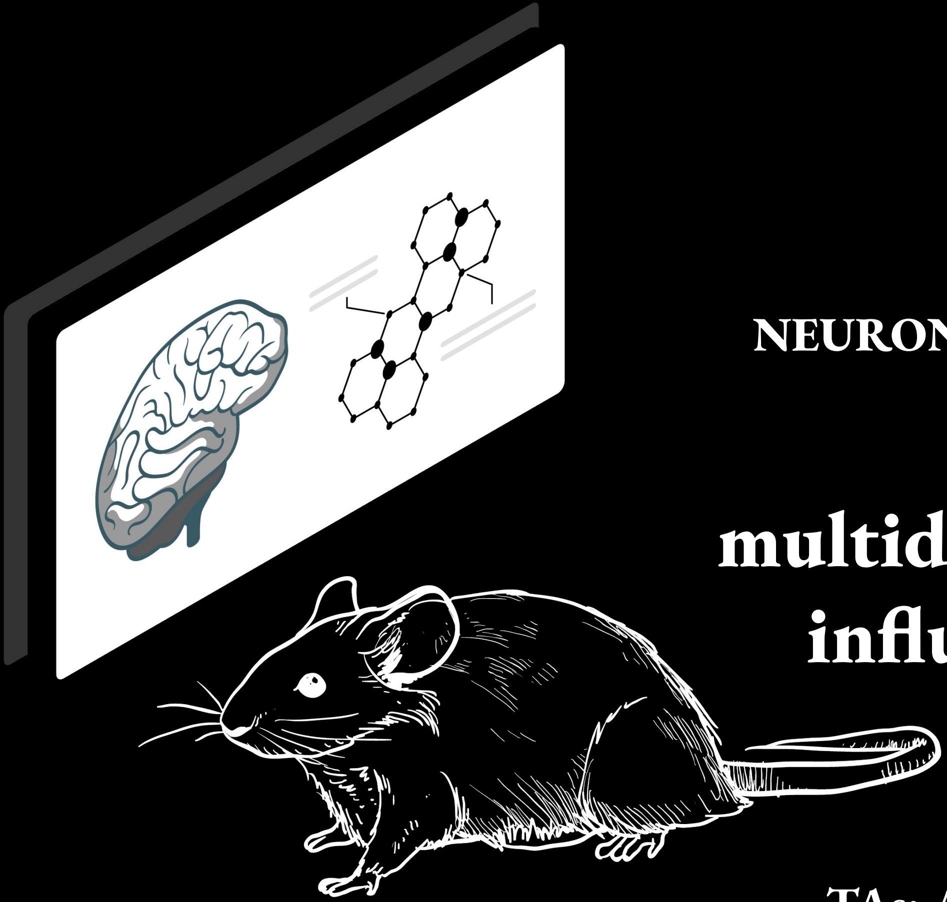

NEURONUTS (@ pod-Abundant Ipomea)

Investigating multidimensional behavioral influences on brainwide neural activity

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Team Introduction

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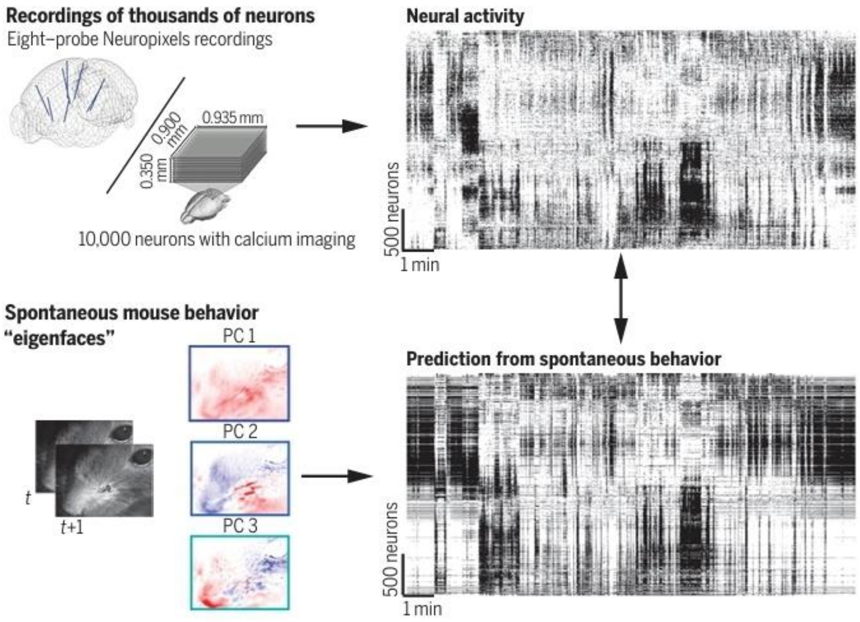
Background

1. Studies like Stringer et al. (2019) have demonstrated that spontaneous neural activity in the brain is structured and behaviorally driven, rather than random noise.

2. Ongoing neural activity is linked to multidimensional behaviors, including running, pupil dilation, and others, suggesting a deeper interplay between internal states and brain function.

3. Primary sensory cortices, previously thought to be solely dedicated to sensory processing, are now understood to integrate sensory inputs with internal behavioral states.



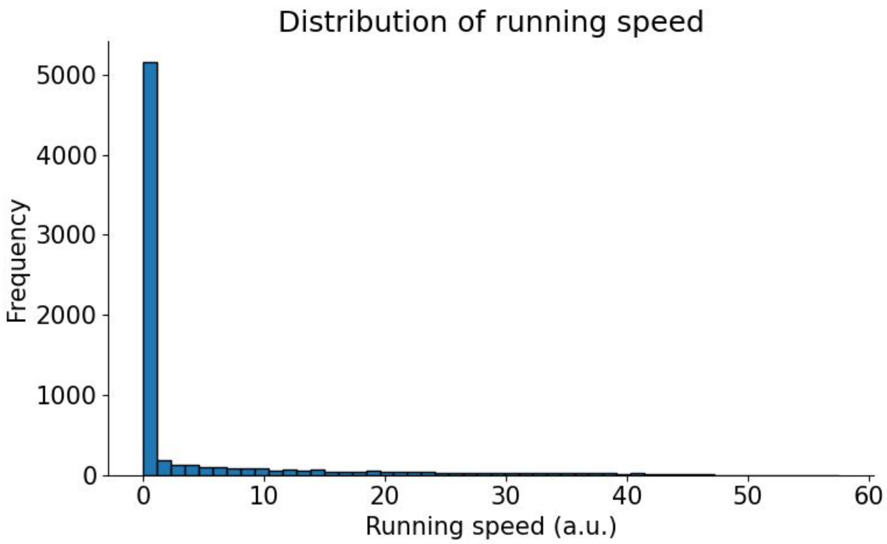
Pivot Story

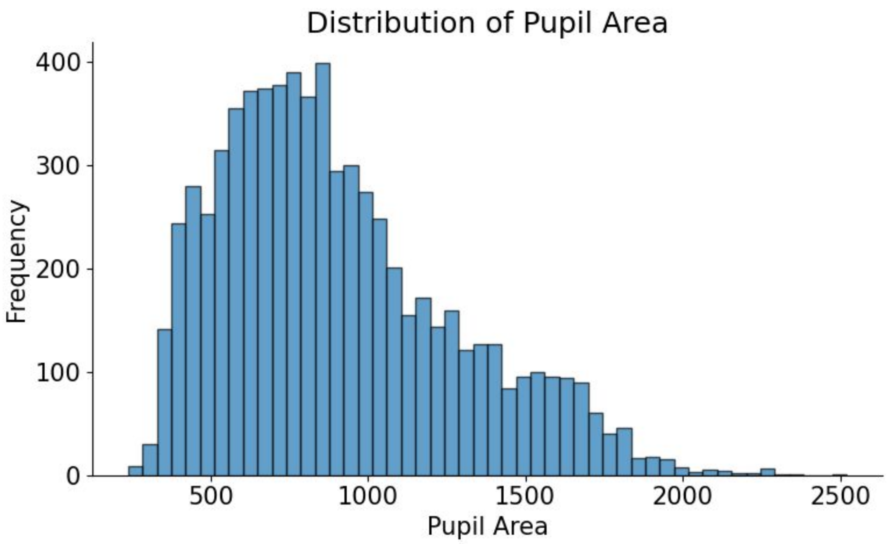
- Initially, we wanted to see how response latencies vary across the visual cortex during visual processing and design a biological plausible neural network based on these latencies.

- Turns out, it is not possible to extract the time course of response of a neuron in a single trial in the Stringer Orientation Dataset.

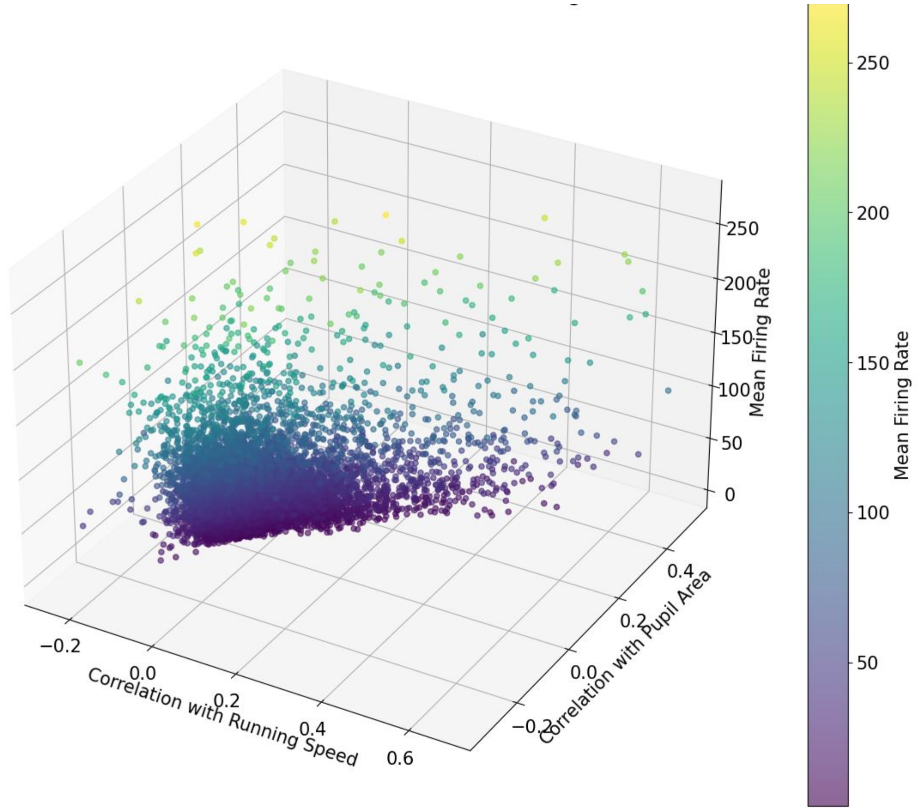
How do spontaneous behaviors such as running and changes in pupil area modulate neural activity within specific cortical depths, and which cortical layers are most significant in encoding these behaviors?

Insights into the Behavioral Data

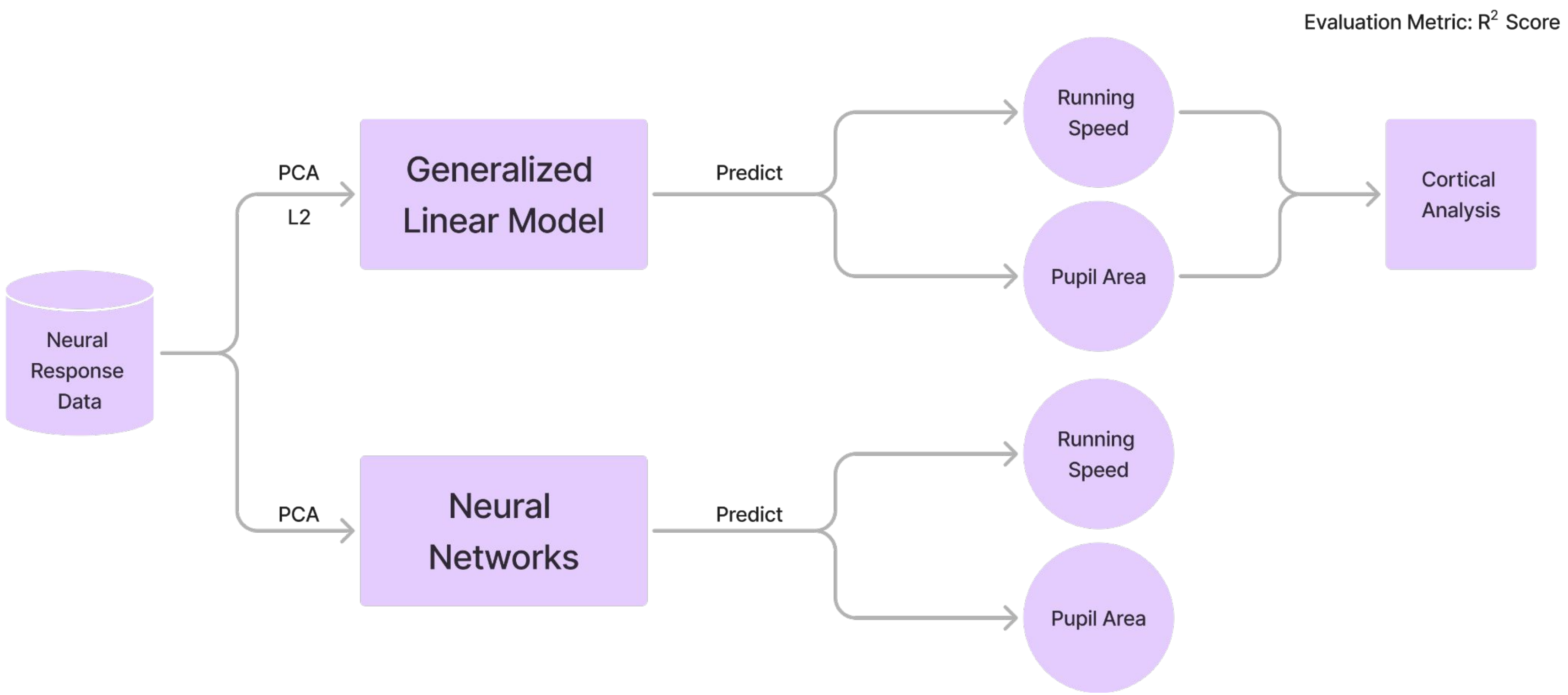




Insights into the Behavioral and Neural Data

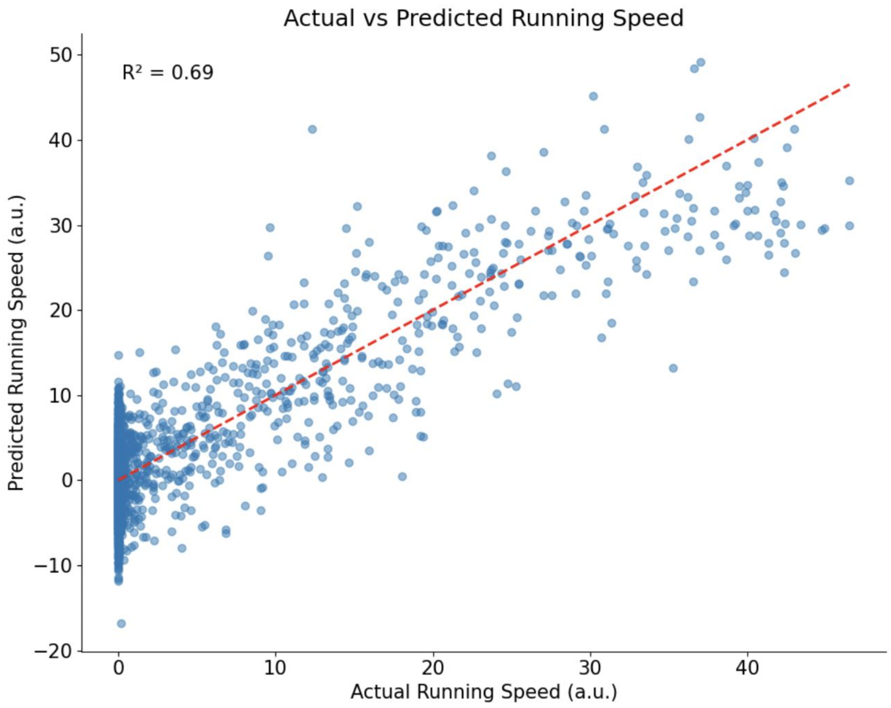


Methodology

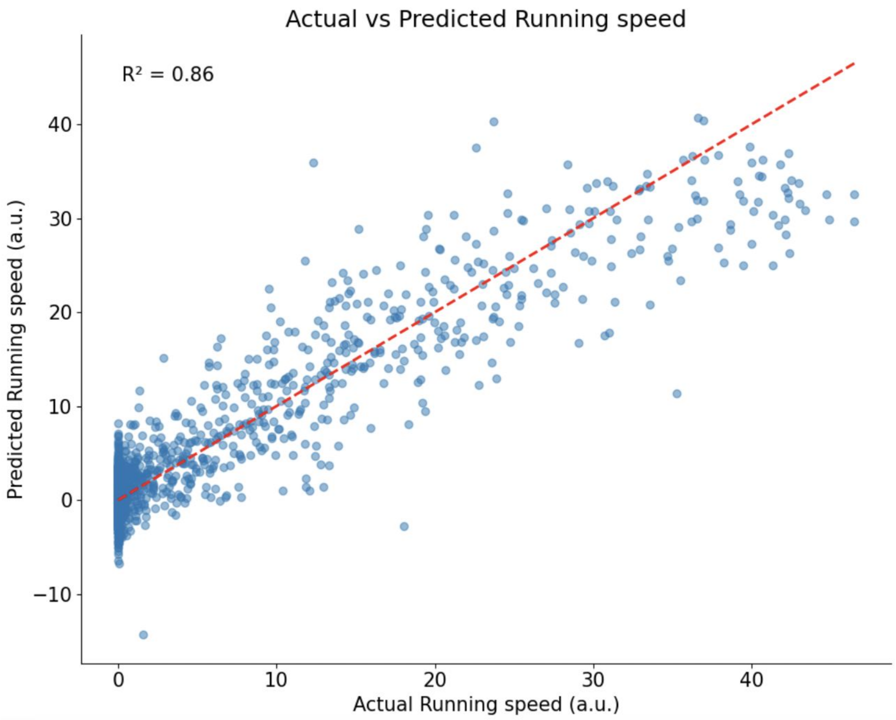


Decoding Running Speed from Neural Activity using GLMs

GLM

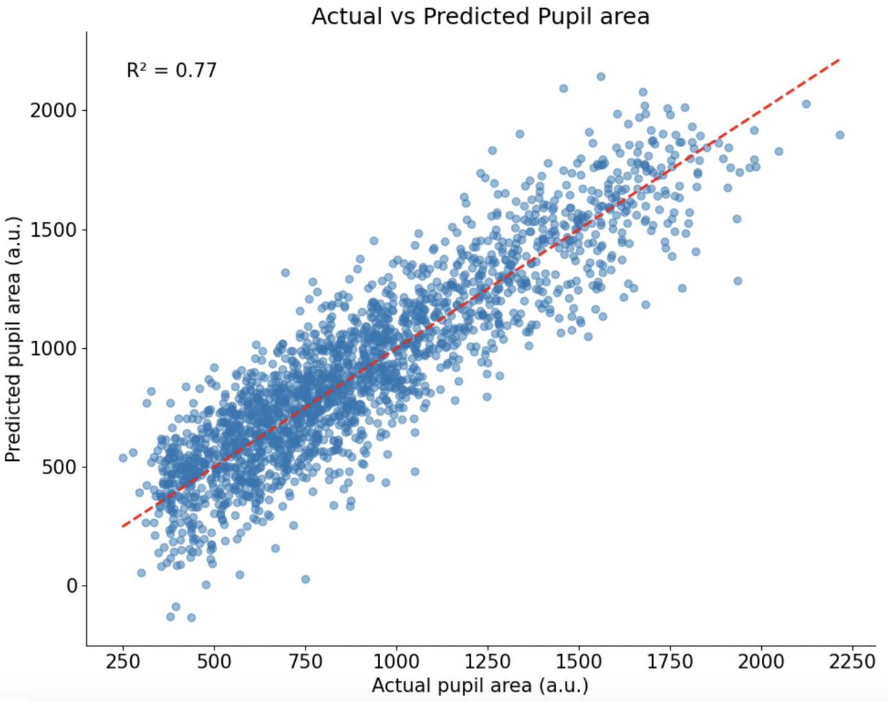


GLM with PCA

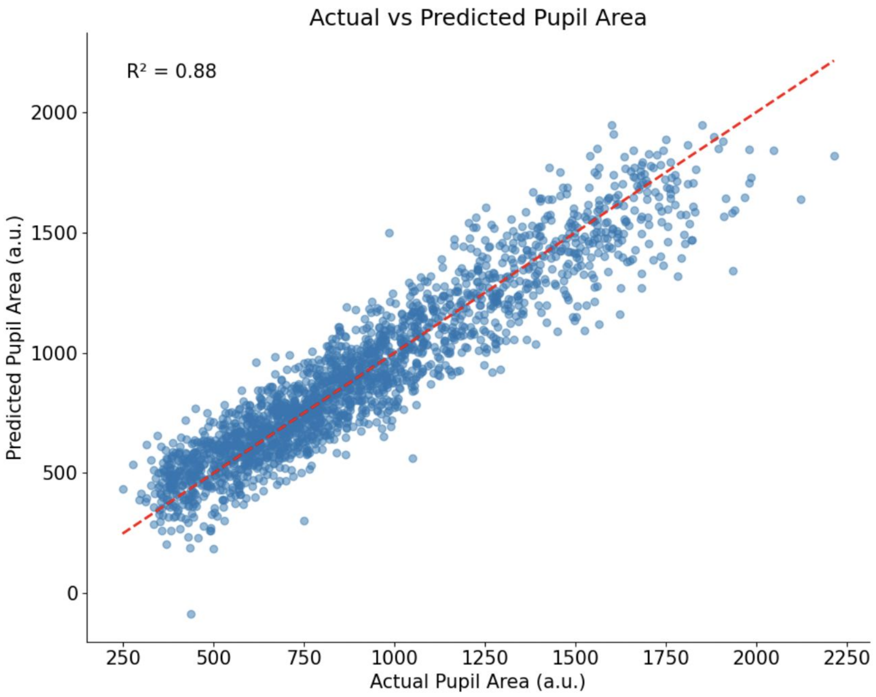


Decoding Pupil Area from Neural Activity using GLMs

GLM

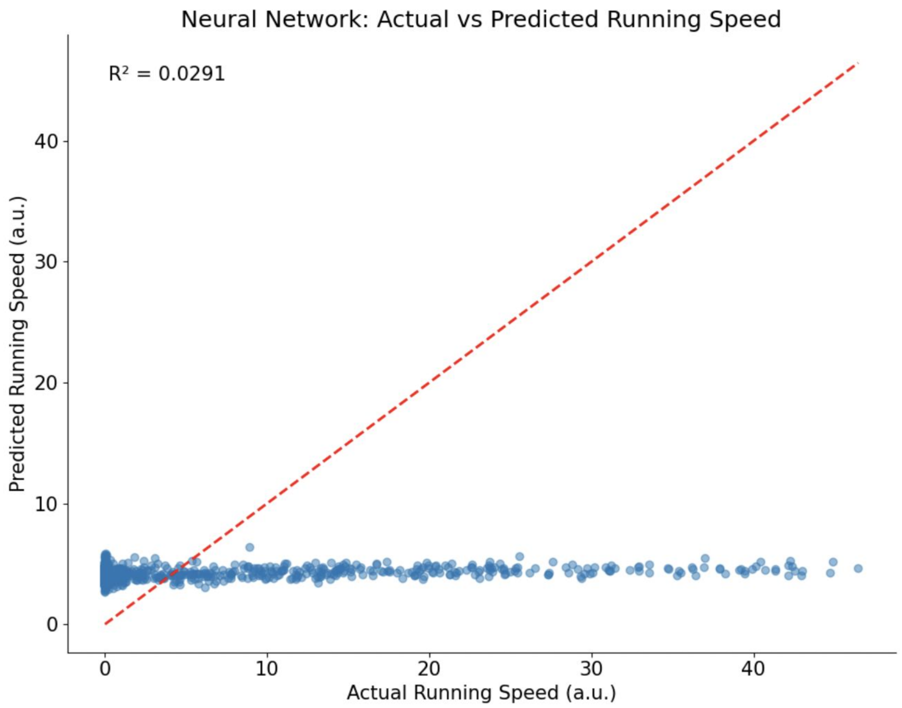


GLM with PCA

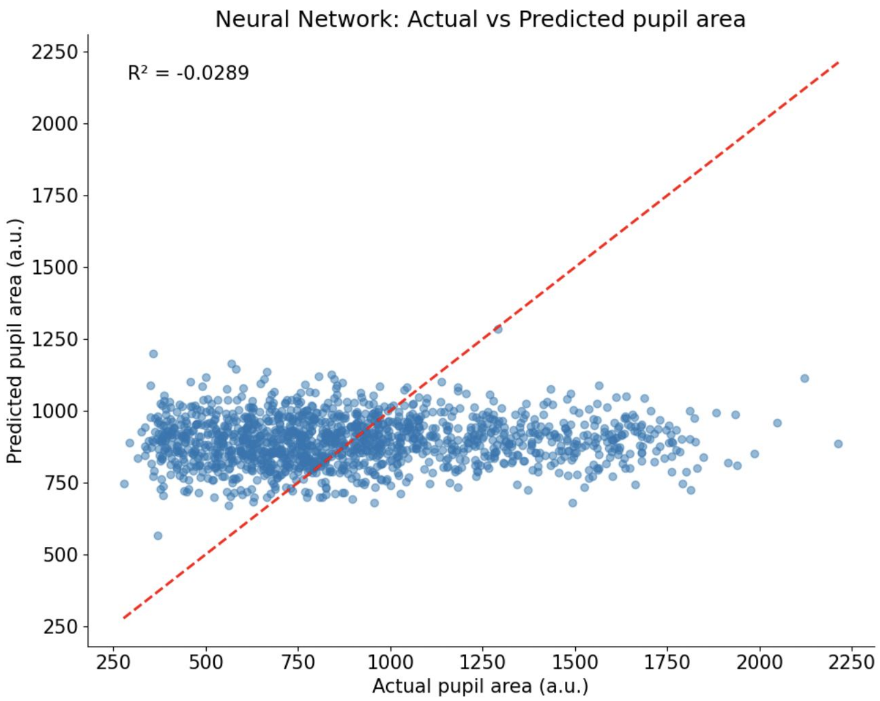


Decoding Running Speed & Pupil Area using Neural Nets

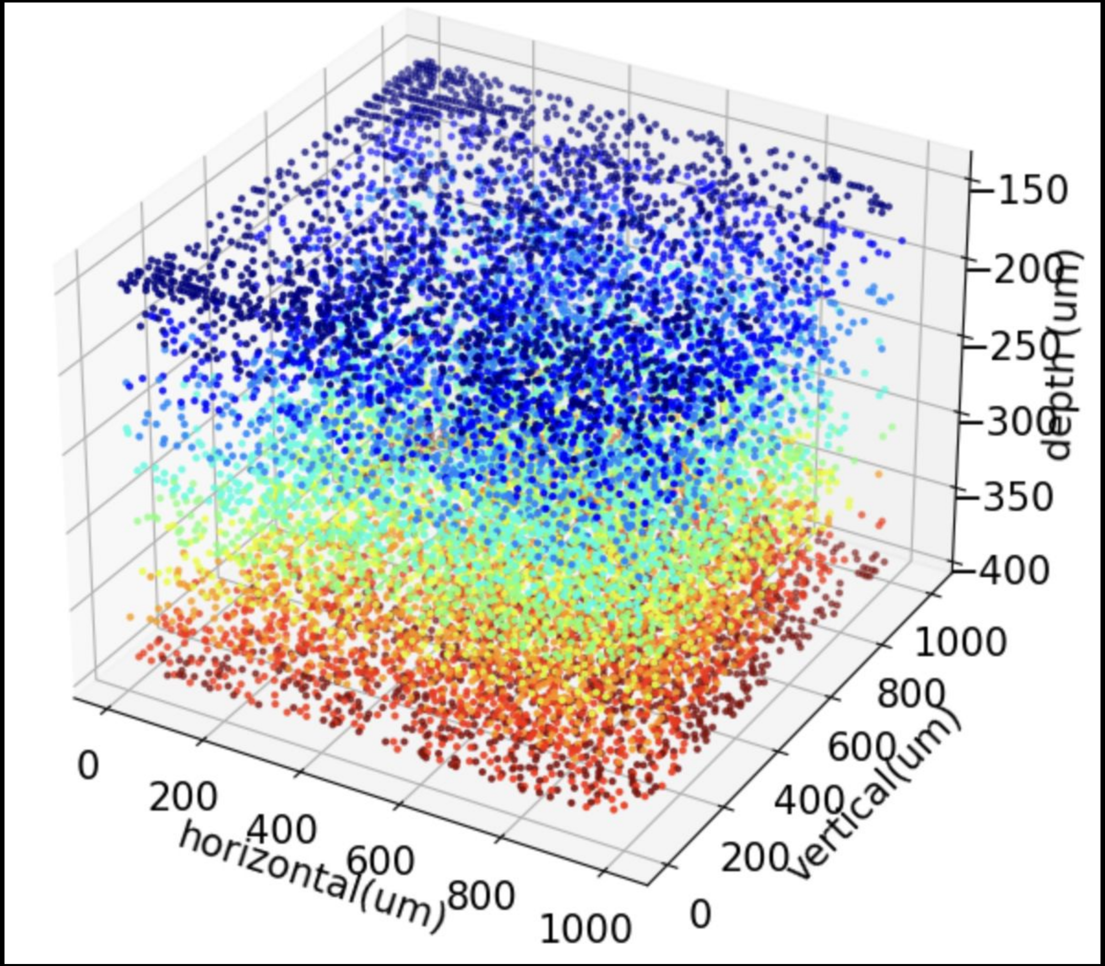
Running Speed



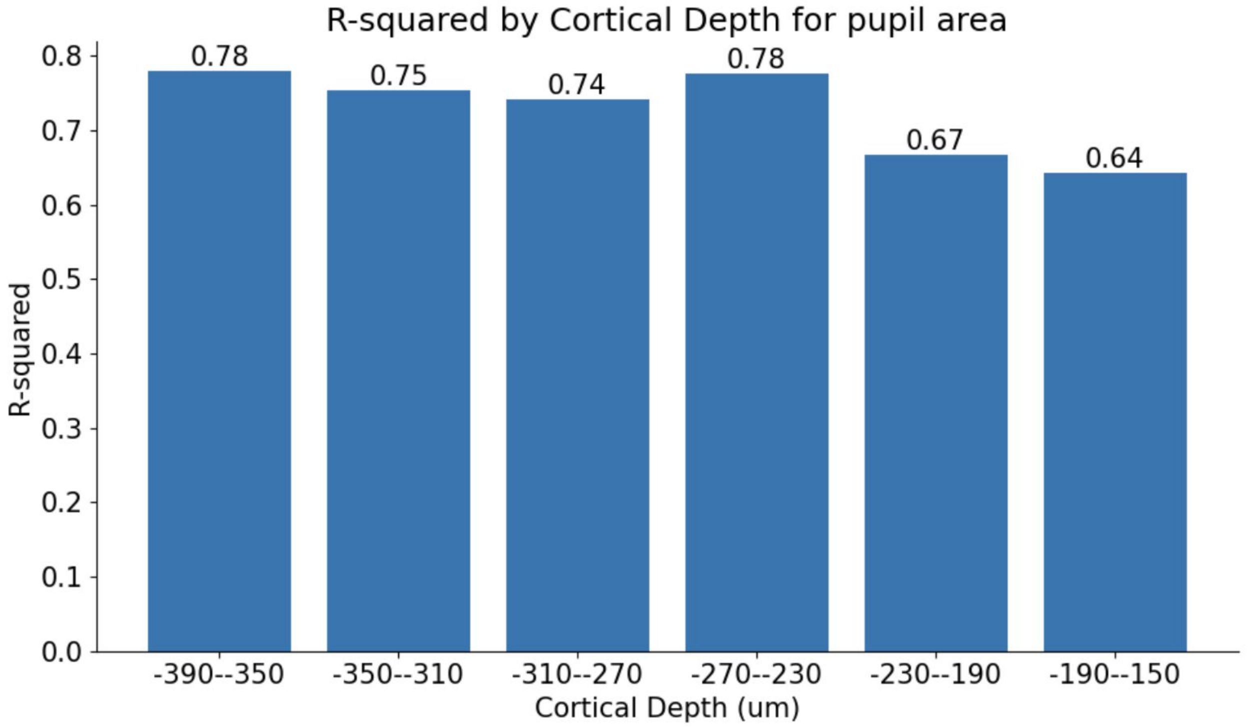
Pupil Area



3D visualization of neurons



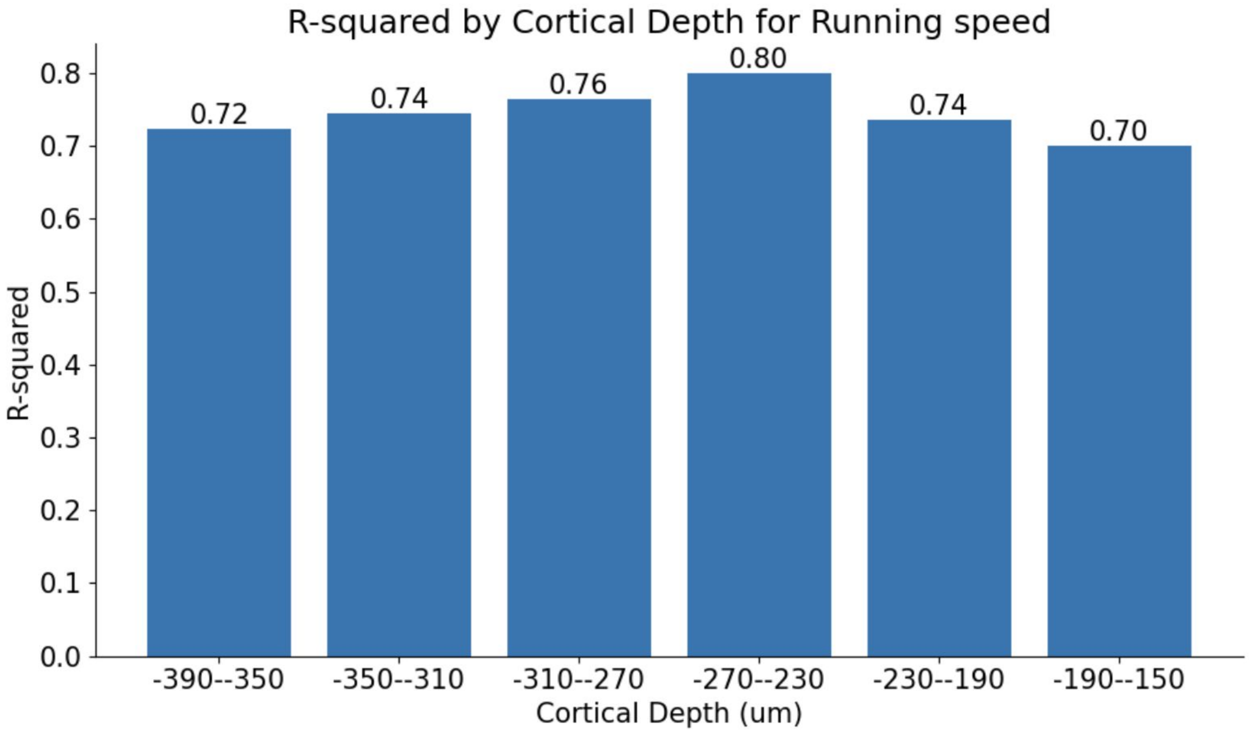
Cortical Depth Analysis for Pupil Area



Depth with highest R^2 value: -390µm to -350µm

Depth with lowest R^2 value: -190µm to -150µm

Cortical Depth Analysis for Running



Depth with highest R^2 value: -270µm to -230 µm

Depth with lowest R^2 value: -190µm to -150 µm

Comparative analysis

Top Performers:

- For pupil area: The range **-390 to -350 μm** is the top performer with an R-squared value of 0.78.
- For running speed: The range **-270 to -230 μm** is the top performer with an R-squared value of 0.80.

Worst Performers:

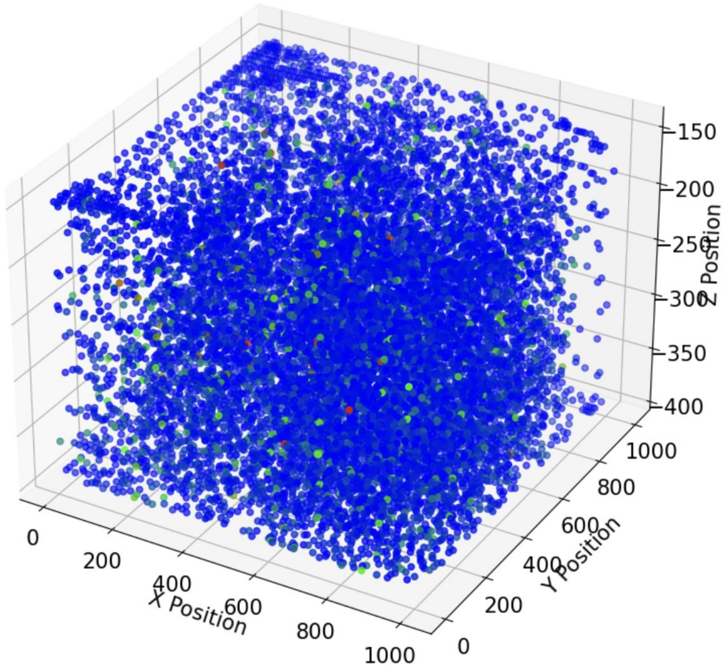
- For both pupil area and running speed, the range **-190 to -150 μm** shows the lowest predictive power with R-squared values of **0.64 and 0.70,** respectively.

Coμmon Depth Ranges:

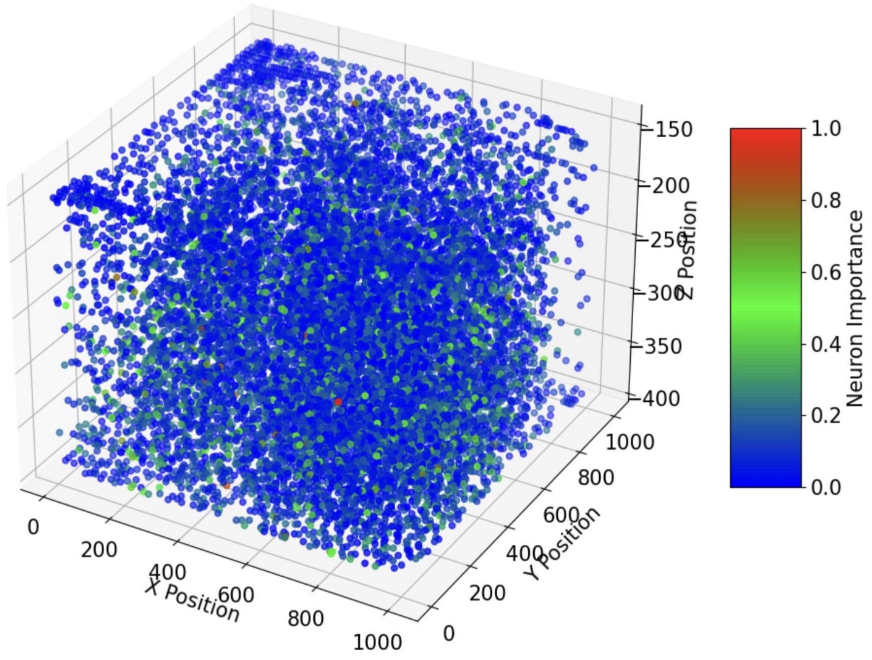
- The ranges **-350 to -310 μm** and **-310 to -270 μm** show relatively high R-squared values for both pupil area and running speed, indicating that these depth ranges are important for both types of spontaneous behaviors.

3D Visualization of Neuron Importance in Encoding Spontaneous Behaviour (Sparse Coding)

Running Speed



Pupil Area



Conclusion

- Majority of neurons show a low coefficient of encoding spontaneous behaviour

- The neurons in deeper cortical layers (**-390 to -350 μm**) are more effective in predicting pupil area, while neurons in mid-deep layers (**-270 to -230 μm**) are more effective in predicting running speed.

- The superficial cortical layers (**-190 to -150 μm**) have the lowest predictive power for both behaviors, suggesting that these neurons might be less involved in encoding pupil area changes and running speed.

- Understanding these depth-dependent variations in predictive power can provide insights into the functional organization of the visual cortex and its role in processing different spontaneous behaviors.

Further Studies

Deepening Understanding of Cortical Depth Involvement:

- Investigate specific neuronal populations
- Refine depth segmentation
- Correlate depth-specific findings with anatomical and functional markers

ধন্যবাদ !

धन्यवाद !

Rahmat!

متشکرم!

Thank You!