

Analysis of ACC Activity During Effort-Based Decision-Making

Joint Lab Meeting - 3.31.2022

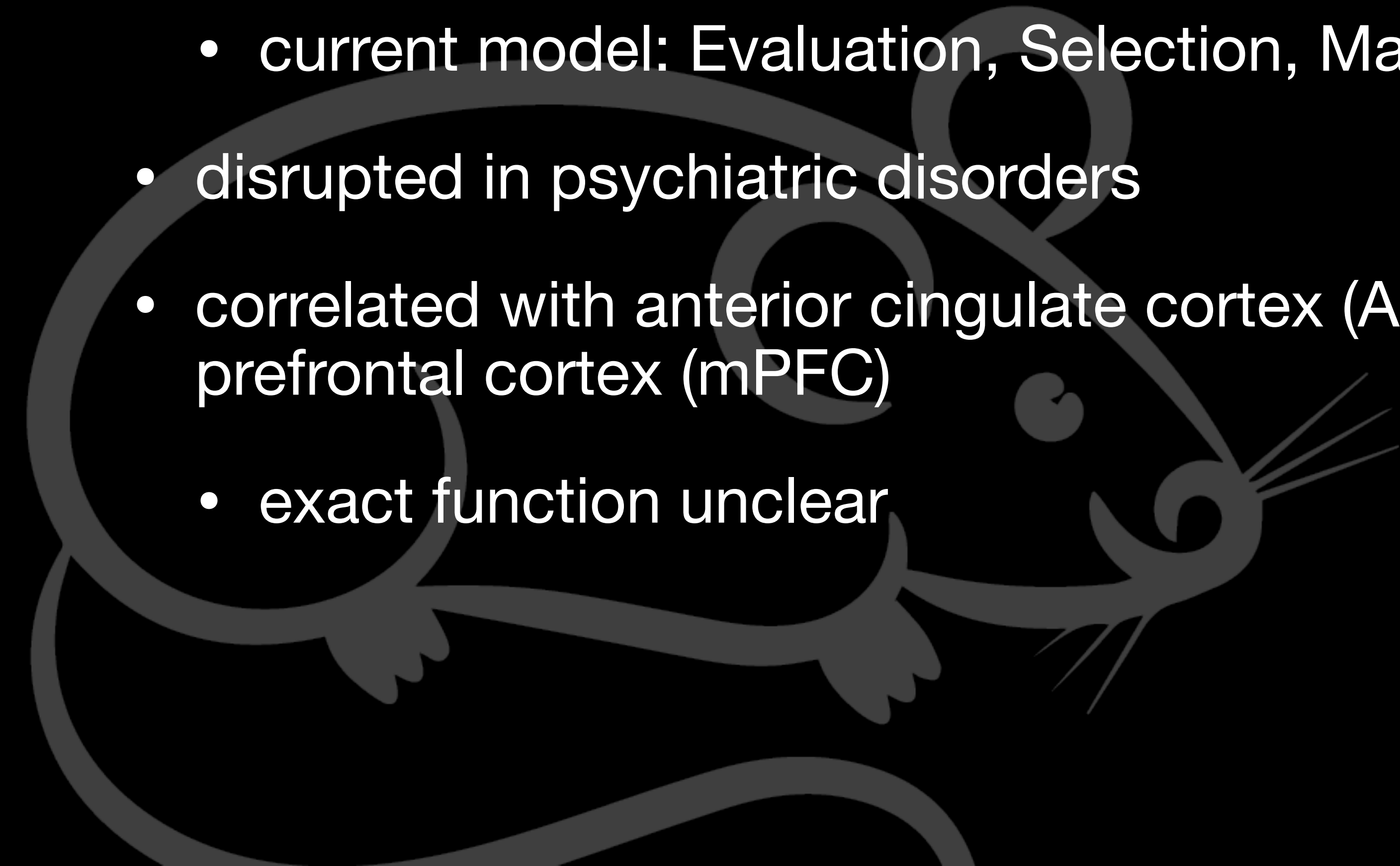
Mateo Umaguing

Outline

- Introduction & Background
- Behavioral Assay & Setup
- Miniscope Data Analysis
- Discussion & Further Directions

Effort-based Decision-Making (EBD)

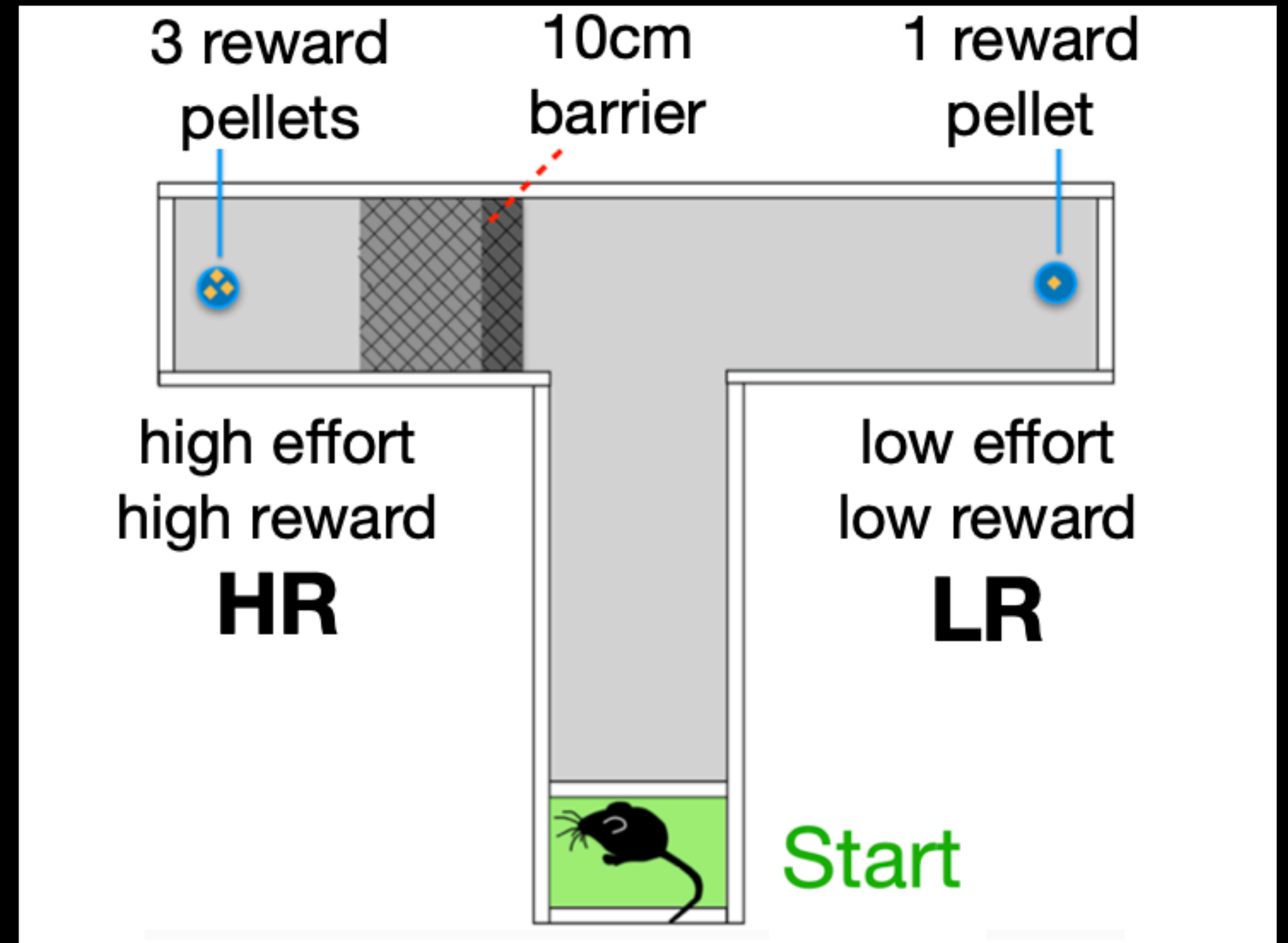
- cognitive process to carry out actions requiring effort
 - current model: Evaluation, Selection, Maintenance of Decision
- disrupted in psychiatric disorders
- correlated with anterior cingulate cortex (ACC) function in the medial prefrontal cortex (mPFC)
 - exact function unclear



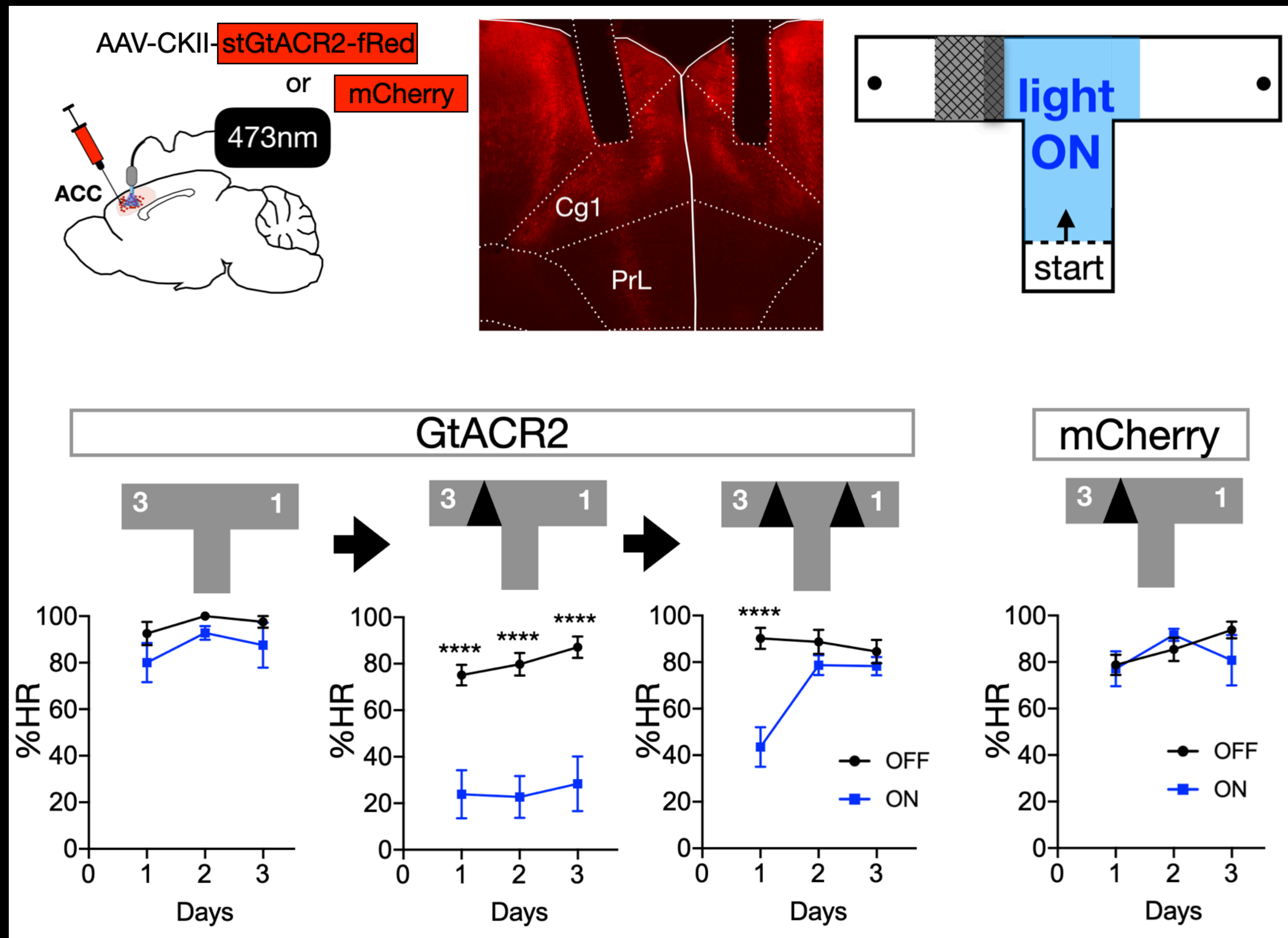
- Introduction & Background
- Behavioral Assay & Setup
- Miniscope Data Analysis
- Discussion & Further Directions

T-Maze Assay

- HVR vs. LVR "reward differential"
- HVR selection ~ effort-based decision

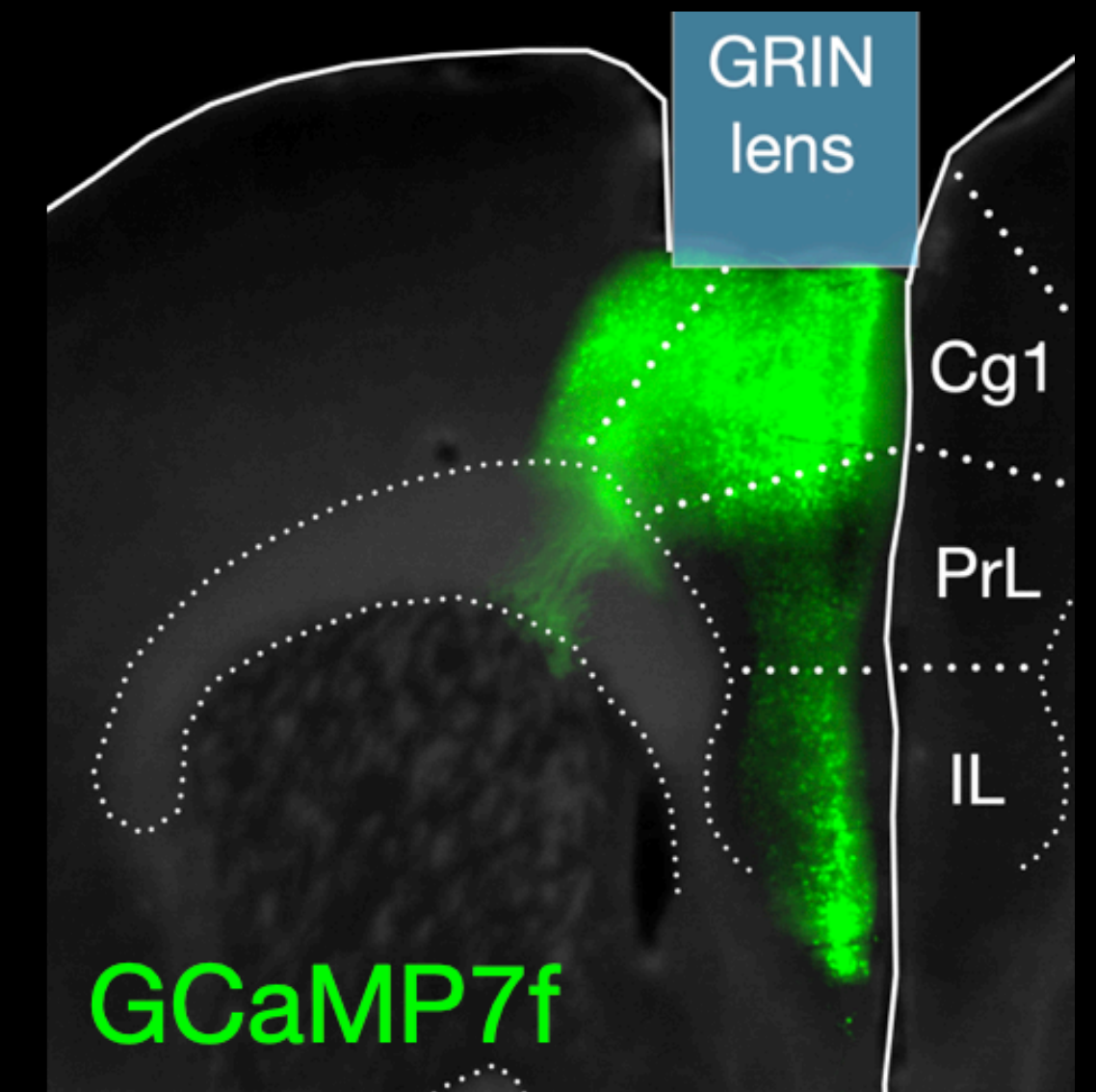
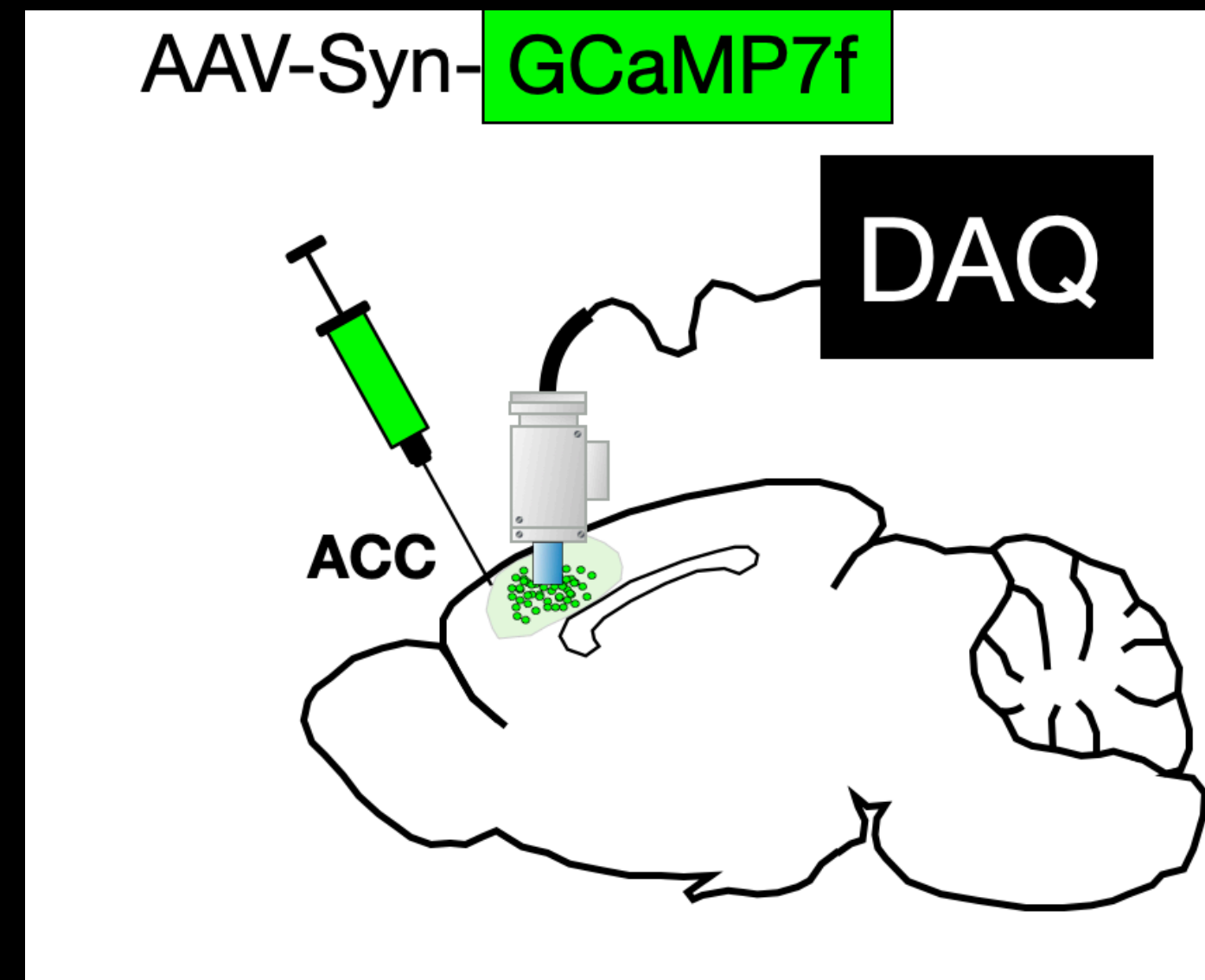


Optogenetic Experiments

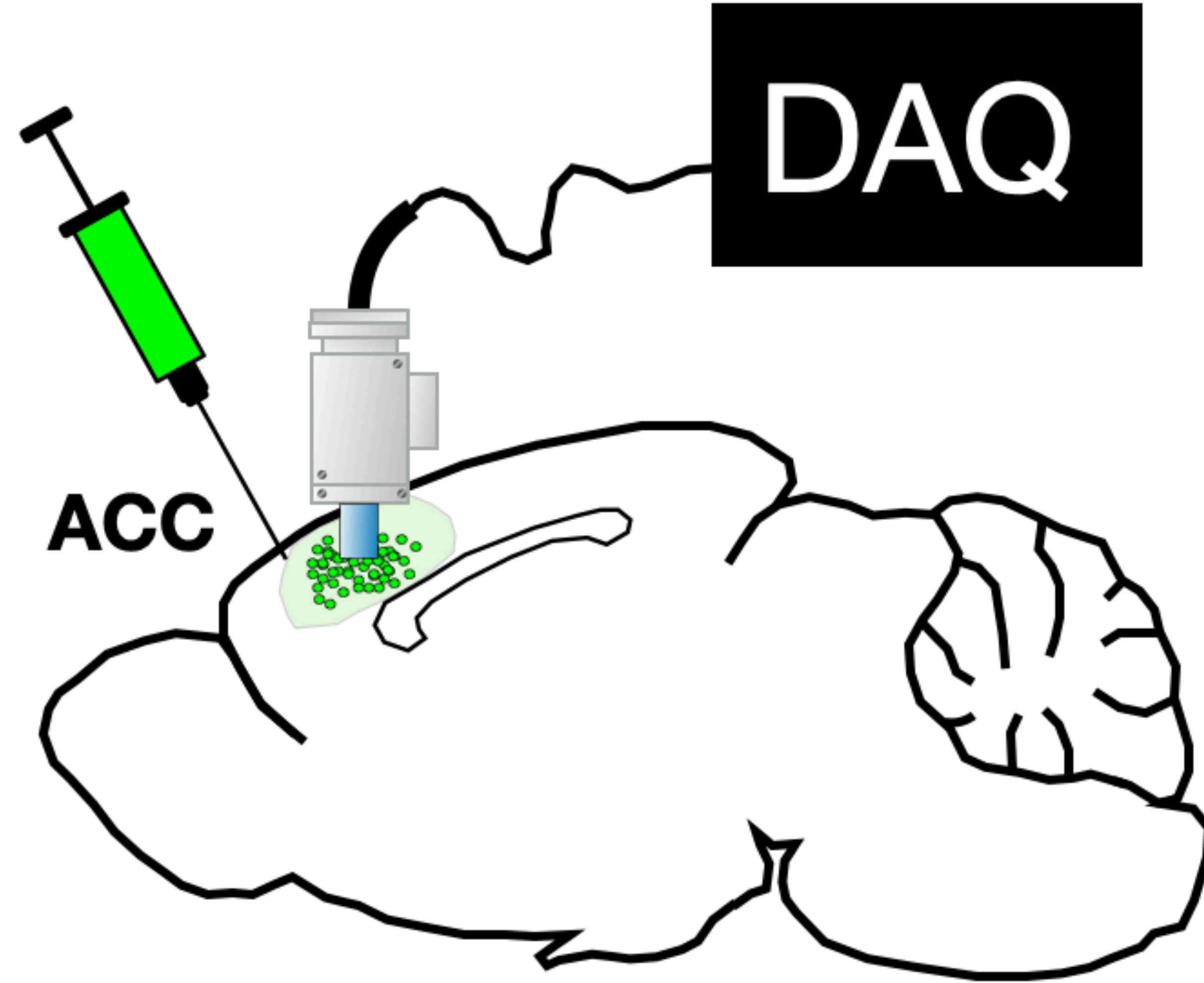


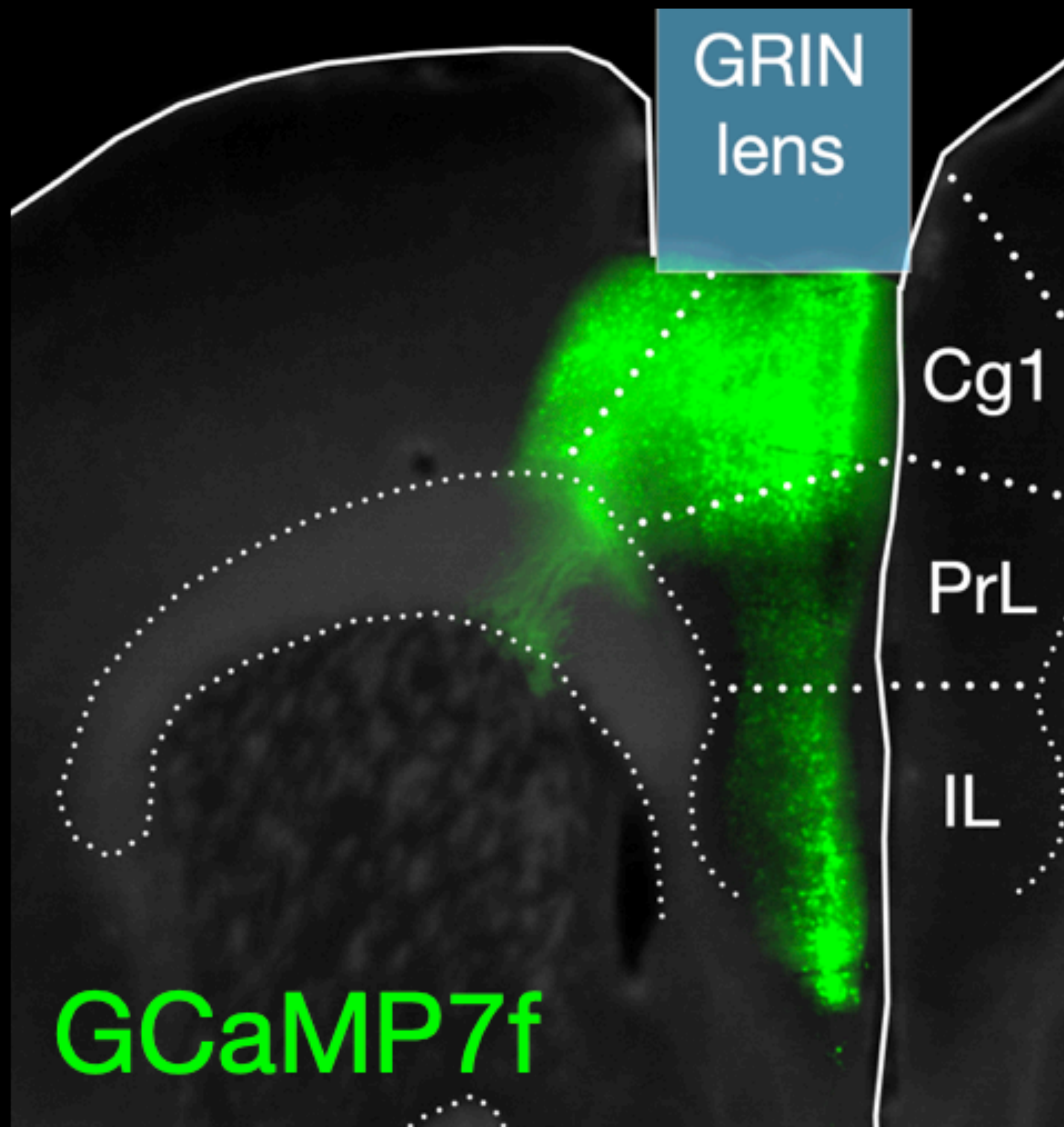
Miniscope Setup

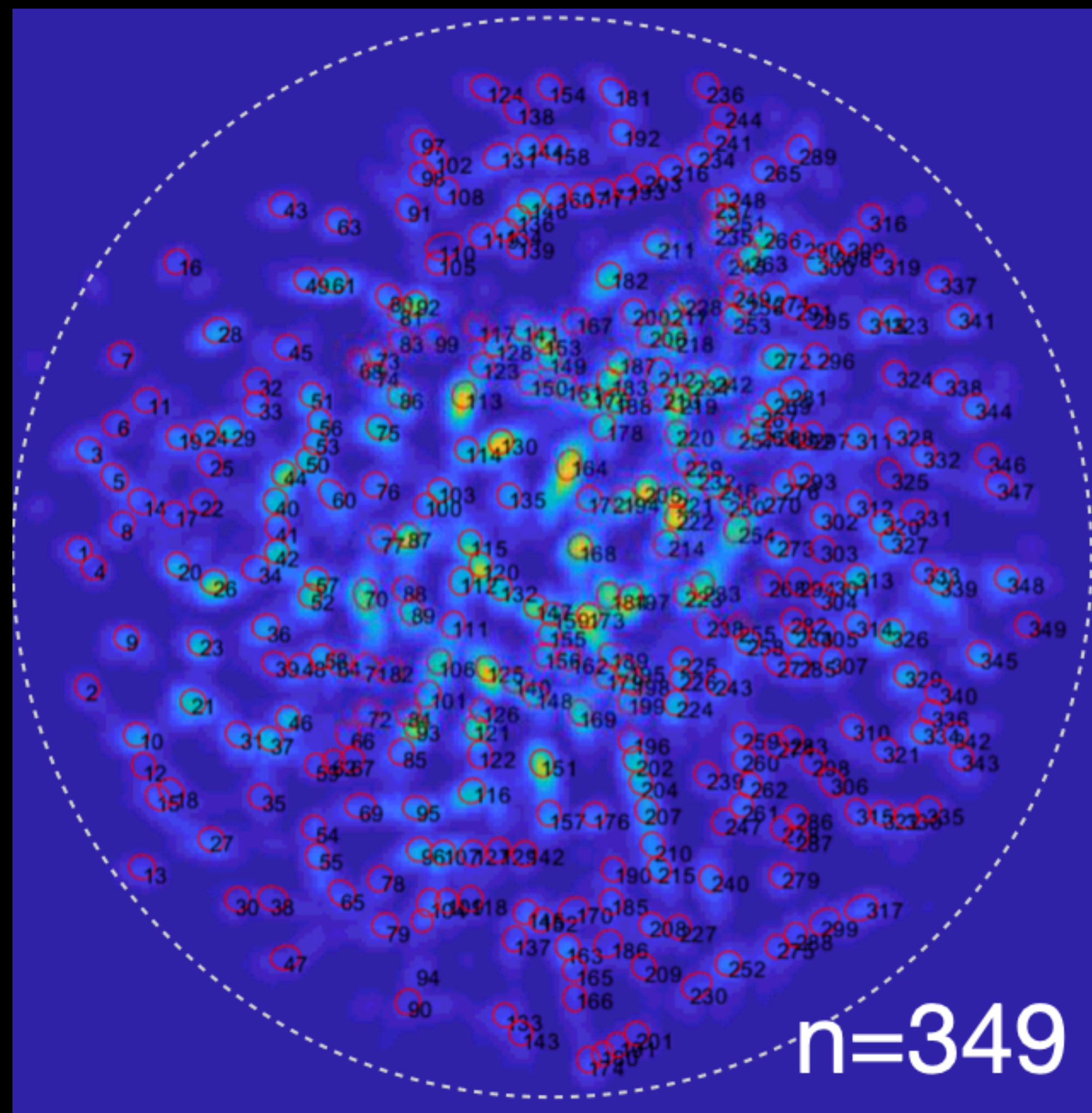
- Ca^{2+} ions ~ depolarization ~ neural activity
- GCaMP7f viral injection



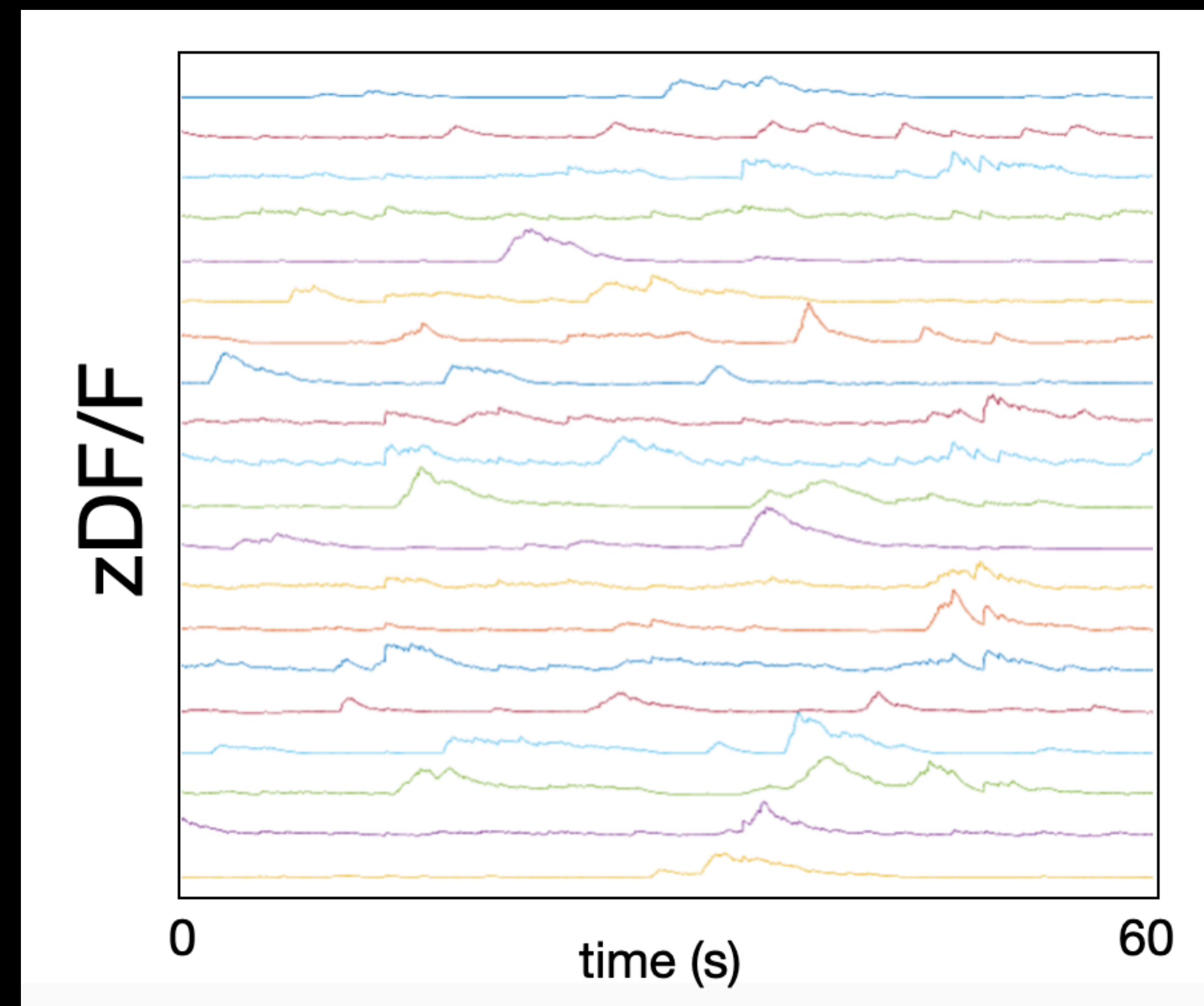
AAV-Syn-GCaMP7f





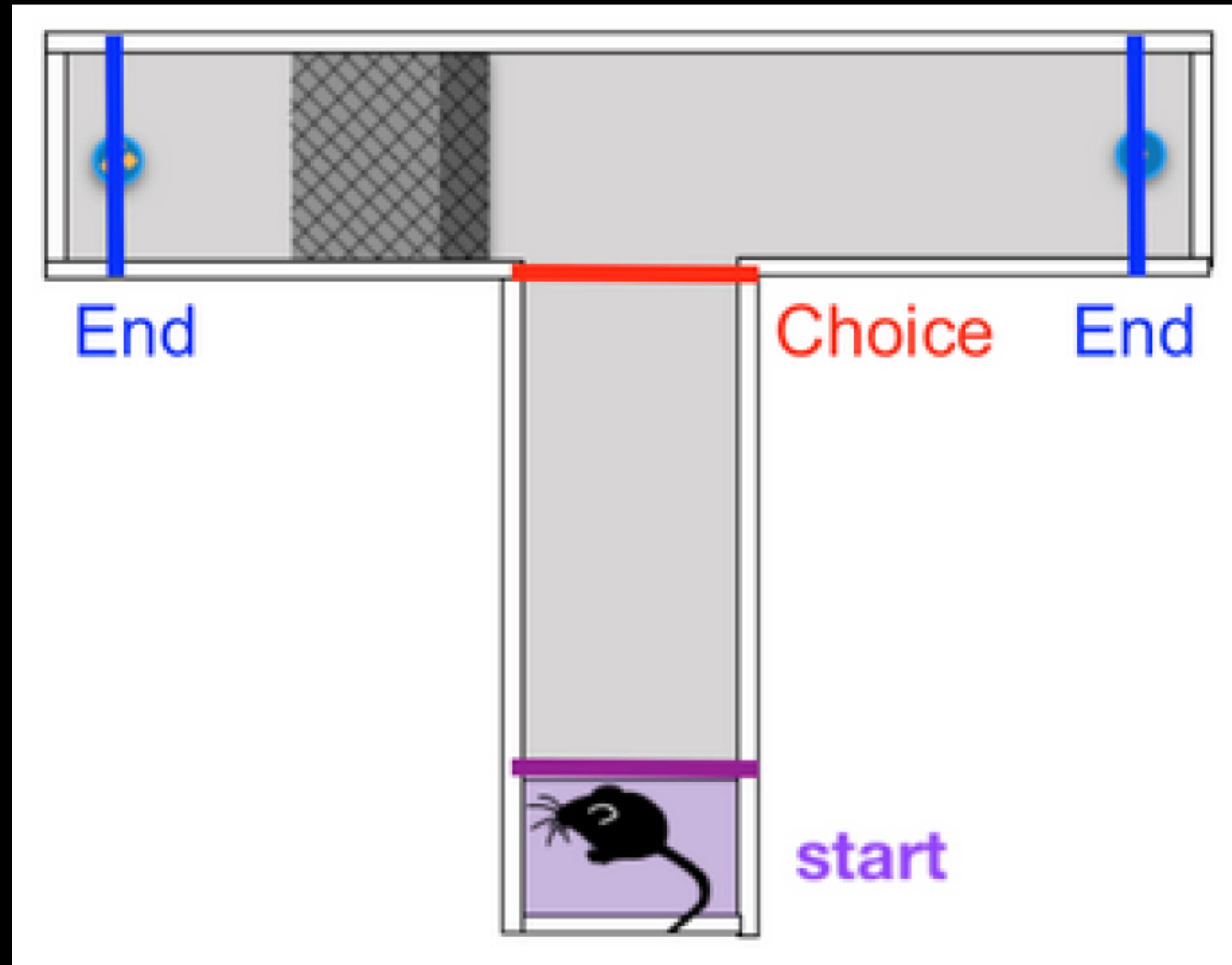


via Min1 pipe



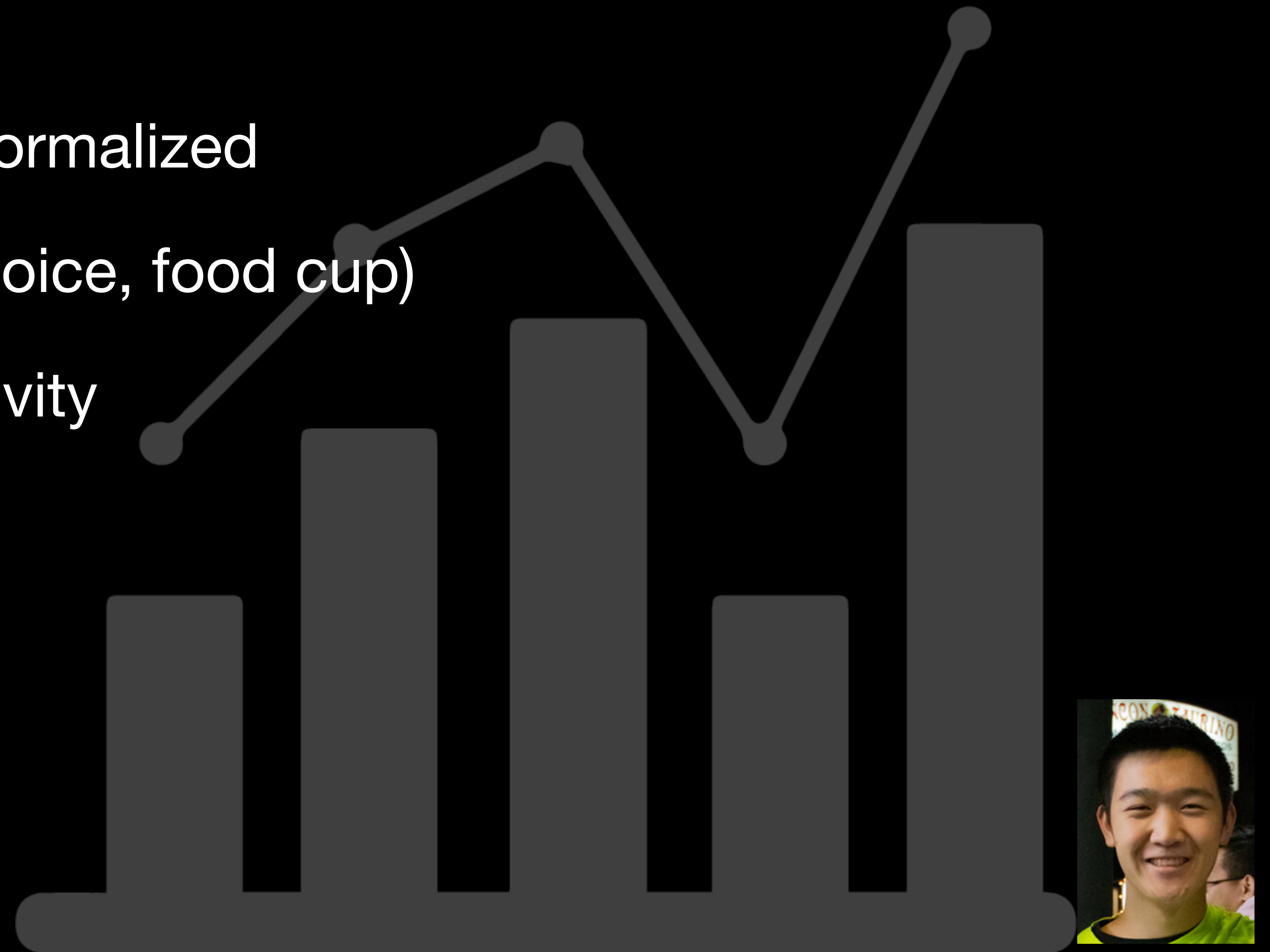
- Introduction & Background
- Behavioral Assay & Setup
- Miniscope Data Analysis
- Discussion & Further Directions

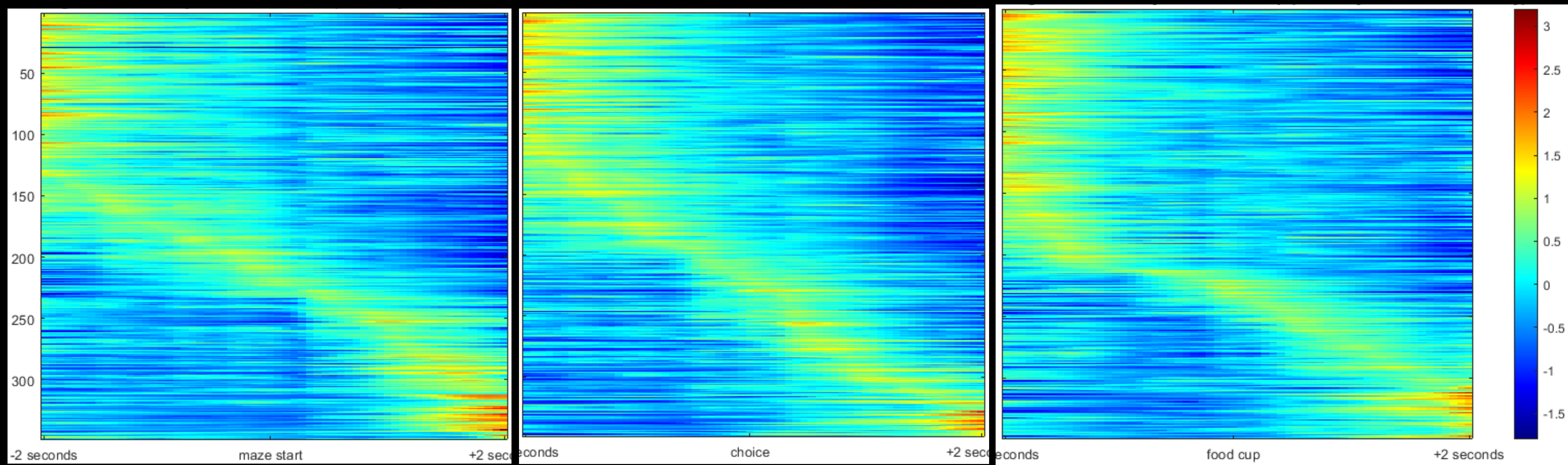
T-Maze Alignment



Resolved Issues

- trial-averaged neuron activities normalized
- centered around events (start, choice, food cup)
- sorted by frame of maximum activity





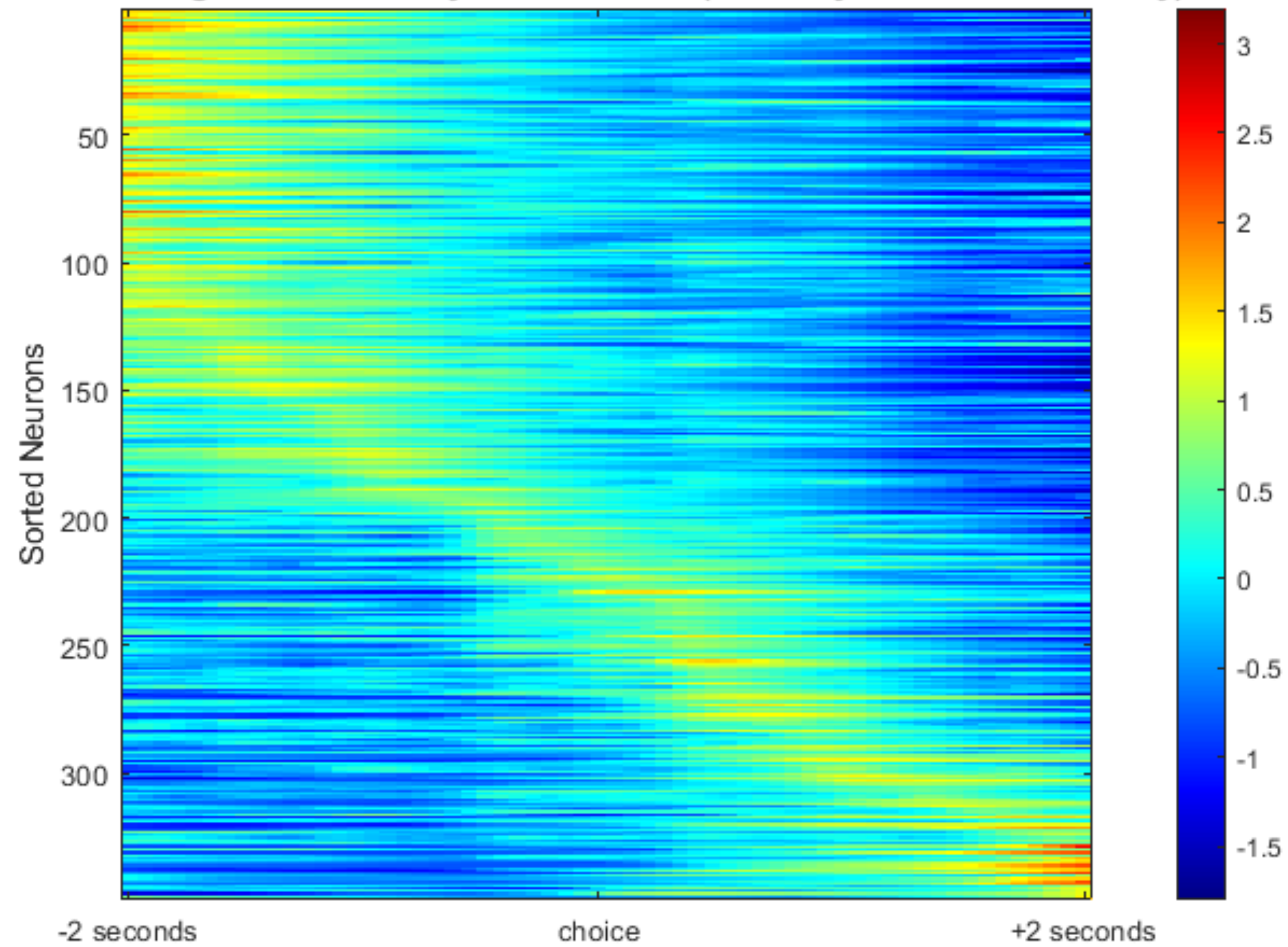
Finding Significant Neurons

- permutation test, 95% one-sided confidence interval
 - mean across 61 frames greater than 95% of 10,000 sampled means
- 88 deemed "significant"

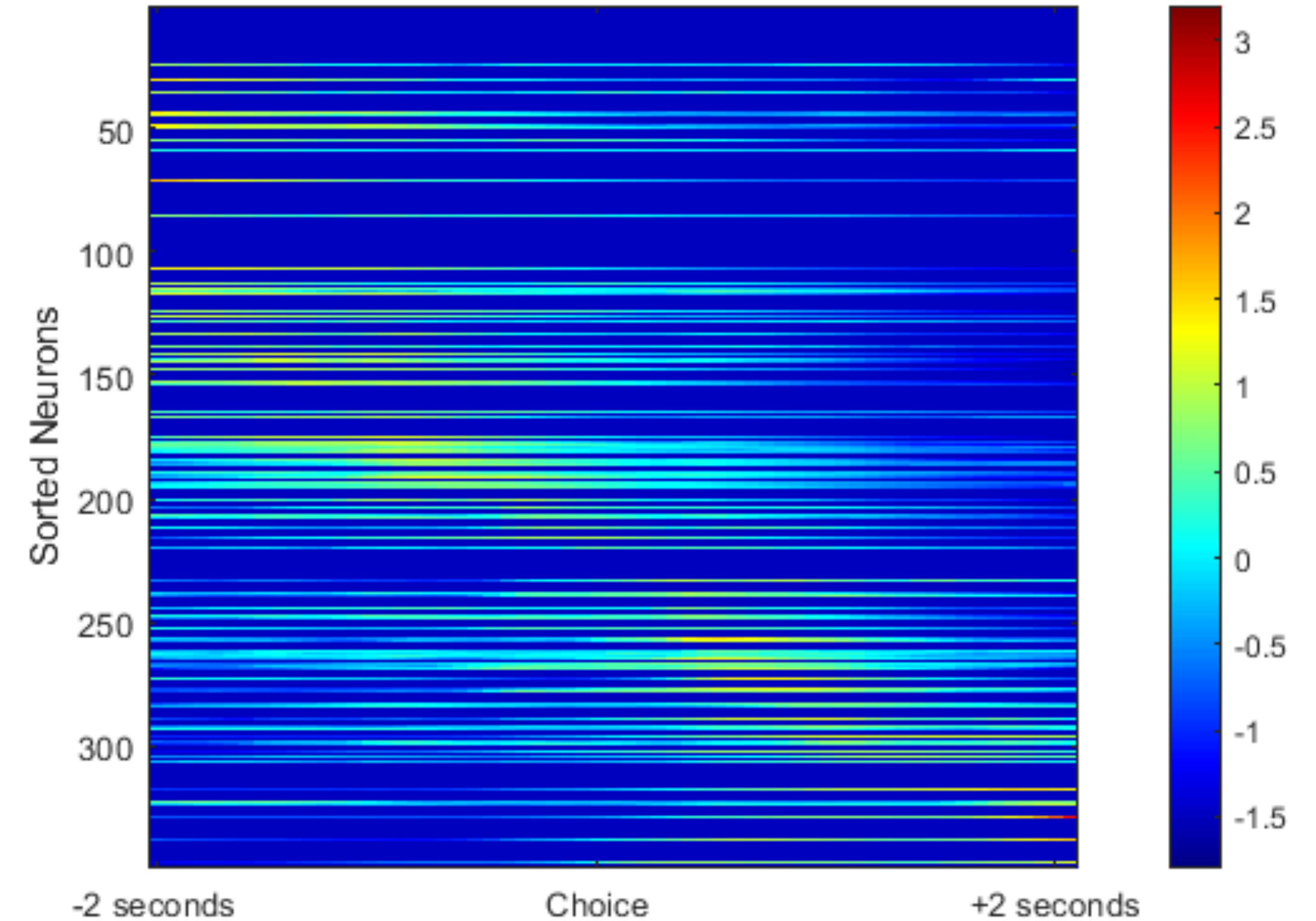


Plotting Significant Neurons

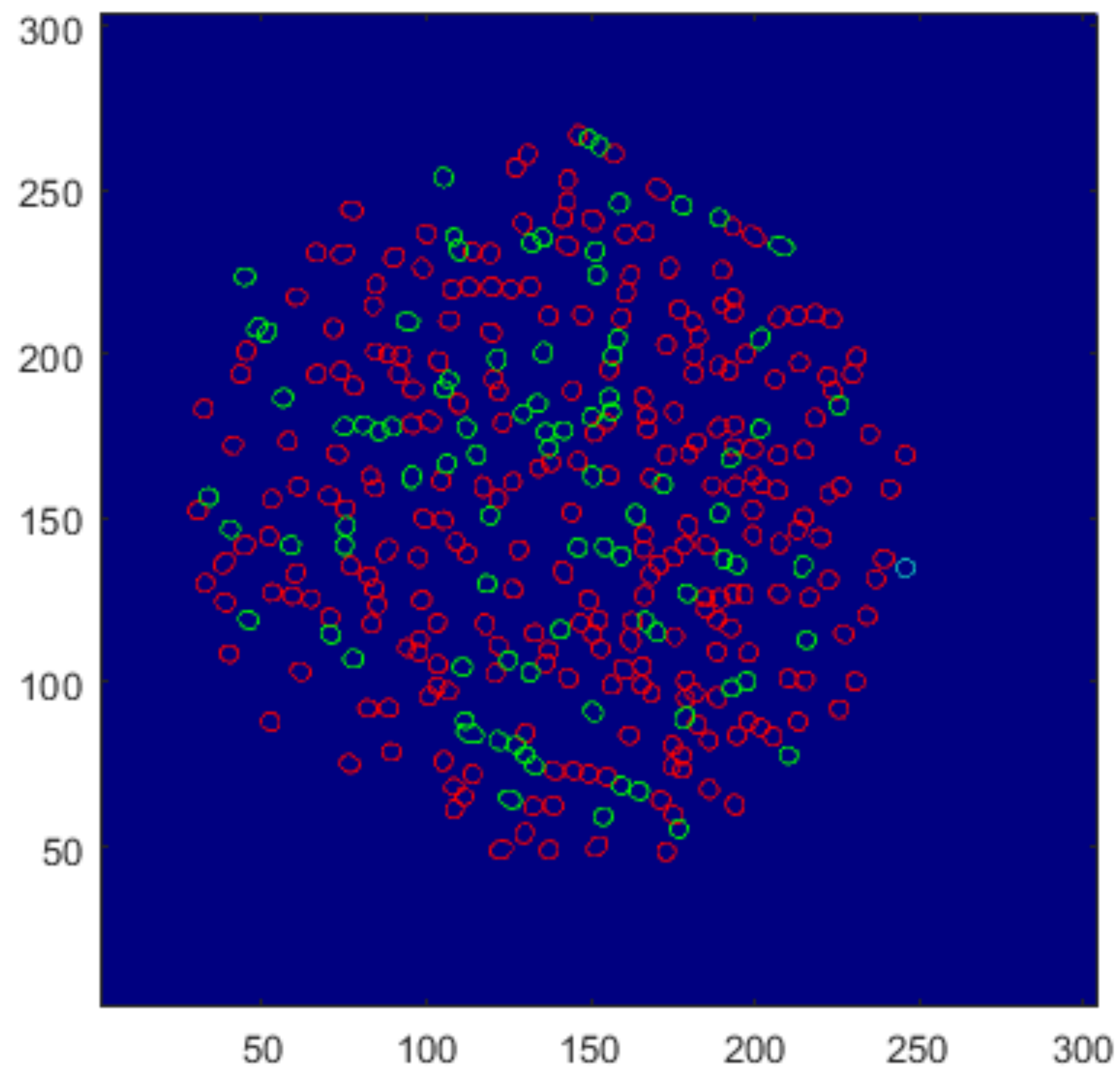
Trial-averaged neural activity around choice (sorted by frame of max activity)



NEURONS: Trial-averaged neural activity around Choice (sorted by frame of max a

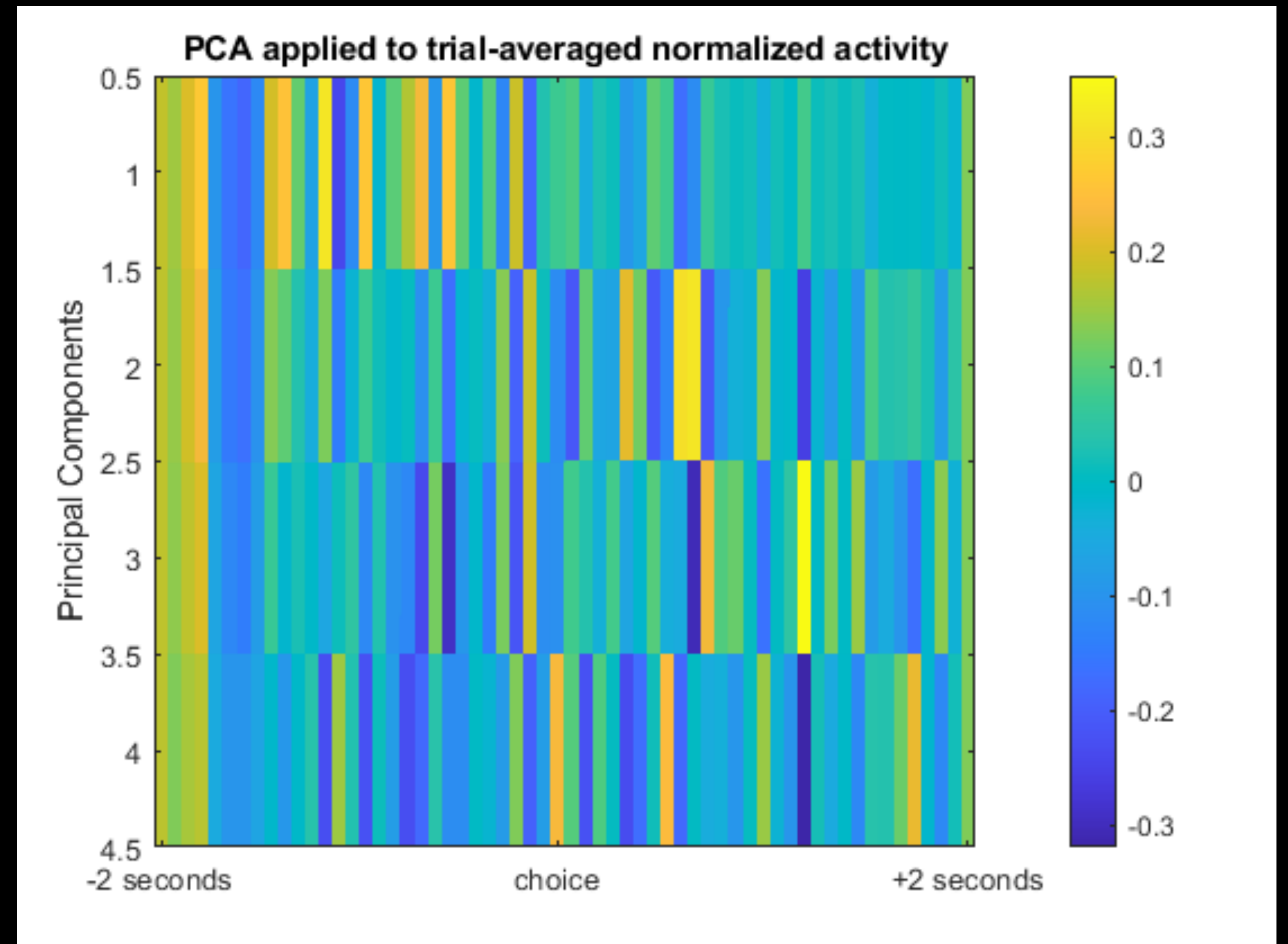


Neural Contours



PCA

- orthogonal vectors with the most variance
- applied on 349 x 61 matrix
- first principal component ~ high activity before choice
- second principal component ~ high activity after choice



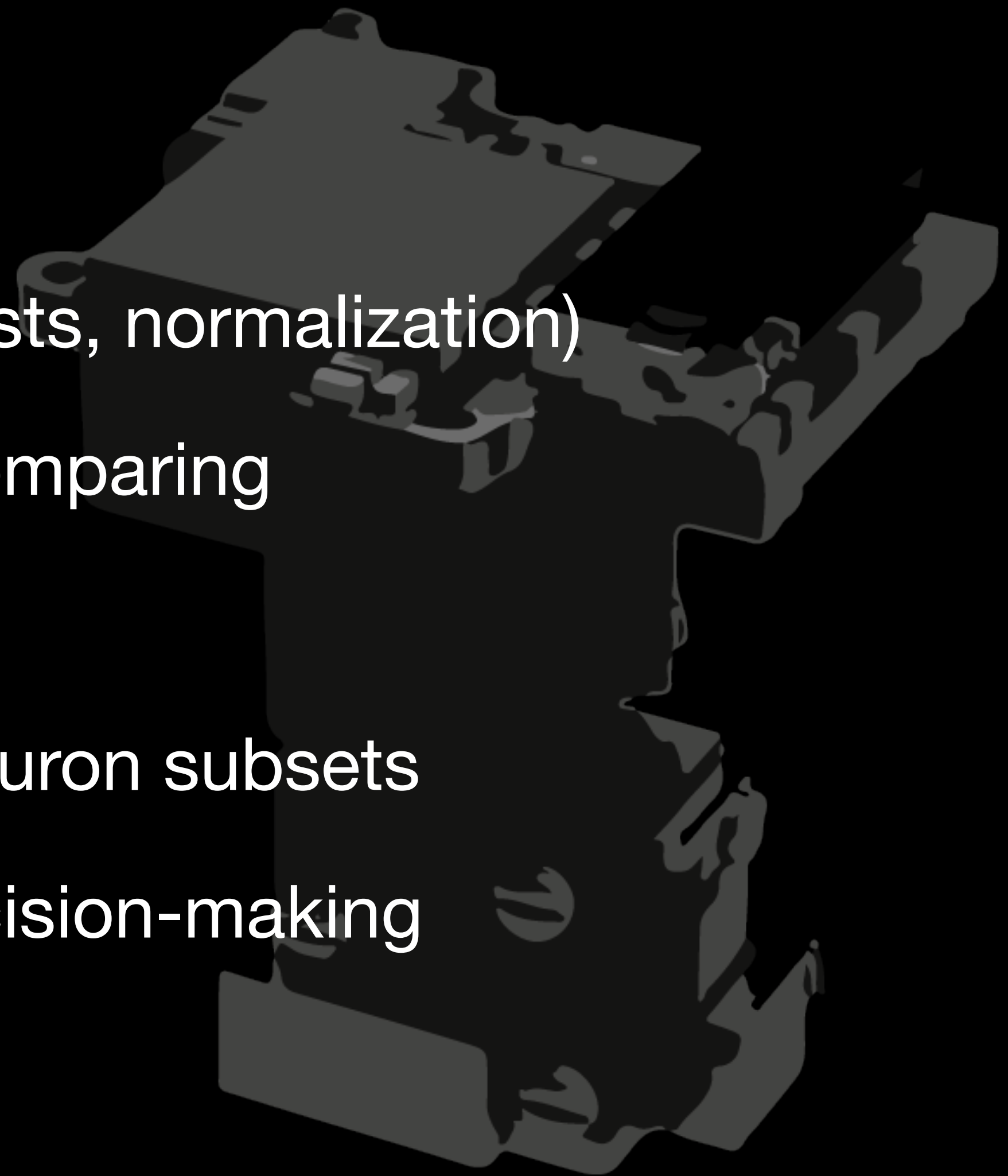
- Introduction & Background
- Behavioral Assay & Setup
- Miniscope Data Analysis
- Discussion & Further Directions

Significant Neuron Interpretation

- high peaks consistent with causal role in decision-making process
- certain neurons reach peak shortly before choice
- possible hypothesis:
 - certain neurons help make decision and/or encode parameters (cost/benefit ratio)
 - other neurons reinforce decision
- mouse showed no hesitation (no VTE)

Future Directions

- refining statistical methods (significance tests, normalization)
- applying analysis to HVR *and* LVR trials, comparing
 - more trials with more animals
- optogenetic activation/silencing of ACC neuron subsets
- model of neuron network as applied to decision-making
 - computation of parameters: effort, cost



Trial-averaged neural activity around choice (sorted by frame of max activity)

