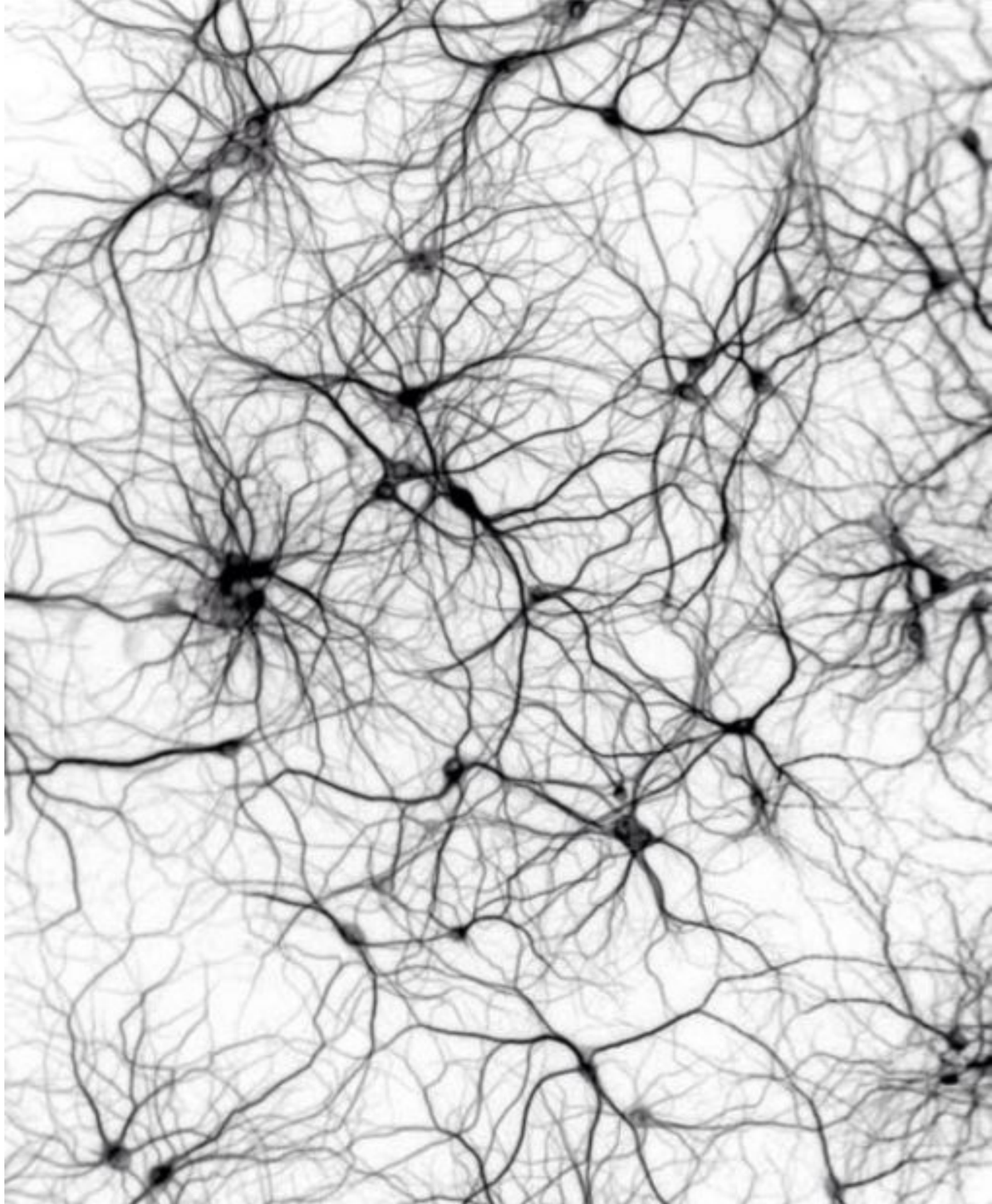
Magical Moose's Pupil DECODER

Stringer Spontaneous Behavior Dataset

Presented By: Yasemin Gunindi
Max Wassermann
Devashri Deulkar
Faith Hunja

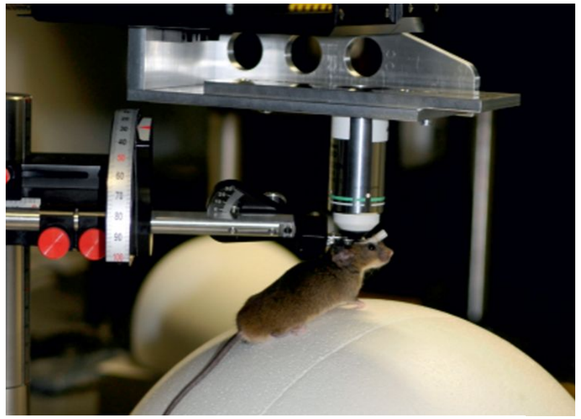
Pod: Magical Moose

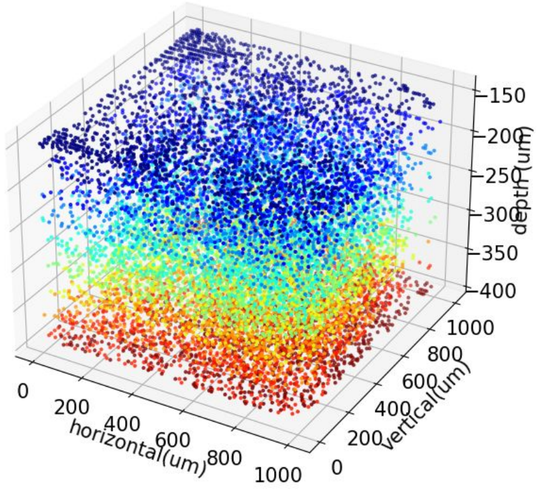
TA: Tomás D'Amelio

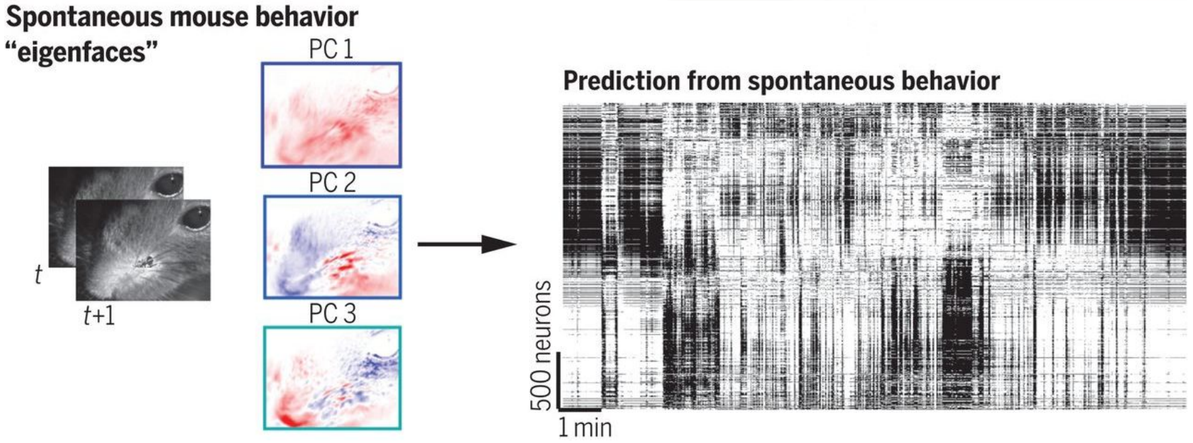


Introduction

- Stringer et al. (2019) could predict V1 neural activity from spontaneous behavior (in the dark!)
- What does V1 encode about behavior?



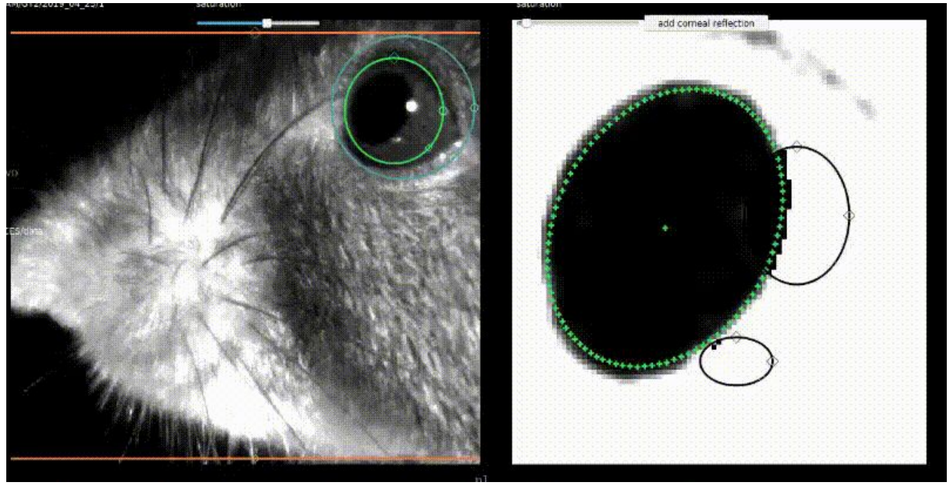




? Are eye movements represented in the primary visual cortex before or after their occurrence, and which cortical depths are best suited for this representation?

Hypothesis

We hypothesize that neural activity in deeper layers at that exact time bin concurrent with the eye movement will yield the most accurate prediction of the relative change in eye movement.



Implementation

Generalized Linear Models as decoder

- Linear Regressor

9 cortical depths x 3 time gaps = 27 models

Metric: Explained Variance

$$\boldsymbol{y}(t) = \boldsymbol{\theta}^{\mathsf{T}}\boldsymbol{x}(t) + \boldsymbol{\eta}$$

$\boldsymbol{y}$ - change of pupil position since last time step

$\boldsymbol{x}$ - spike count of time bin

$\boldsymbol{\eta}$ - noise

Model

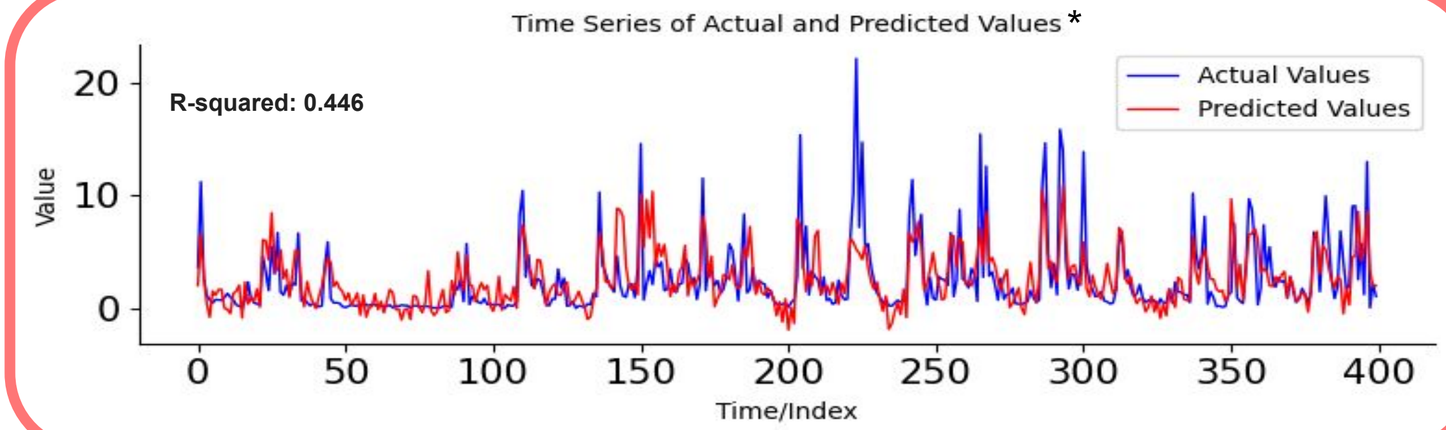
Neural data is normalized with z-score

Neural data is layered by its depth and time gaps are introduced

Principal Component Analysis with 100 components

Time series split with 10 folds

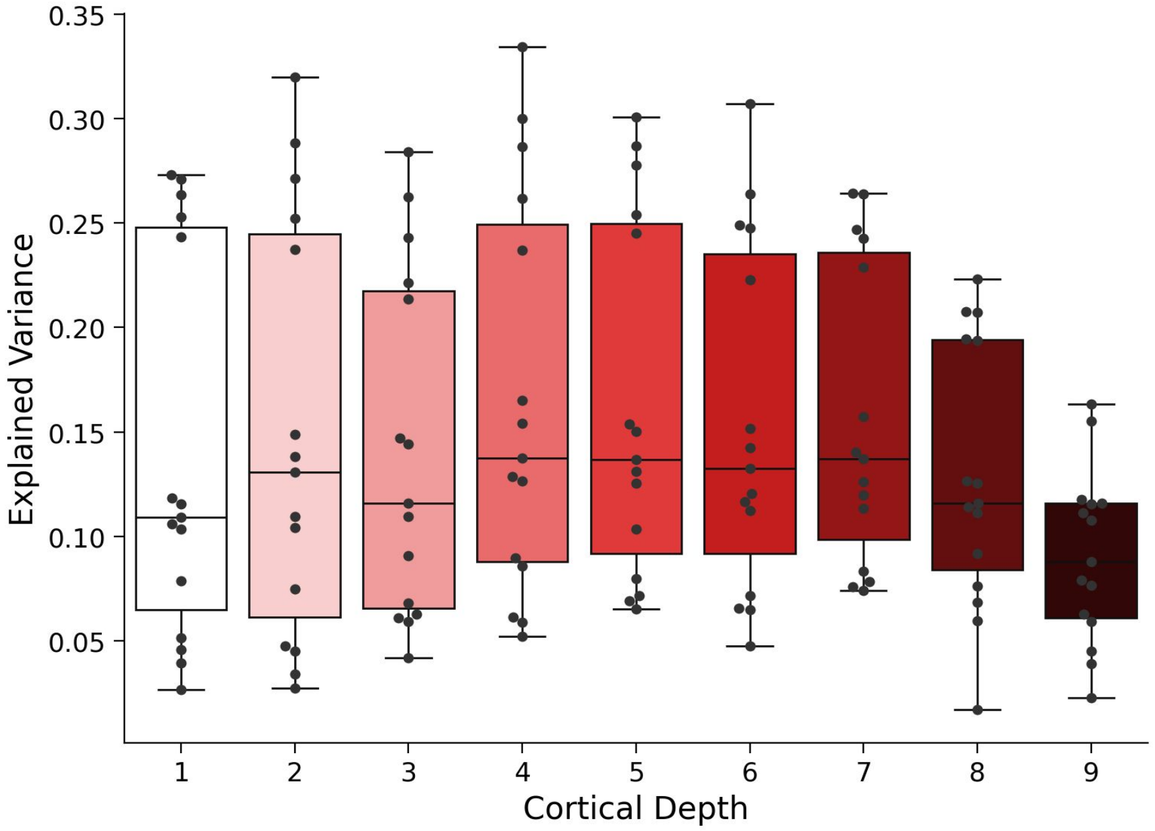
*One model example.



Explained variance score of last half of the time splits

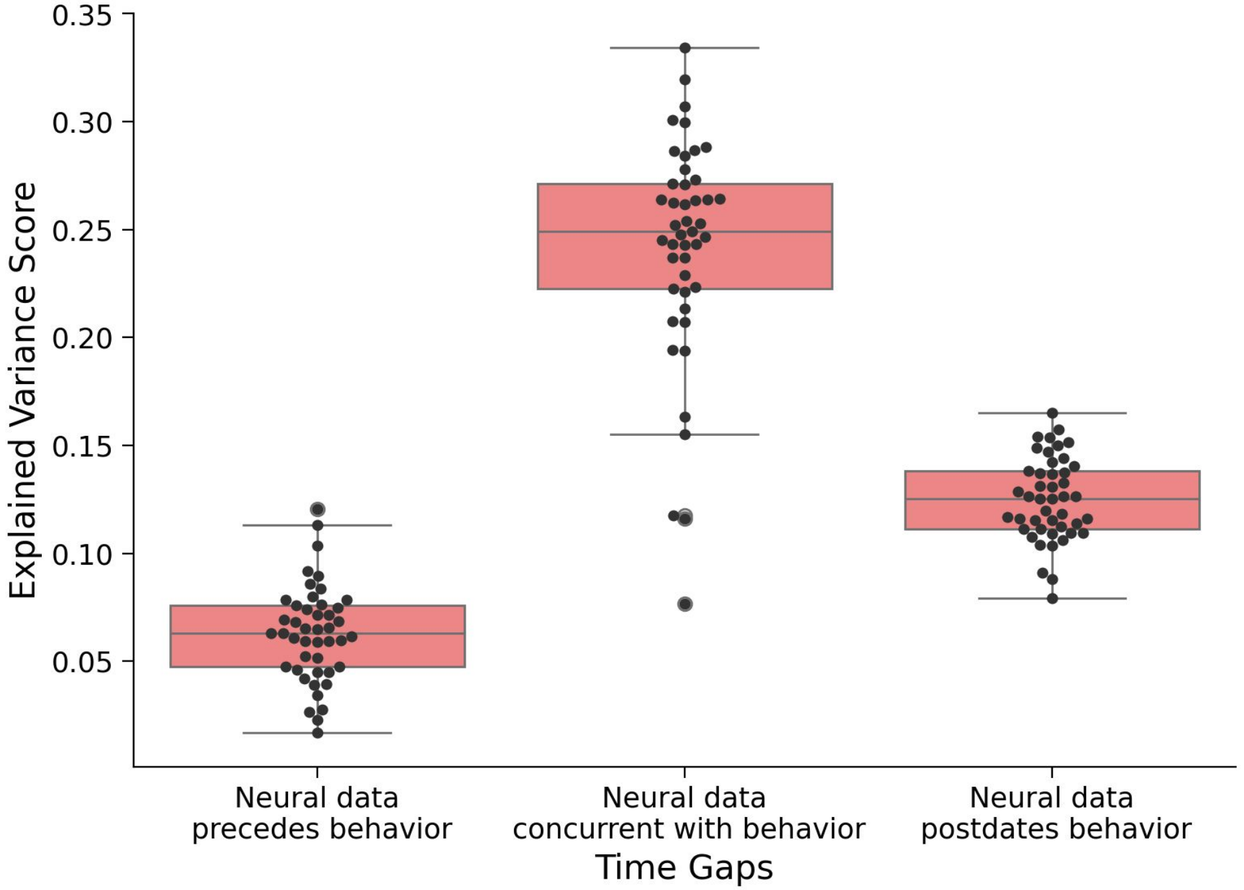
Statistical testing for explained variance scores

Cortical Depth*



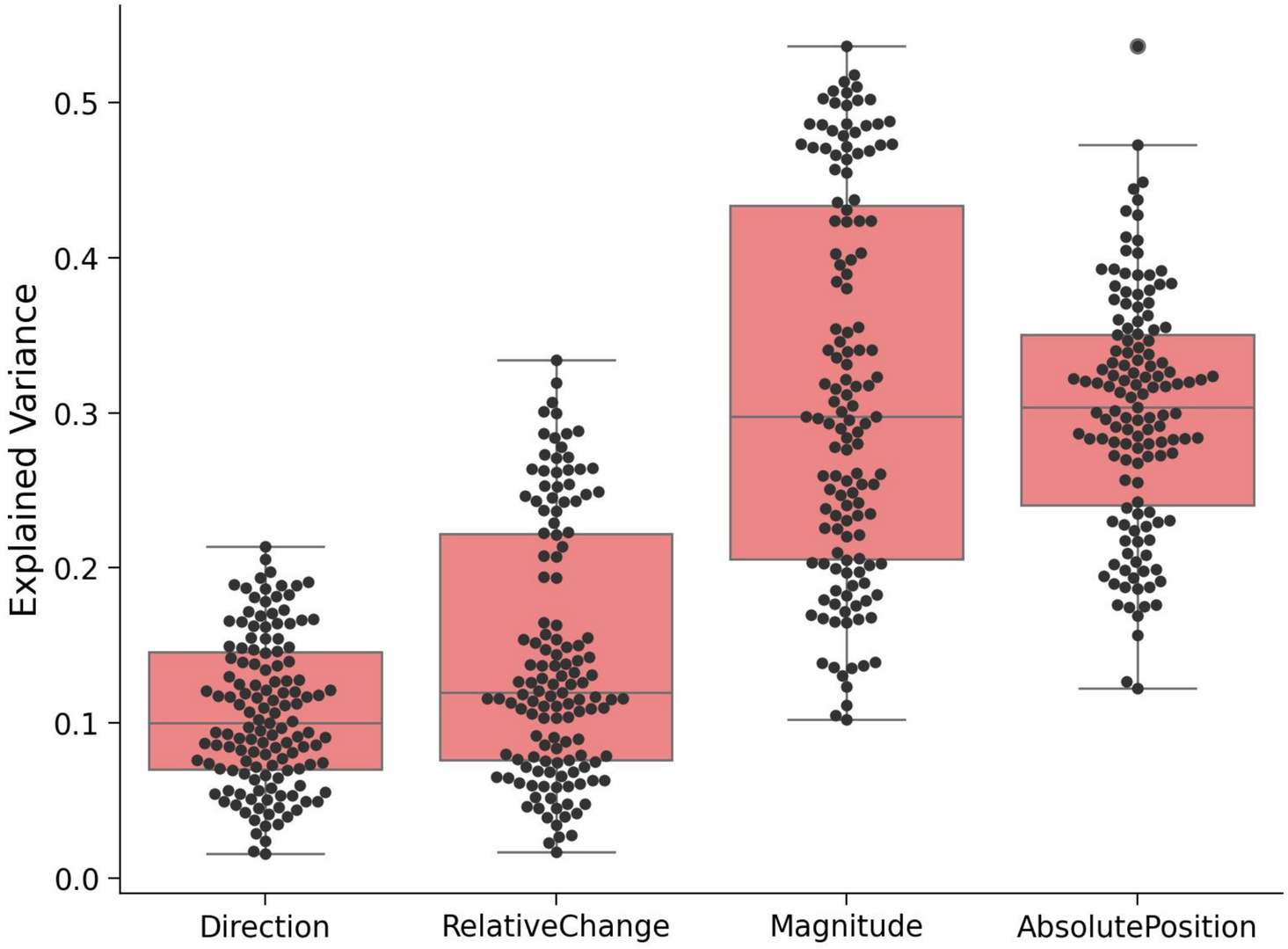
*No significant differences among cortical depths is found.

Time Gaps**



**All time gaps are significantly different with p<.001. Post-hoc tests revealed all pairs differed significantly p <.001.

Eye Movement*



Defining eye movement:

- Absolute Position
- Relative Change
- Direction of relative change
- Magnitude of relative change

*The only non-significant difference is observed between absolute position and magnitude. Significance levels between direction and relative change are $p < .05$, while for other comparisons, significance levels are $< .001$.

Conclusion

Findings:

- No significant differences between cortical depths
- Significant difference between time gaps
  - Concurrent NA > Future NA > Past NA
- Significant differences amongst different definitions of eye movements
  - Magnitude > Position > Relative Change > Direction

Limitations:

- Large Time Bins (1.2s)
- Sample size of one mouse
- Imperfect estimate of pupil position

Future work:

- Different models
- Fine grained analysis of time gaps
- Different types of training

Any questions?