Main Experimental Question:

What can fMRI reveal about how different object categories are represented in the ventral object vision pathway?

Three models of the functional architecture of the ventral object vision pathway:

1. Areas specialized for representing specific categories of objects (localized category-specificity)
2. Areas specialized for differing perceptual processes (e.g. visual expertise)
3. Distributed and overlapping representations of different categories of objects (object form topography)
Experimental question supporting model 3 (distributed and overlapping representations):

Did each stimulus category evoke a pattern of response different from those evoked by all other individual categories?

Haxby et al. compared within-category to between-category correlations in order to determine whether the patterns of response to different categories were distinguishable.

They found distinct patterns of response for each of the different categories of stimuli.
They found a similar level of discrimination accuracy even when they:

- excluded voxels that responded maximally to specific categories from their analysis.
- examined only voxels that responded maximally to specific categories.
- controlled for low-level features of the stimuli including luminance, mean contrast, and spatial frequencies.
Findings → Model: Distributed, Overlapping Representations?

• “The specificity of the pattern of response for each category was a property of a much greater extent of object-selective cortex in the ventral temporal lobe than the sector that responded maximally to that category.”

• “The representation of a face or object is reflected by a distinct pattern of response across a wide expanse of cortex in which both large- and small-amplitude responses carry information about object appearance.

Object Form Topography & Population Encoding

The architecture of object form topography “may be analogous to that found within early visual areas, such as V1, which contain spatially organized maps of simpler visual features, such as retinotopic location, edge orientation, and color.”

“In a representation based on continuous dimensions, small and intermediate responses would be as important as large responses for specifying the location of a vector in feature space that best describes the appearance of a perceived face.”

Unanswered Questions

How does this proposed model reconcile with established neuropsychological evidence (discrimination between exemplars, prosopagnosia and the FFA)?

Can these results be replicated across different subjects? Do individual differences matter for object form topography?
Activation of the middle fusiform ‘face area’ increases with expertise in recognizing novel objects

Gauthier et al. (1999)

Overview

Subjects were trained to recognize novel objects called greebles with expertise. The greeble stimuli were designed to have high similarity between exemplars, as faces do.

fMRI data comparing these subjects’ processing of inverted and upright faces vs. greebles showed similar changes in activation patterns.

fMRI data on subjects’ processing of greebles after becoming experts showed activation similar to that in response to faces.

A, B, C, and D represent different ROIs.
Abstract

“Using functional magnetic resonance imaging (fMRI), we found an area in the fusiform gyrus in 12 of the 15 subjects tested that was significantly more active when the subjects viewed faces than when they viewed assorted common objects.”

“In each of five subjects tested, the predefined candidate “face area” also responded significantly more strongly to passive viewing of (1) intact than scrambled two-tone faces, (2) full front-view face photos than front-view photos of houses, and (in a different set of five subjects) (3) three-quarter-view face photos (with hair concealed) than photos of human hands; it also responded more strongly during (4) a consecutive matching task performed on three-quarter-view faces versus hands.”