

Neural Representations and Categorization of Visual Input in the Brain

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Abstract

- Investigation into categorization of visual input in lower level (Early visual cortex), mid-level (LOC), and higher-level areas (PPA)
- It remains unclear to what degree the LOC modulates based on subordinate category
- Brain activation correlations for categories of visual input as well as image feature correlations were carried out to observe patterns in BOLD5000 fMRI neural data.
- This research is intended to clarify what role LOC plays in object recognition, and to what degree categorization exists in ROIs in the visual processing system.

BOLD5000 Results

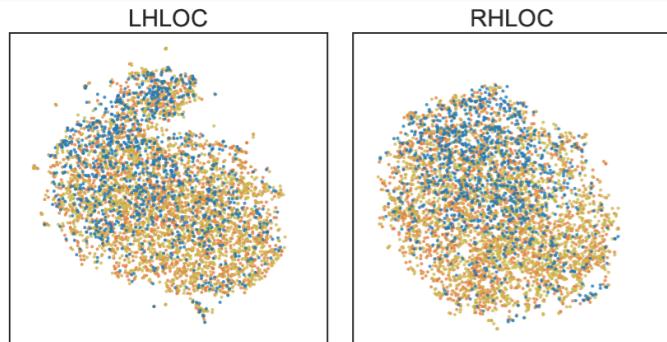


Figure 2. t-SNE analysis on the 4,916 scenes in voxel space for CSI1

- This data was used to investigate the nature of visual representation for categories

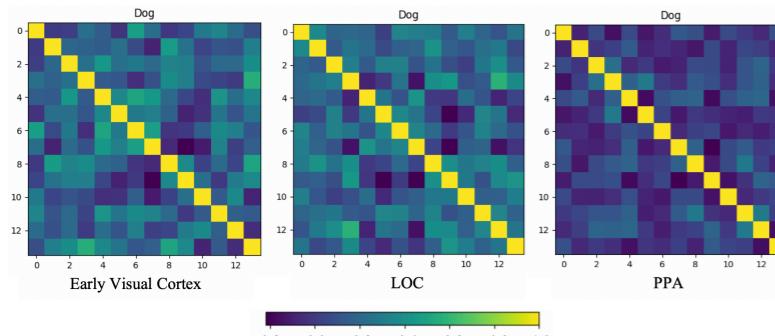
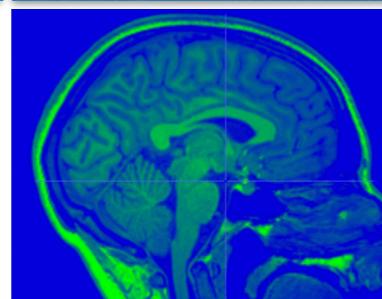


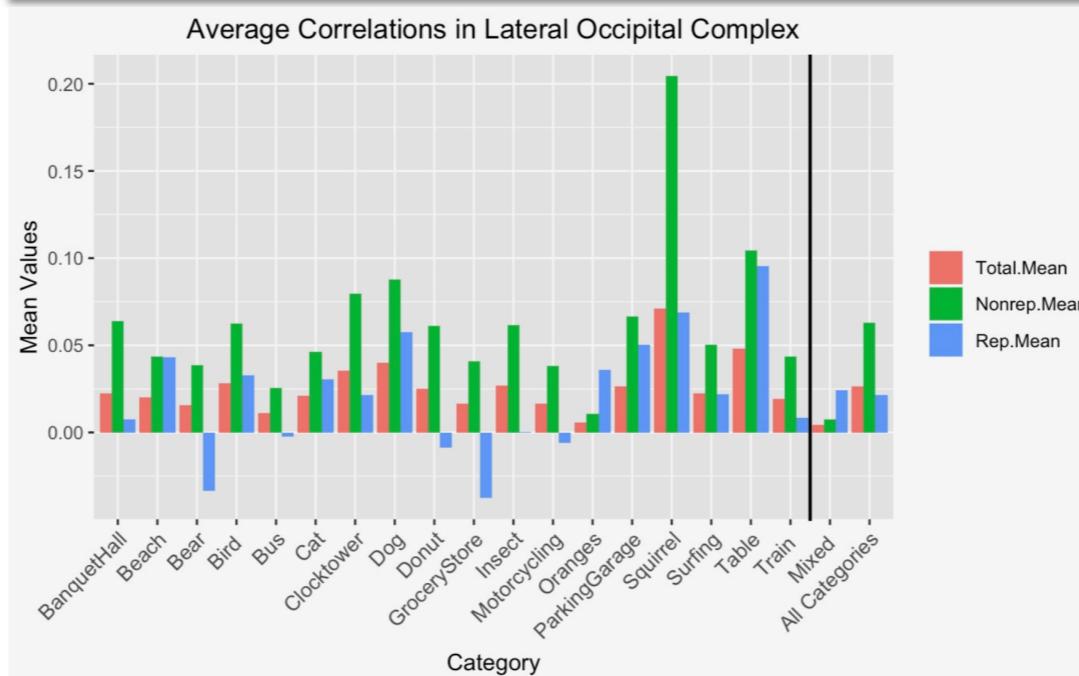
Figure 3. Representational Similarity Analysis for "Dog" in 3 ROIS – Early visual cortex, LOC, and PPA.

fMRI Data Collection



- Slow event related fMRI
- Each participant was presented 5,254 images: 4, 916 unique images and 113 images that were repeated 4 times
- Participants completed valence judgement tasks on each image

Results: Generalization in LOC



Materials

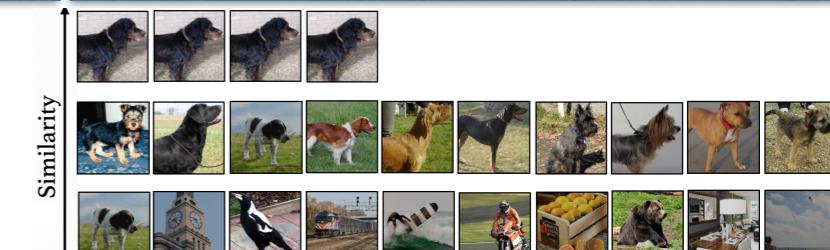


Figure 1. Categories consist of four repeated images (row 1), which have the highest amount of similarity and 10 non-repeated image stimuli (row 2) that are within the same category. The baseline, mixed category, is made of 10 images (row 3) from all different categories. Images were selected from three computer vision datasets (SUN, COCO, ImageNet)

Results: Image Similarity

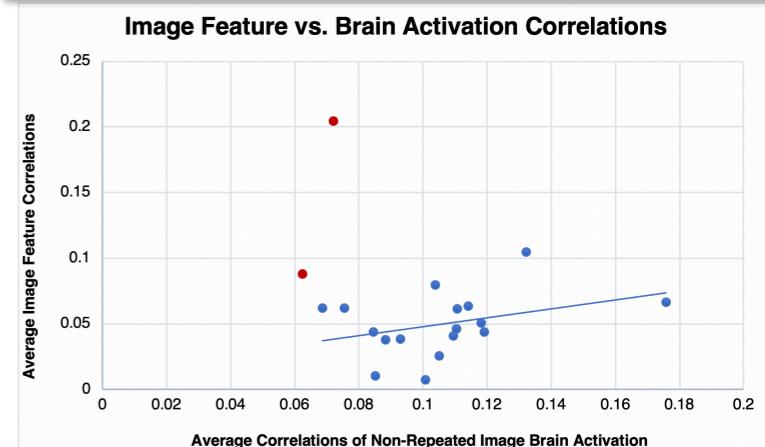


Figure 4. Average image feature correlations vs. Average correlations of non-repeated image brain activation in LOC. The red data points represent "Dog" and "Squirrel". The blue data points represent the rest of the categories

Conclusions

- Responses in LOC are higher at the categorical level as opposed to specific exemplars
- Neural activation in PPA is not invariant to variability in the appearance of category exemplars
- Variability in LOC activation can be attributed to the moderately positive relationship between image feature similarity and brain activation

Average Correlations in PPA vs. LOC for Scene Categories

