Unraveling the Interplay: Exploring the Relationship between Visual Cortex and Midbrain with Pupillary Responses

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pod: Huayangosaurus_Flamenco

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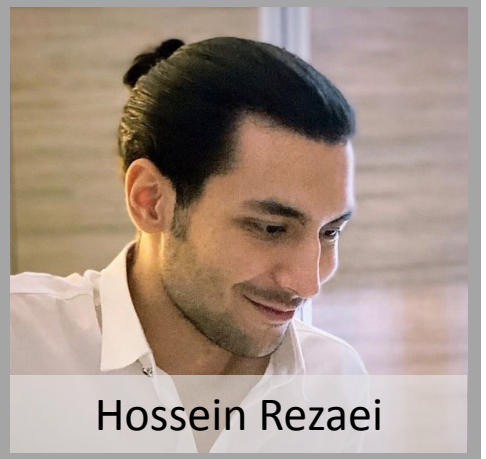

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Introduction

- **Visual cortex**

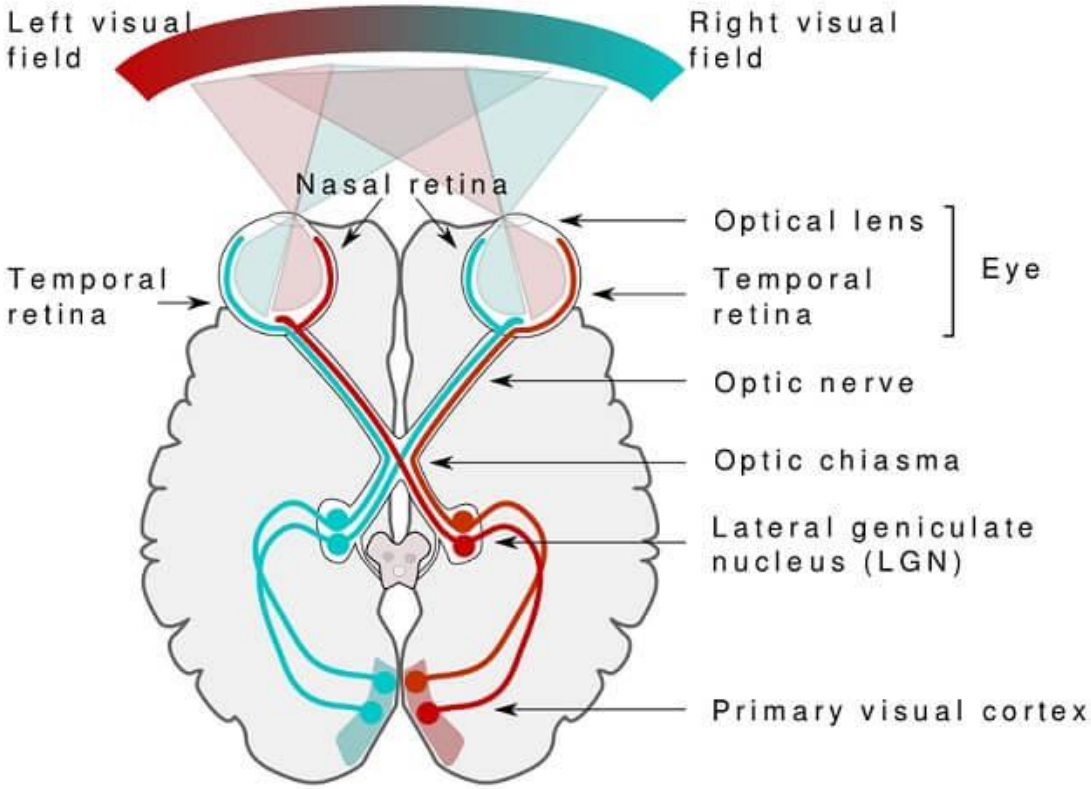
  The visual cortex is the primary cortical region of the brain that receives, integrates, and processes visual information relayed from the retinas.

- **Contrast level**

  Contrast, a cornerstone visual feature, is derived from the variation in intensity around the mean luminance of a visual signal.

- **Pupil area**

  Pupil is the small black circle located in the center of the eyeball. Surrounding the pupil is the colored part of the eye, the iris.



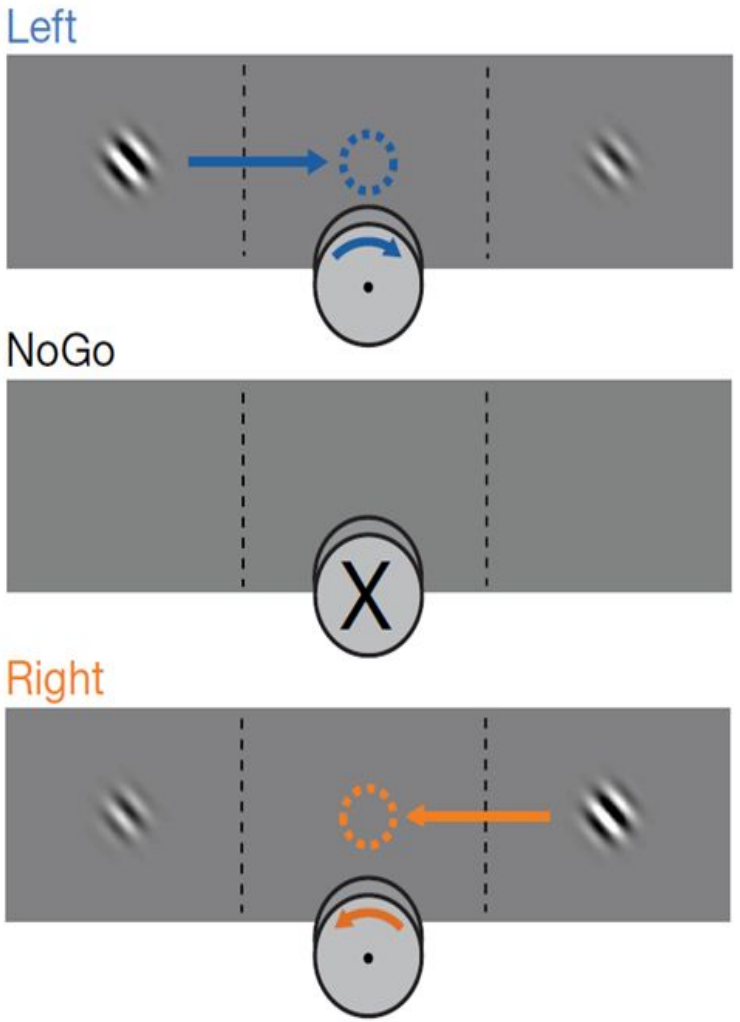
Goals

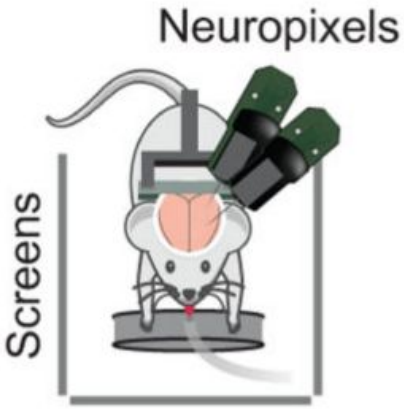
Relationship between the visual cortex and the regulation of pupil size.

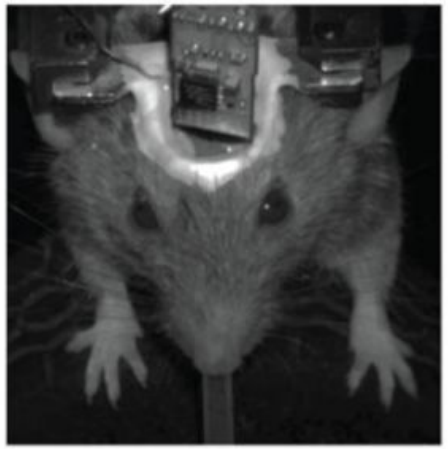
Predicting contrast levels detected by the visual cortex and explore the correlation between visual cortex activity and the control of iris muscles.

The Steinmetz Dataset

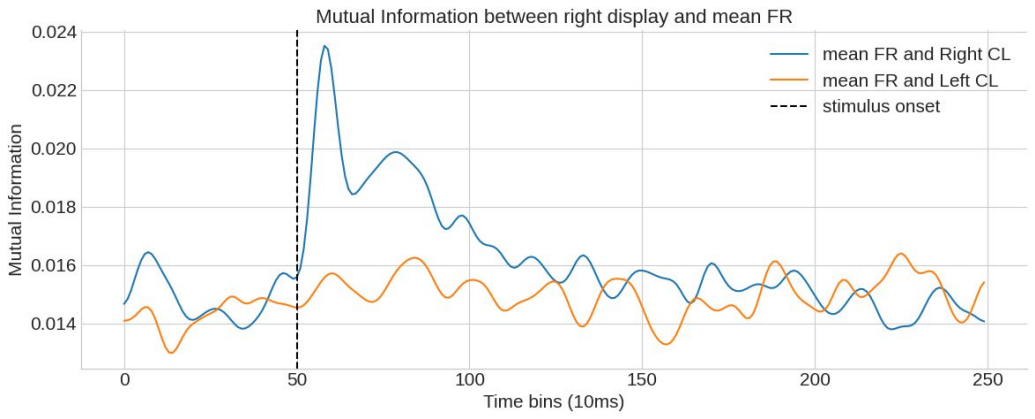
The Steinmetz dataset We used Neuropixels probes to record from ~30,000 neurons in 42 brain regions of mice performing a visual discrimination task.



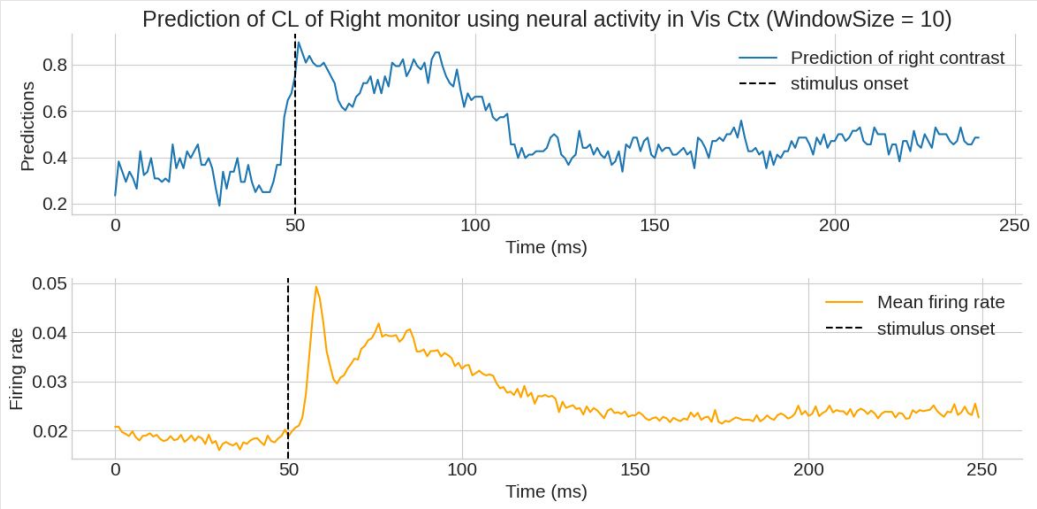


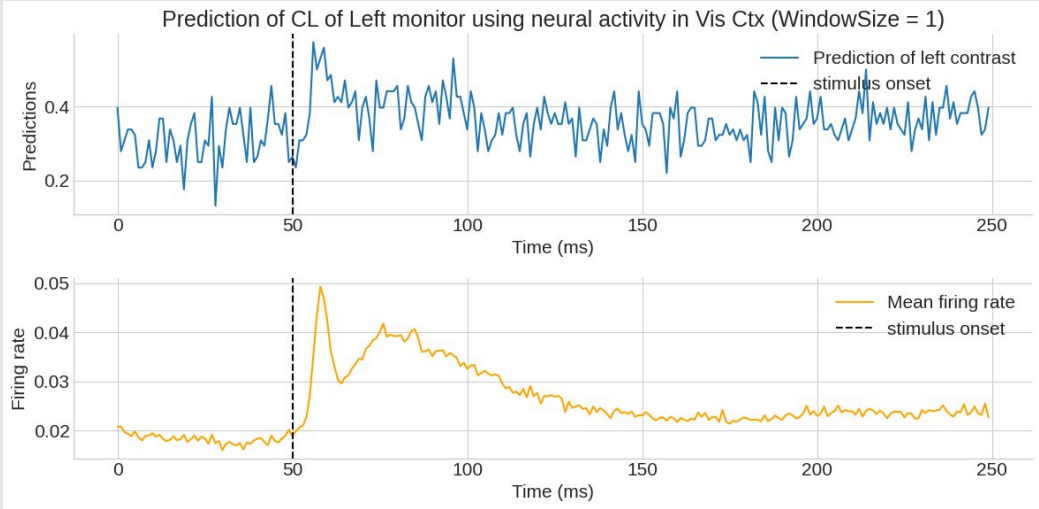


Result

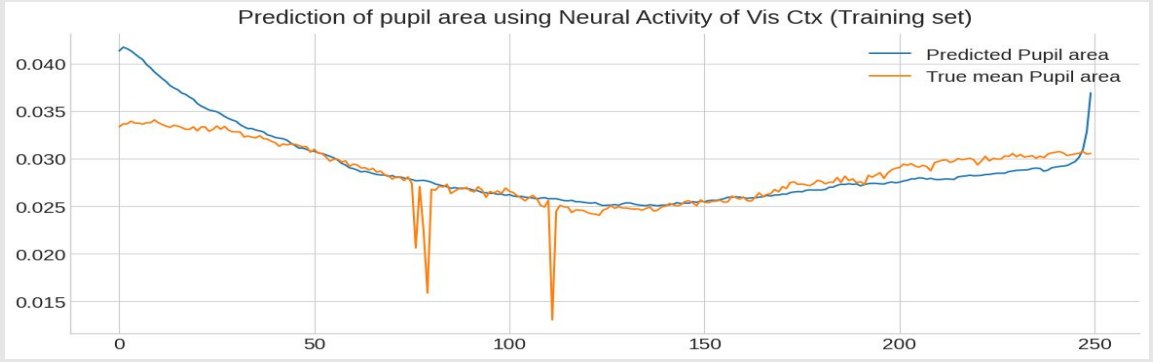


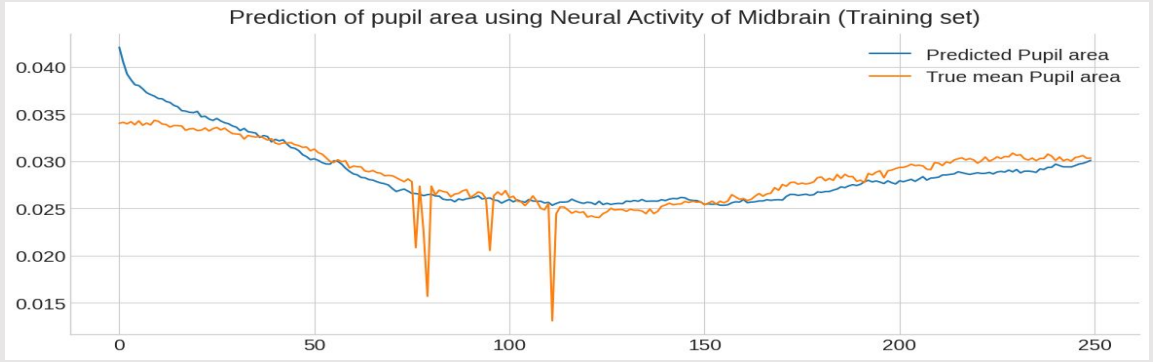
- We used session 11.
- Neural recording is only from the left hemisphere.
- We expected that there is no information from the perception of left contrast in firing rates, MI between left display and FR can confirm that.
- We trained a SVM model on left and right contrast that can confirms perception of Contrast level is encoded in vis ctx.

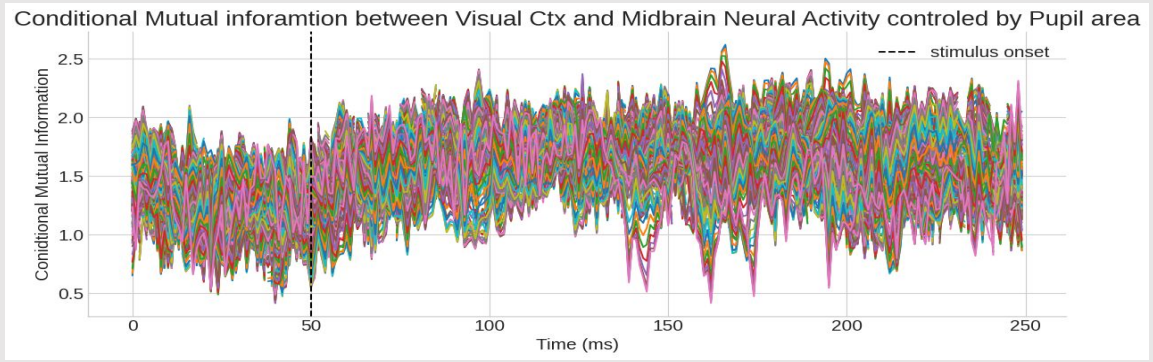




Result





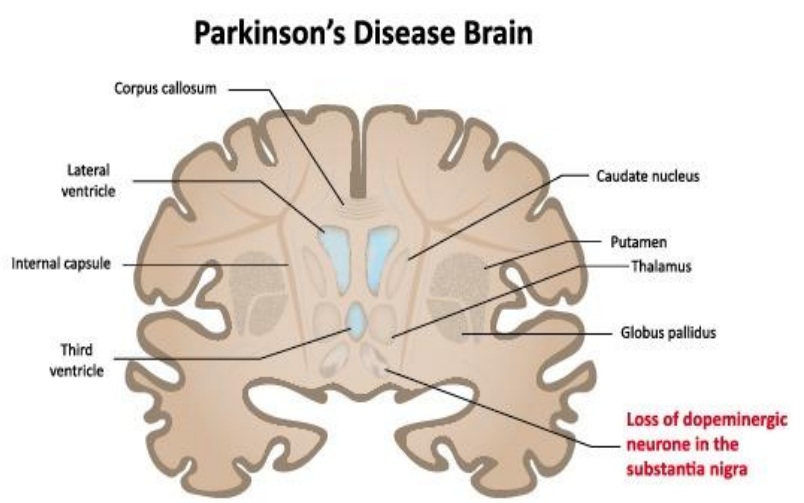


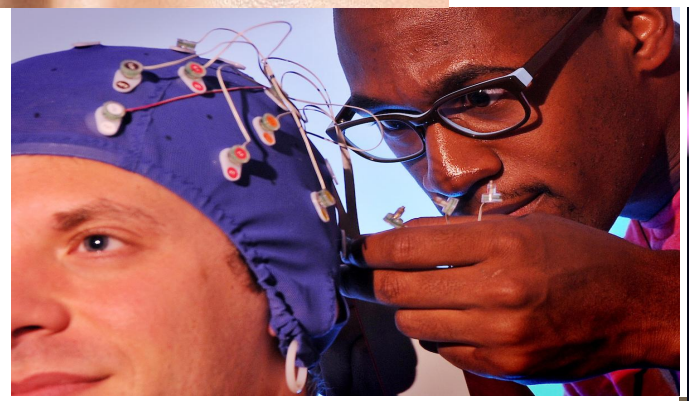
- We used 9th session here.
- We trained a LSTM on Visual cortex and Midbrain neural activity.
- The result show that we can have a precise prediction of pupil area using the information of Vis Ctx and midbrain.
- It can tell us there is a strong correlation between the flow of information between Visual cortex and Midbrain
- We assume that the visual cortex has a strong rule in regulation of pupil size and iris muscles.

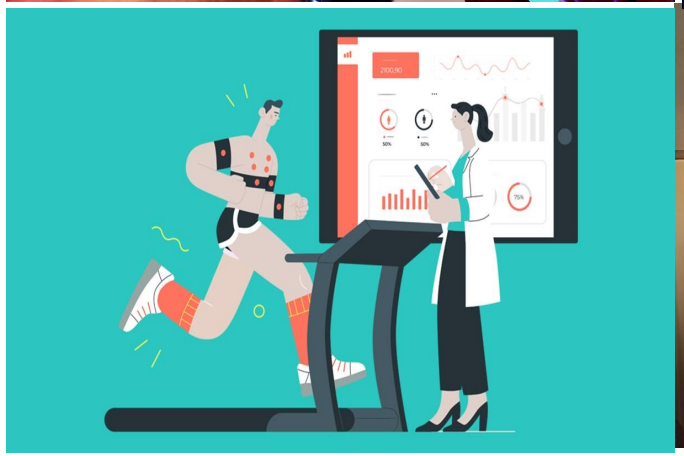
- Conditional Mutual information has an increased after that the stimulus is presenting. it can show us that after perception of Contrast level that we shown is happening in Visual cortex, regularly orders of pupil area can has an origin from Visual cortex.

Applications

1. Diagnosing and monitoring neurological disorders like Parkinson's disease
2. Understanding cognitive and emotional processes in psychology and neuroscience research
3. Improve human-computer interaction
4. Monitor changes in mental states during sports performance
5. Increasing driver safety



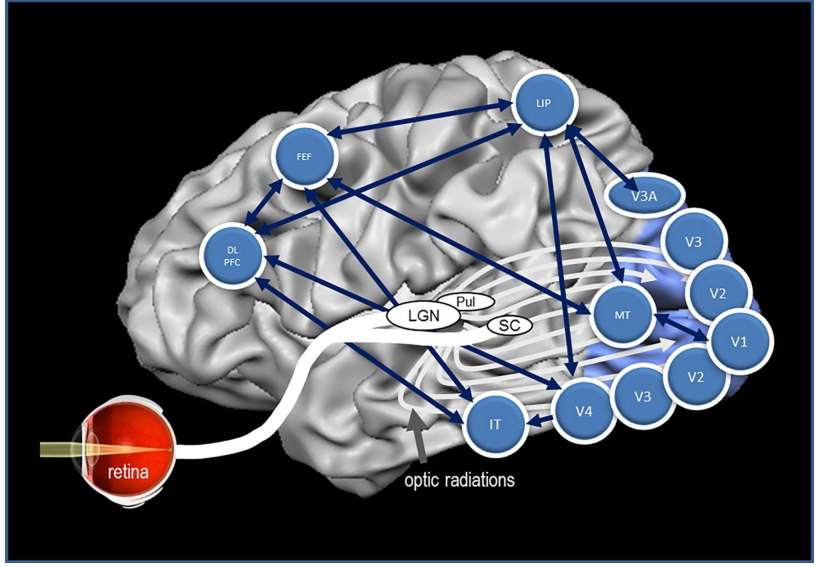


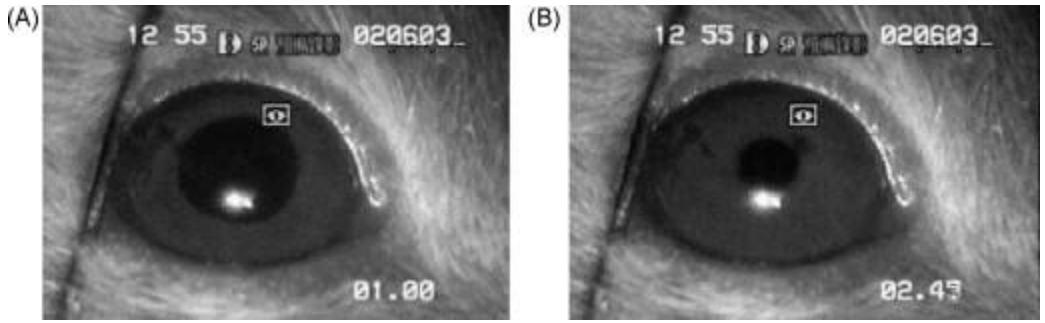


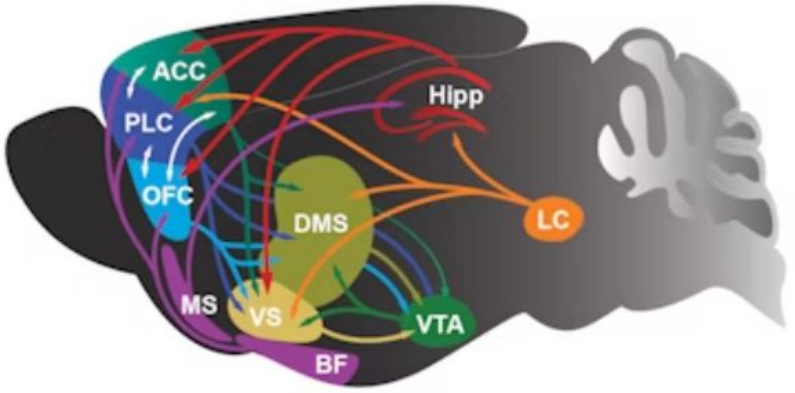
Chen(2018)-Murphy(2014)-Wilson(2003)-Veltman(1996)-Kato(2019

Discussion

- RNNs are effective at modeling sequential data and capturing temporal dependencies.
- Attention and pupillary response are regulated by common brain regions, including the visual cortex.
- Analyzing the learned representations within the RNN may reveal patterns or features that correlate with changes in attention and influence pupillary responses.







Summary

Key Objectives:

- Precise Neural Activity Analysis By Encoding Contrast Level
- Possible Relationship Between Regulation Pupil Area And Visual Cortex

Potential Applications:

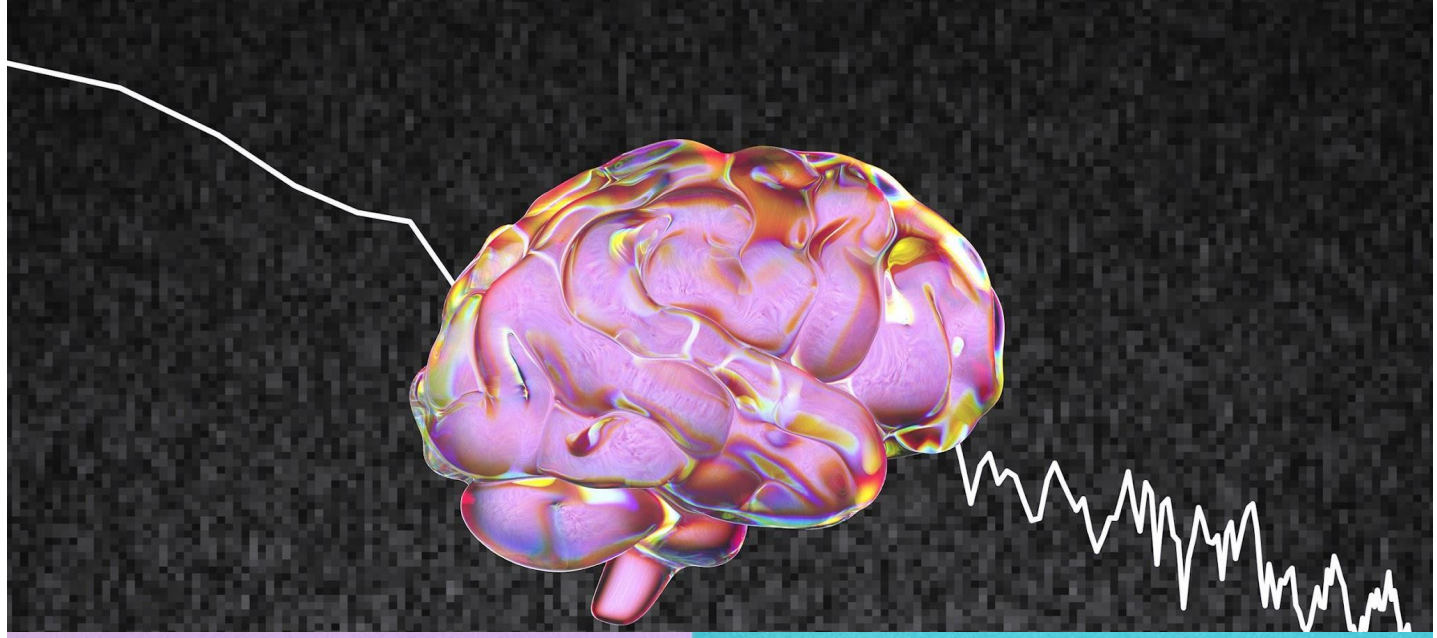
- Neuroscience
- Psychology
- Assistive Technologies

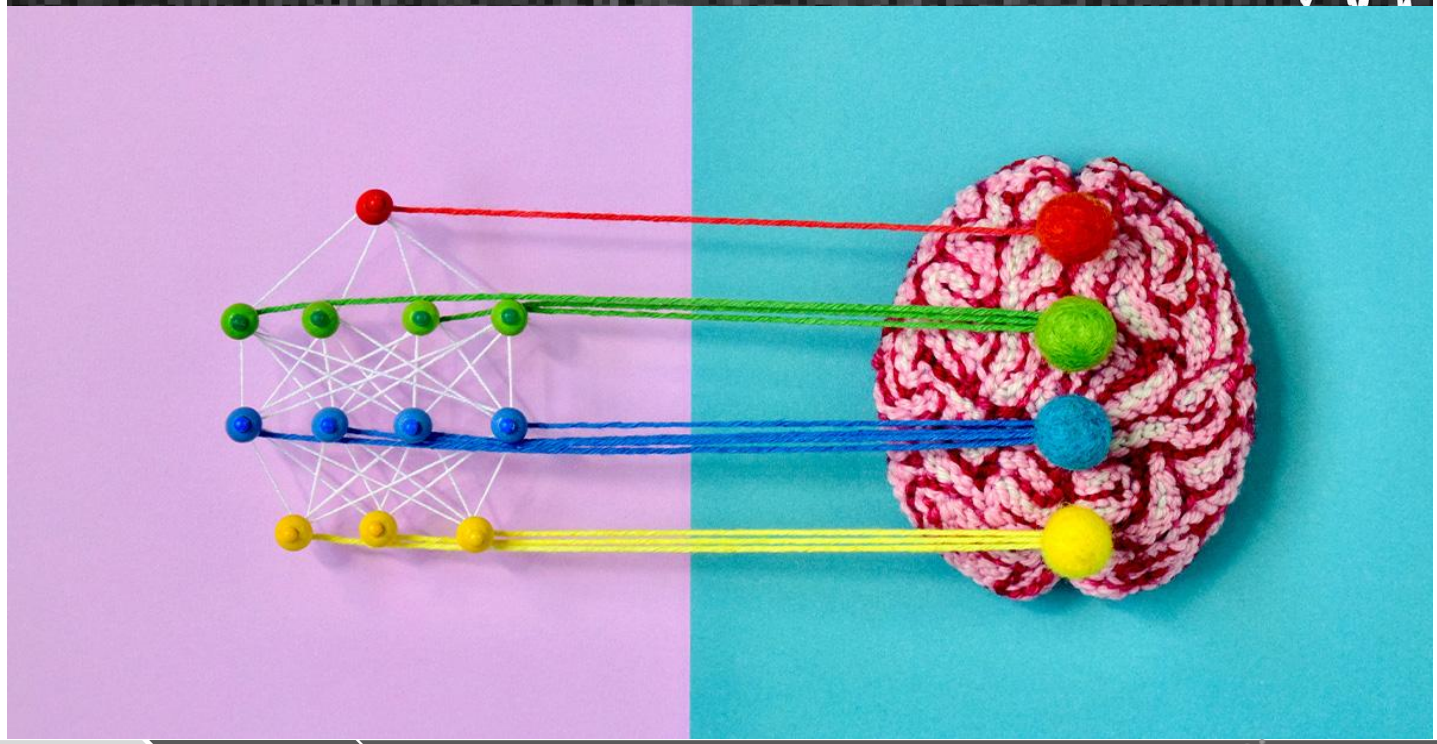
Significance:

- Advancing Brain Understanding
- Transforming Human Interaction

Future Implications:

- Research & Technology Integration
- Enhanced Human Assistance





Thank You

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