Neural Taskonomy: Inferring the Similarity of Task-Derived Representations from Brain Activity

Aria Y. Wang[1,2], Leila Wehbe[1,2], Michael J. Tarr[1,2,3]

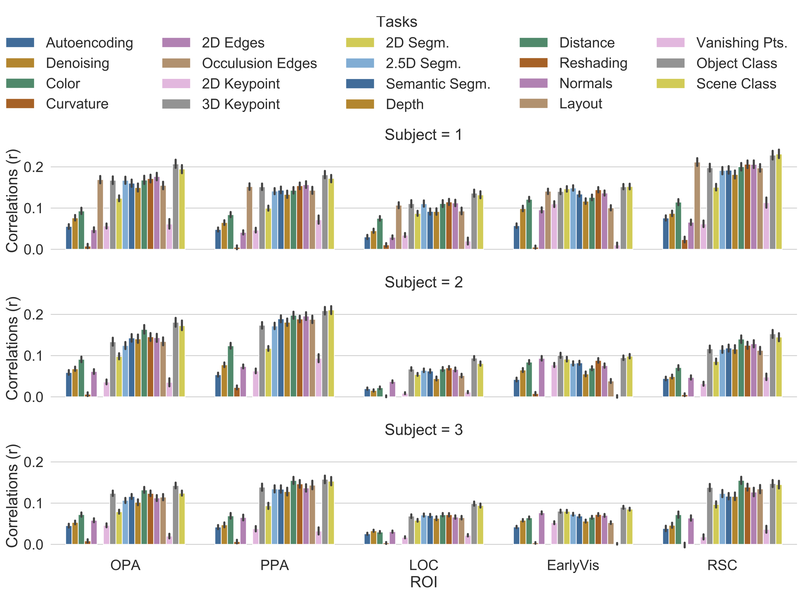
[1]Carnegie Mellon Neuroscience Institute, [2]Machine Learning Department, [3]Department of Psychology

Introduction

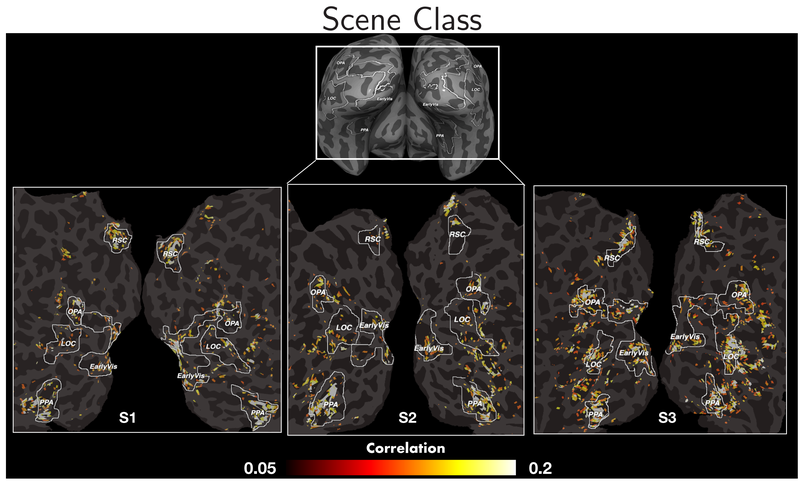
- "Taskonomy" describes the task relationships found through transfer learning using computer vision models[1].
- The Goal: Does the brain represent task information the similar way as found through transfer learning?
- BOLD5000[2] – fMRI dataset using stimuli sampled from ImageNet, COCO and SUN.

- Method: We extracted features from the latent spaces of 19 vision tasks in the Taskonomy model bank[1] and constructed encoding models to predict brain activity to images. Prediction maps were used to infer the relationships between tasks.

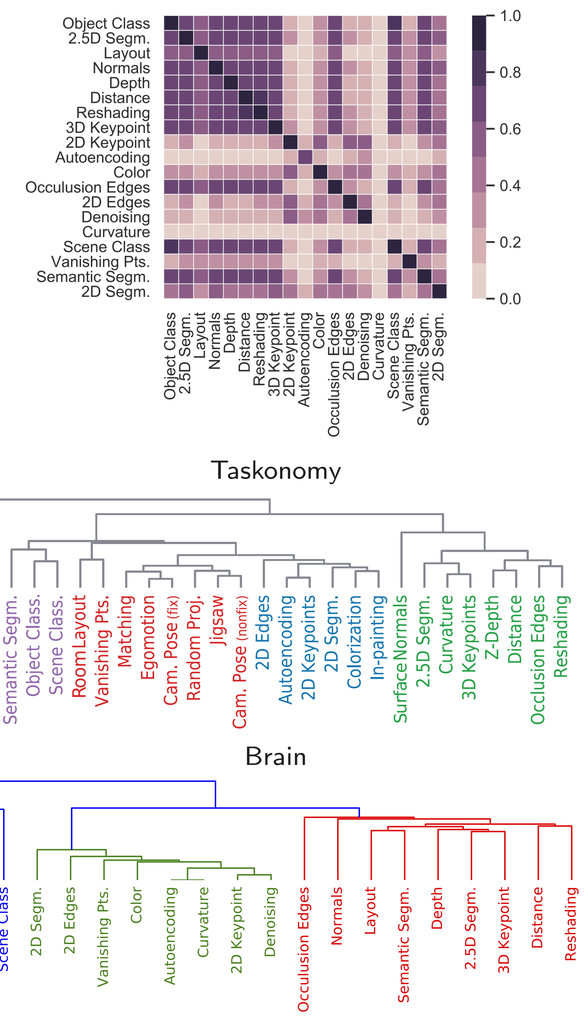
Model Performance - ROIs



Model Performance - Whole Brain



Neural Taskonomy



Conclusions

- Task-specific models are useful for explicating the neural encoding of task-related information.
- Features from 2D tasks and 3D tasks recruit distinct regions of visual cortex (3D features preferred).
- The neural representation of different tasks can be used to infer the relationships between tasks.

References

[1] A. R. Zamir et al. "Taskonomy: Disentangling task transfer learning". In: *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition*. 2018, pp. 3712–3722.

[2] N. Chang et al. "BOLD5000, a public fMRI dataset while viewing 5000 visual images". In: *Scientific data* 6.1 (2019), p. 49.