allow for two photon microscopic recording of signaling in the brain.

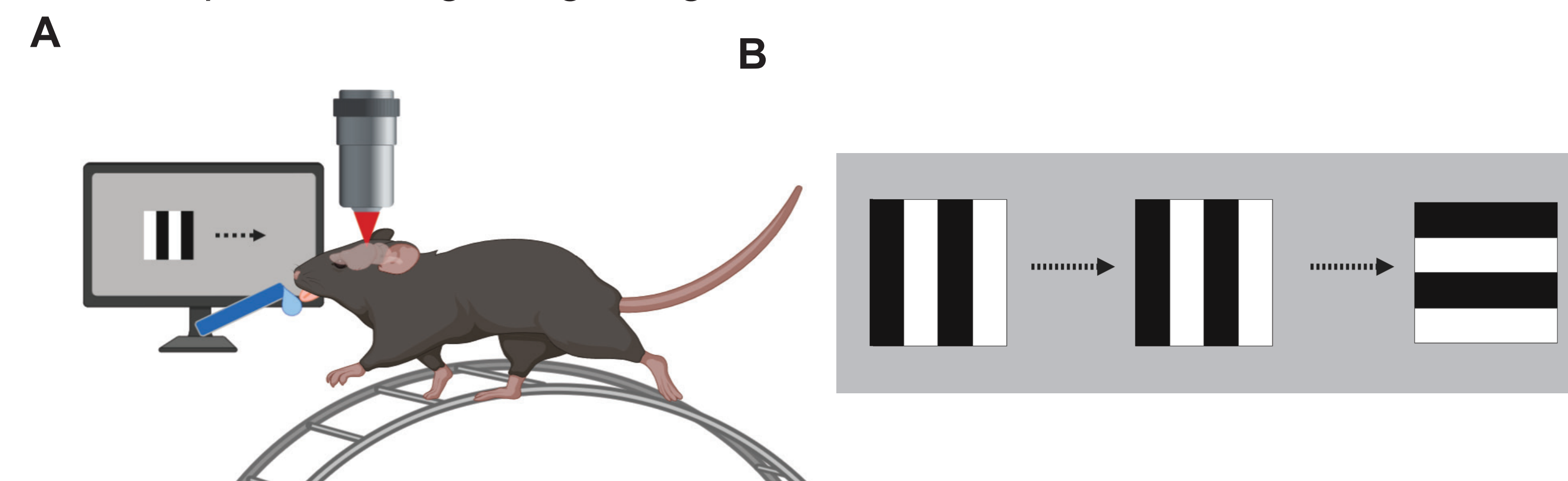


Figure 1. A) Experimental setup of behavioral task and recording. B) Example stimulus orientation change.

Surgical preparation of subjects: GCaMP is a protein that increases its green fluorescence when it binds to calcium ions, acting as a signal for brain activity. GCaMP is introduced into the brain via a viral agent. After injection of GCaMP virus into the pulvinar, a headplate with posts allowing for head fixation is attached directly to the skull. A 5mm craniotomy is performed and the removed skull piece is replaced with a glass coverslip.

Mapping of V1 and recording of neural activity: After the virus is given ample time to express, the animal is head-fixed under a wide field microscope and presented a directional stimulus in order to map the response, and thus the location, of V1 under the cranial window. After retinotopic mapping of V1, the animal is presented with similar stimuli under a two-photon microscope to locate the cells in V1 that are most responsive, and experiments are performed.

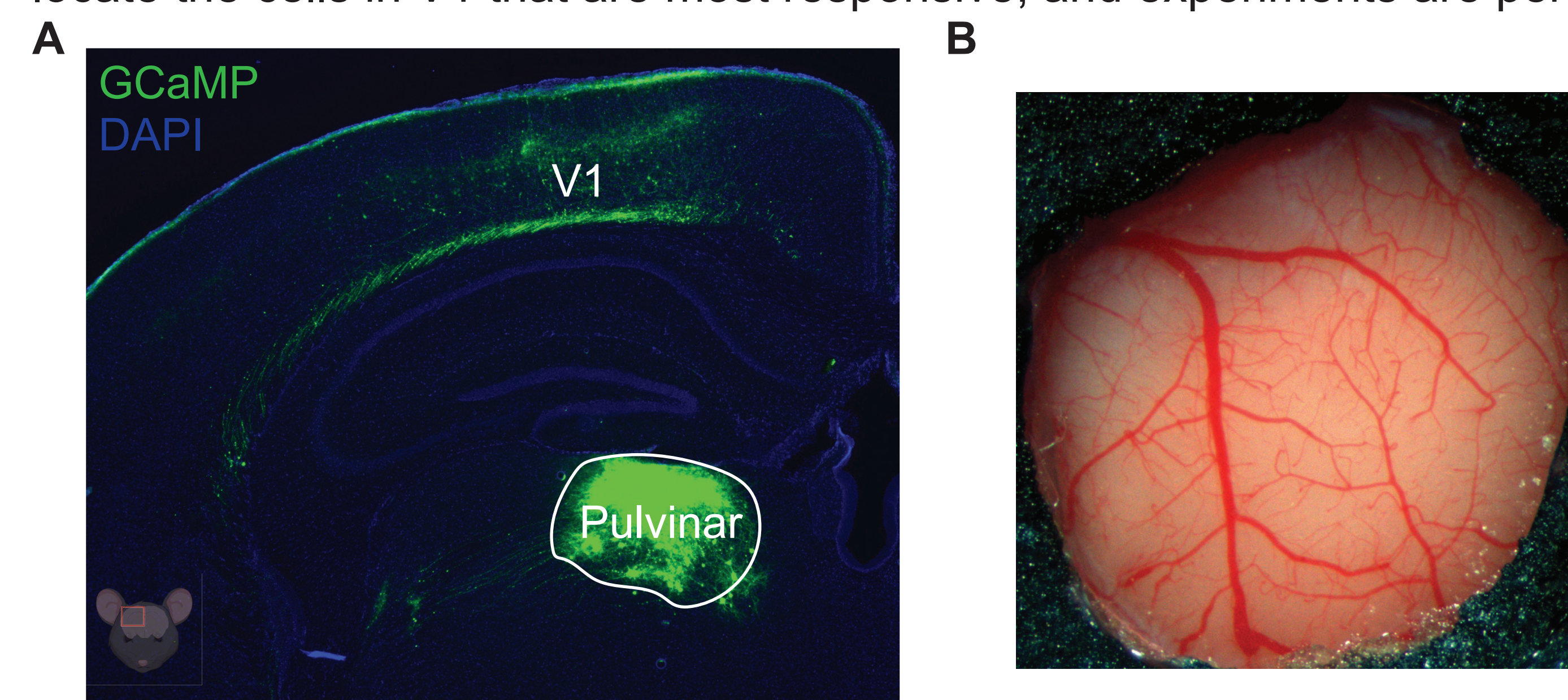


Figure 2. A) Axonal projections between the pulvinar and V1 (green). Pulvinar of Cre-positive pulvinar mouse injected with 100 nL Cre-dependent GCaMP virus. Image taken 4 weeks post-injection. Behavioral experiments begin 2-3 weeks post-injection and 1-2 weeks post-craniotomy in order to allow full viral expression. B) Cranial window over V1 through which brain activity is recorded.

RESULTS

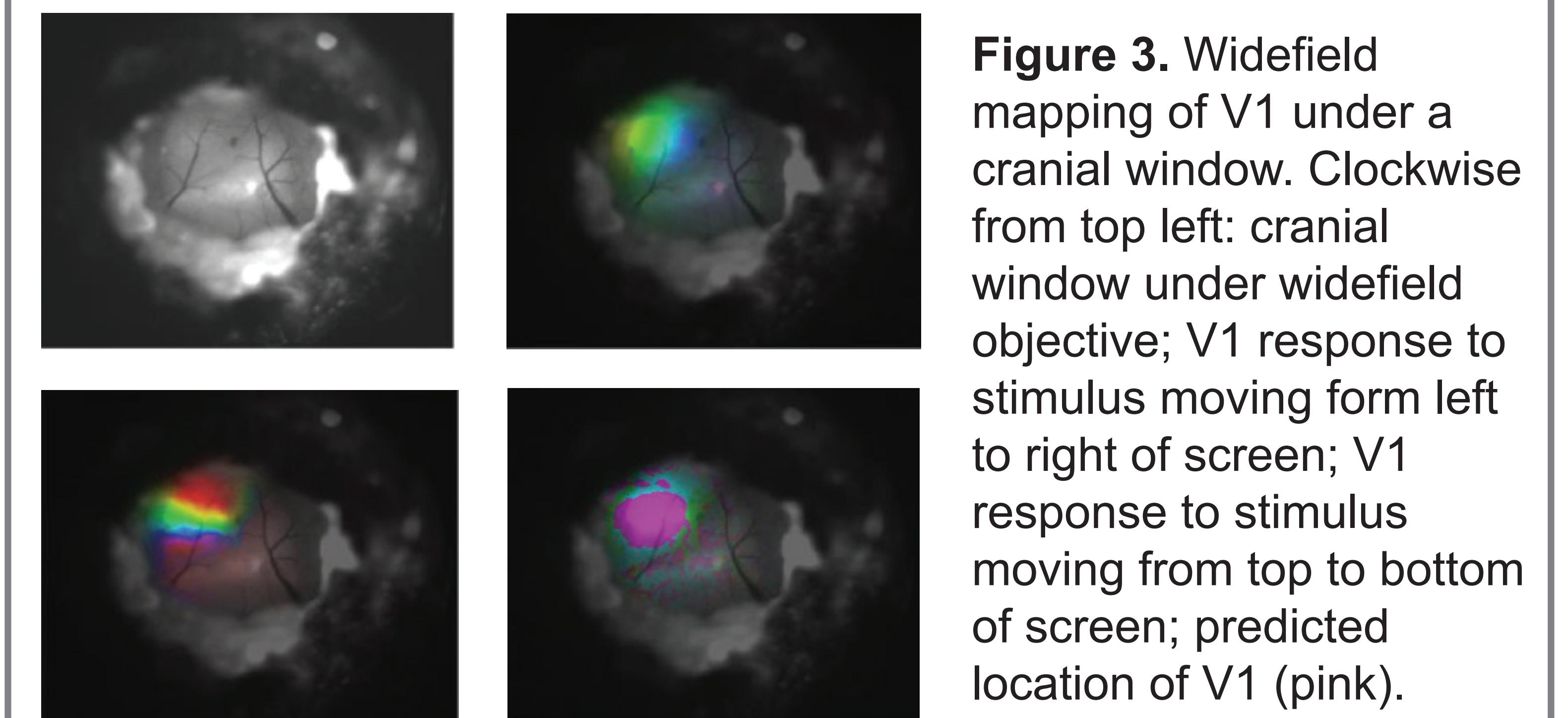


Figure 3. Widefield mapping of V1 under a cranial window. Clockwise from top left: cranial window under widefield objective; V1 response to stimulus moving from left to right of screen; V1 response to stimulus moving from top to bottom of screen; predicted location of V1 (pink).

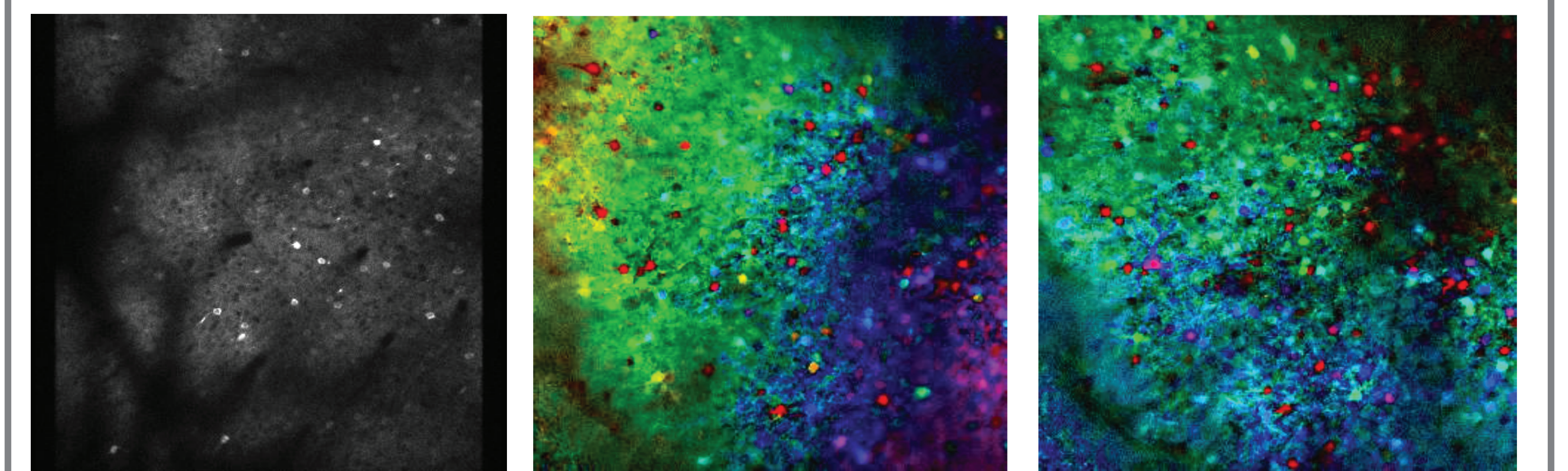


Figure 4. Two-photon mapping of V1. Individual neurons are in white on far left. From left to right: image of V1 through two-photon objective; topographic mapping of V1 cellular response to stimulus moving from left to right of screen; topographic mapping of V1 neuronal response to stimulus moving from top to bottom of screen.

CONCLUSION

Findings:

- Injection of GCaMP virus into pulvinar results in a labeling of neurons and their axons projecting from pulvinar to V1; labeled cells show a retinotopographic response to visual stimuli

Future Directions:

- Implementation of behavioral training on larger cohorts of mice
- Selective shutdown of projections to V1 from pulvinar through co-injection of inhibitory DREADDs virus with GCaMP into pulvinar
- Analysis of effect of pulvinar shutdown on behavioral task performance involving active visual attention hypothesized to require processing by the pulvinar