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How accurately are animacy-related categories distributed in the visual cortex regions according to the hypotheses of region-wise functionalities?

NMA Final Project
Injera Pod - Group 2 “The Nomads”

Meet Our Team

THE NOMADS


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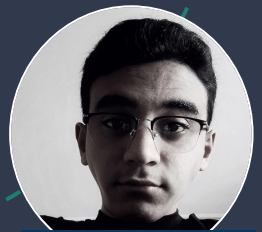
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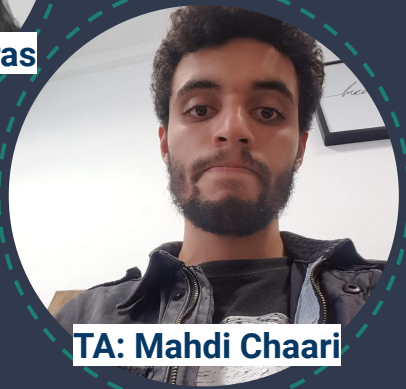
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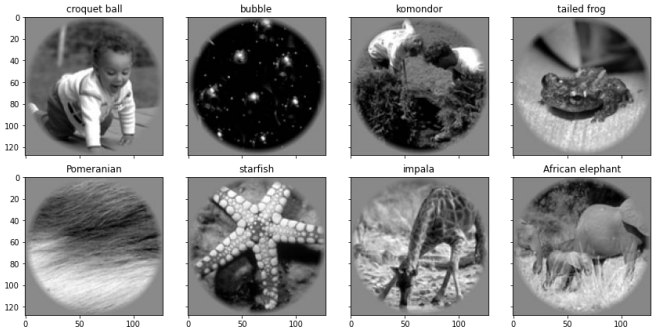
Background

- Animacy is a mid-level visual feature processed by the visual cortex and is primarily described as the difference between living and non-living objects.
- Despite the extensive research on animacy and other mid-level features, it is yet unclear how these features are encoded in the brain and which regions are likely to be discriminative to animacy-related visual stimuli.
- Recent studies suggest that animacy is most likely represented in the mid-level visual cortex, containing late V2, V3, and V4.

Research Question

How accurately are animacy-related categories distributed in the visual cortex regions according to the hypotheses of region-wise functionalities?



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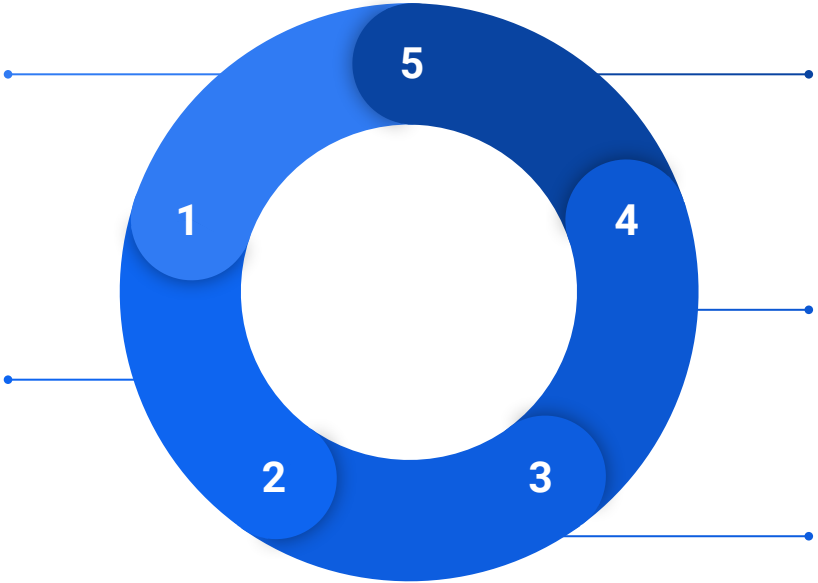
Methodology

KAY DATASET

We used the Kay dataset of natural images with their fMRI responses.
Kay, K.N.; Naselaris, T.; Gallant, J.(2011): fMRI of human visual areas in response to natural images. CRCNS.org. http://dx.doi.org/10.6080/K0QN64NG

MANUALLY RELABELING

Manually relabeled the data to be animate and inanimate classes.



ANALYSIS & RESULTS

Compute accuracy scores, confusion matrices, and F1 scores for further interpretations.

SUPPORT VECTOR MACHINES (SVM)

Were utilized for regional discrimitaion of the responses.

BALANCING & DIVIDING THE DATASET

We balanced the data to have equal samples of animate and inanimate classes, then we divided it based on the regions of interest (V1,V2,V3...)

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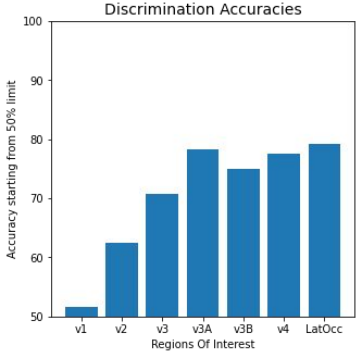
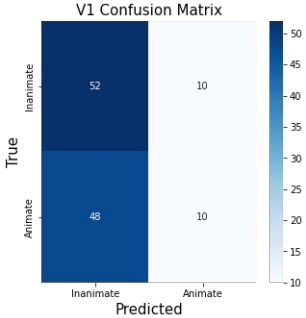
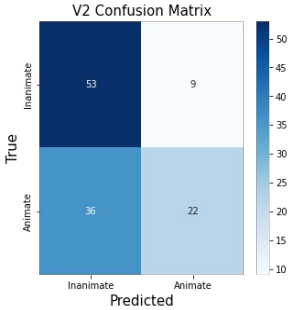
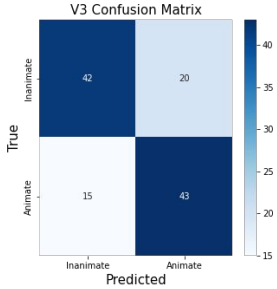
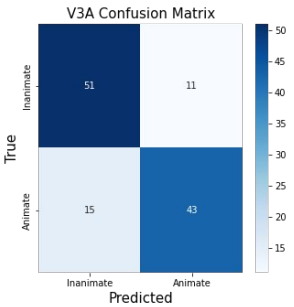
Results

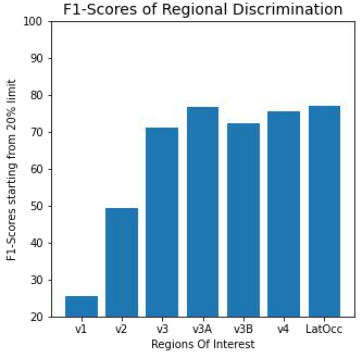


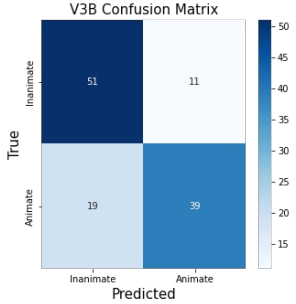


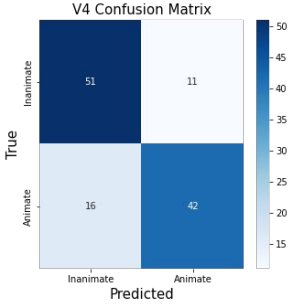


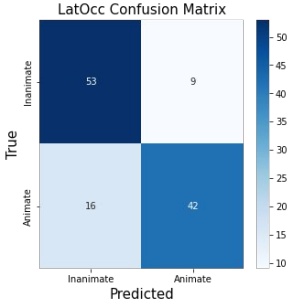


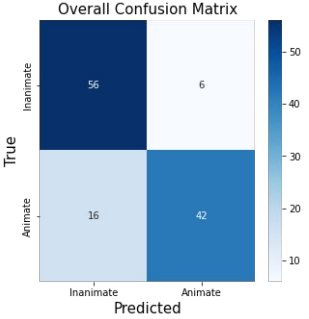










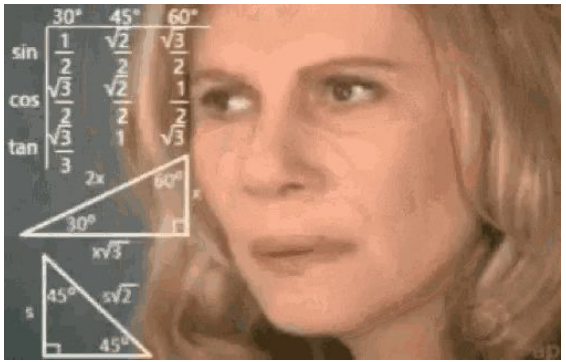


Interpretations and Discussion

- Support Vector Machines (SVMs) linearly discriminate the distributions and patterns of animate and inanimate categories .

- Our approach succeeded in finding different discriminative capacities related to different visual regions.

- The lowest discriminations between animate and inanimate objects were seen in V1 and V2, while the highest discriminations were found in the V3A and Lateral Occipital areas.



- These results support the claims about animacy being decoded in the mid-level visual cortex, and can also be represented in higher visual areas as the Lateral Occipital area.

Our Experience

One of the challenges we encountered was that only one member of our team knew how to actually write the code!

Relabeling the data was intimidating at first but it was worth it as our results were satisfactory.

Probably the best part about this experience was getting to work with and learn from each other.

We were fortunate to have passionate, motivated and patient people like Mahdi, Aryan, and Kirsten on our team, and we are grateful for all of their assistance.

References

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- DiCarlo, J.J. and Cox, D.D., 2007. Untangling invariant object recognition. Trends in cognitive sciences, 11(8), pp.333-341.