Dissociable Representations of Objects, Scenes, and Intermediate Views

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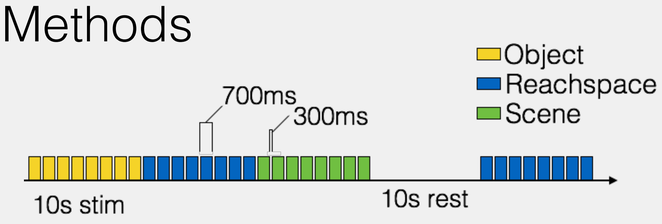
How are intermediate spaces represented in the brain, relative to objects and scenes?

Approach
- Neuroimaging to study responses to objects, scenes and reachspaces
- Image feature modeling to explore a possible mechanism for dissociation.

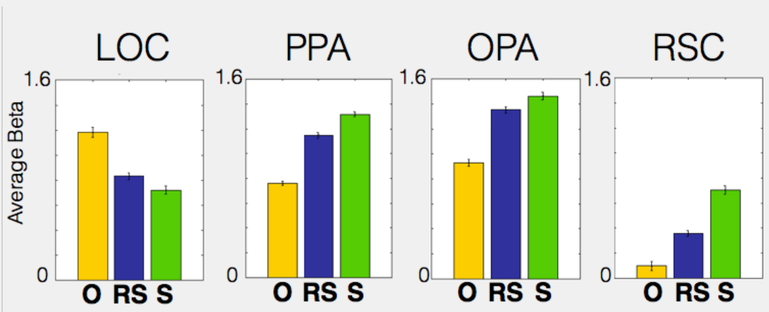
Neuroimaging

Methods



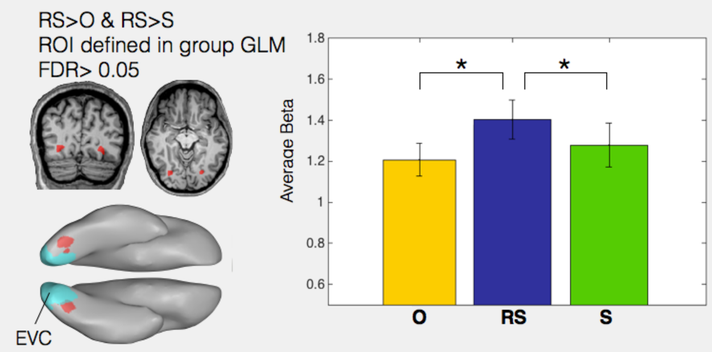
Blocked design
5 blocks/cond/run
8 runs
N = 10

How do reachspaces drive object and scene areas?



Reachspaces elicit intermediate activity in object and scene regions.

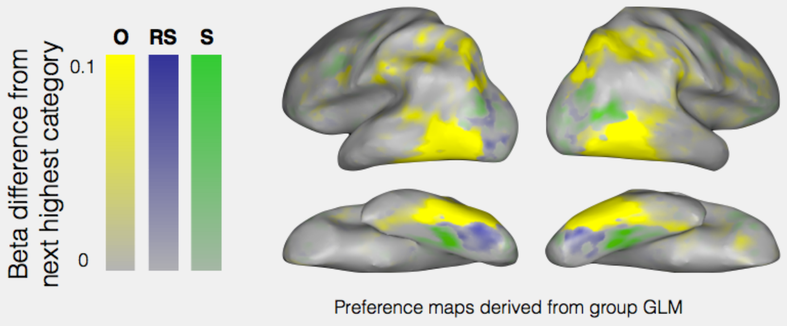
Is there a region that prefers reachspaces?



Evidence for a posterior ventral region that prefers RS to O and S.

Weaker selectivity than known category-selective areas.

Examining the topography of responses

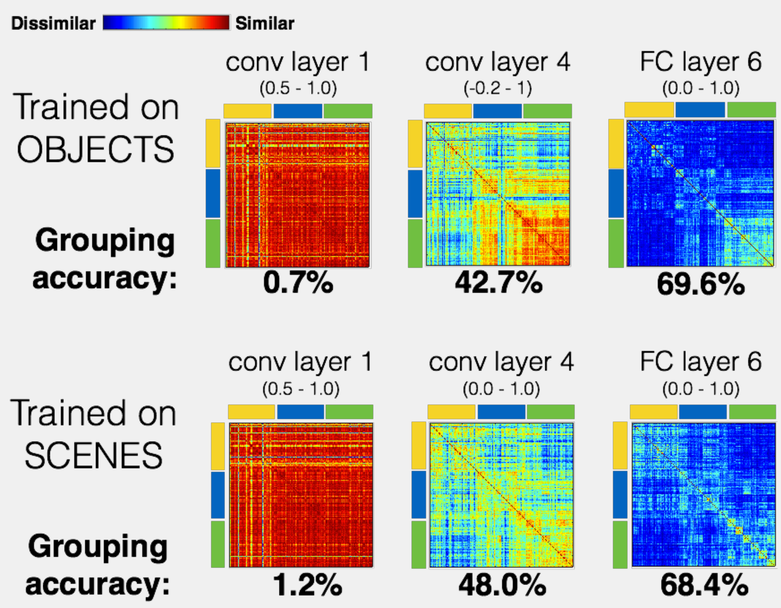


Large-scale preference divisions by scale of space.

Modeling

Can deep nets distinguish RS from O and S?

- AlexNet trained on ImageNet and Places205
- Extract deep net responses from image set
- Compute grouping accuracy of each layer (using k means, k = 3, adjusted rand index)



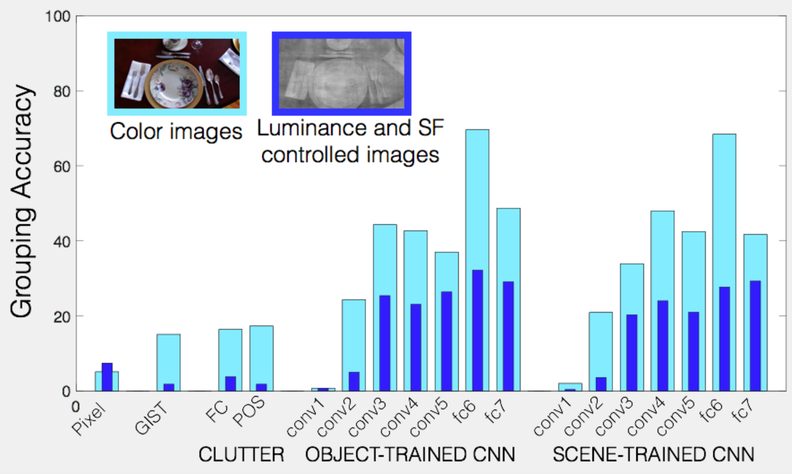
CNNs trained on both objects and scenes detect these differences.

Indicates that O, RS, S have systematic visual feature differences.

Distinctions emerge in later layers

How much is captured by low-level image features?

- Extract features from CNNs, GIST and two clutter models
- Compare original image set with image set controlled for luminance and spatial frequency



CNNs can distinguish O, RS, S even with low-level features controlled

Higher level features exist that distinguish scale of space.

Conclusions

- Objects, scenes and reachspaces elicit different signatures of neural activity.
- There are regions that prefer RS to O and S.
- Visual feature differences might underlie neural dissociation.

Future Directions

- Are the patterns of responses over cortex better explained by scale of space or by semantic category?
- Do areas preferring different scales of space have characteristic connectivity signatures?