Neural representations of reachspaces dissociate from scenes and objects

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Introduction

Objects are single, unitary, bounded entities. Scenes are large-scale, navigable spatial layouts. How should near-scale, reachable space be classified into this dichotomy, given that such spaces consist of more than one object, yet don’t support navigation?

Are there regions that prefer reachspaces to scenes and objects?

- ROIs defined using conjunction contrast: RS>O and RS>S
- ROIs defined in single subjects
- Betas extracted from independent data

Robustness Test - Is this independent of semantic category?

- Graph univariate activations to the 6 semantic categories separately

How do these regions respond to a broader sampling of image categories?

- Extract activation to localizer conditions in RS-preferring patches
- RS areas are not face- or hand-preferring regions
- RS areas are strongly activated by images of multiple objects

This preference holds across a number of semantic categories

What is the topography of scale preference?

- 3-way winner-map showing preferred conditions and degree of preference (group data)

Are reachspace-preferring areas responding to close scale space, object ensembles, or the combination of both?

- Compare activation to full RSs, object-only layouts, and RSs with objects removed

Methods

Reachspaces: task-relevant spaces within reach that consist of multiple objects arrayed on a horizontal surface.

- 3 scales of space, each with 6 semantic categories
- 2 standard localizer runs
- 8 runs of O-RS-S images (Object, Reachspace, Scene)
- 4 each on separate image sets
- one-back repeat detection
- 6 semantic categories included, at each of 3 scales of space
- N = 12

Stimulus Set

- 3 scales of space, each with 6 semantic categories
- bar bathroom dining rm kitchen office studio

fMRI blocked design

- 2 standard localizer runs
- 8 runs of O-RS-S images (Object, Reachspace, Scene)
- 4 each on separate image sets
- one-back repeat detection
- 6 semantic categories included, at each of 3 scales of space
- N = 12

Conclusions

- There are three areas that preferentially respond to reachspaces -> near space perception may recruit specialized neural networks.
- Preliminary evidence suggests that these areas respond strongly to object ensembles
- Reachspaces also drive activity in both scene- and object-processing networks -> near space perception may also recruit object- and scene-based computations.

Overall, evidence suggests that reachspaces are not “just scenes” or “just objects” in terms of their neural representation

Next steps

Is this selectivity independent of low-level feature variations?

- scan images matched in luminance and spatial frequency

Are reachspace-preferring areas responding to close scale space, object ensembles, or the combination of both?

- compare activation to full RSs, object-only layouts, and RSs with objects removed