

# The distribution of location information in the ventral visual pathway revealed by fMRI pattern analyses

Rebecca F. Schwarzlose<sup>1,2</sup>, Sabin Dang<sup>2</sup>, Nancy Kanwisher<sup>1,2</sup>

1) Brain & Cognitive Sciences, MIT 2) McGovern Institute for Brain Research, MIT

## Introduction

Ungerleider & Mishkin (1982) argued that processing of visual information proceeds through two cortical pathways: an occipitotemporal “what” pathway for object shape information, and an occipitoparietal “where” pathway for location information. Subsequent studies have suggested that the two types of information are not completely dissociated in these streams. We used pattern analysis methods to measure location information present in the pattern of response across voxels within each of 8 functionally-defined regions in the occipitotemporal pathway.

## Methods

Imaging data from 9 participants were acquired on a Siemens 3T MRI scanner (voxel size 1.4 x 1.4 x 2.0 mm). The study was comprised of two interleaved sets of scans: the localizer scans used to define the regions to be analyzed and the experimental scans used to assess the profile of response in those regions.

Localizer scans: blocks of faces, headless bodies, outdoor scenes, assorted objects, and grid-scrambled objects.

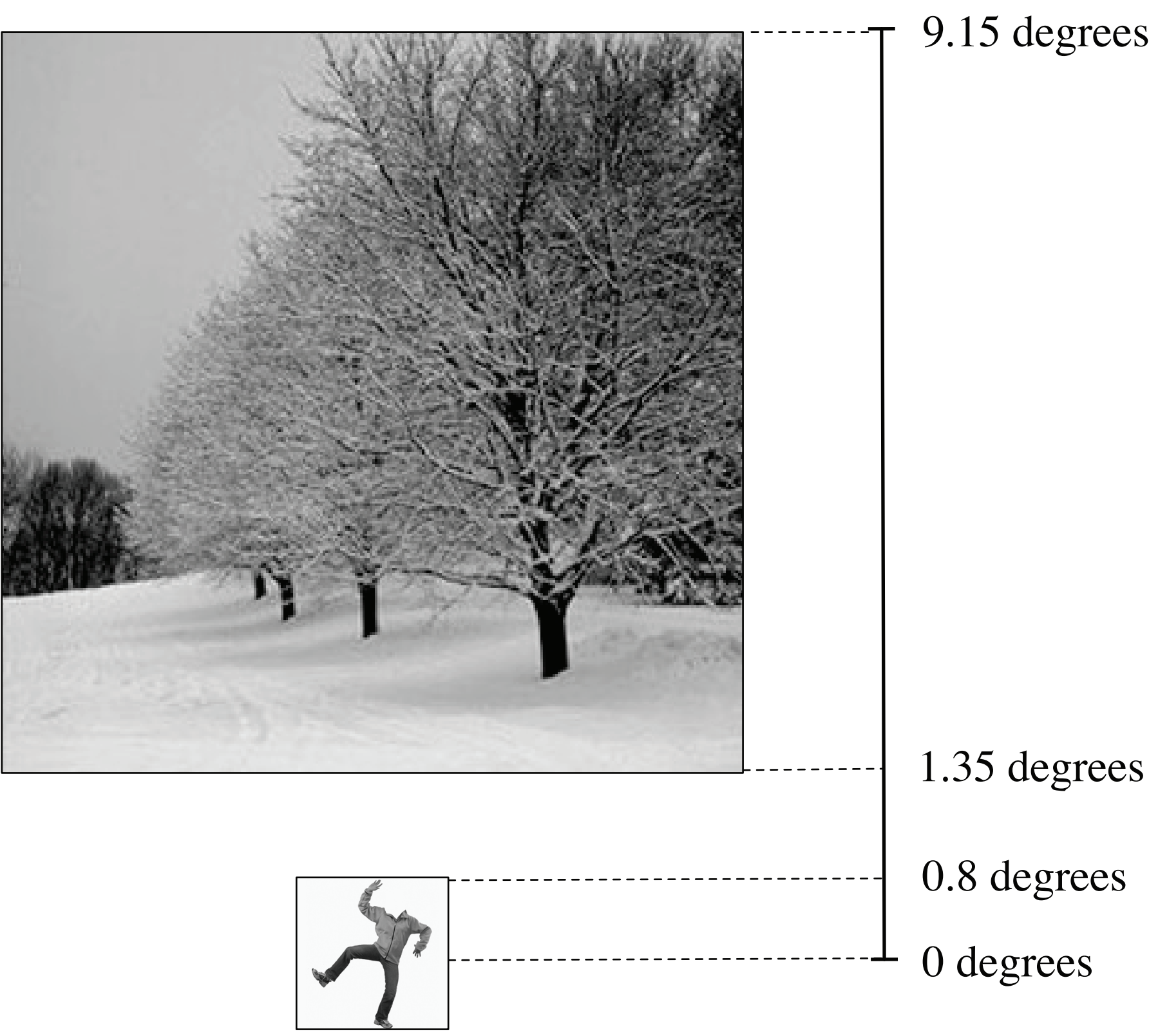
ROIs were defined using the following contrasts:

FFA and OFA: faces > objects,

FBA and EBA: bodies > objects,

PPA and TOS: scenes > objects, pFs and

LO: objects > grid-scrambled objects.



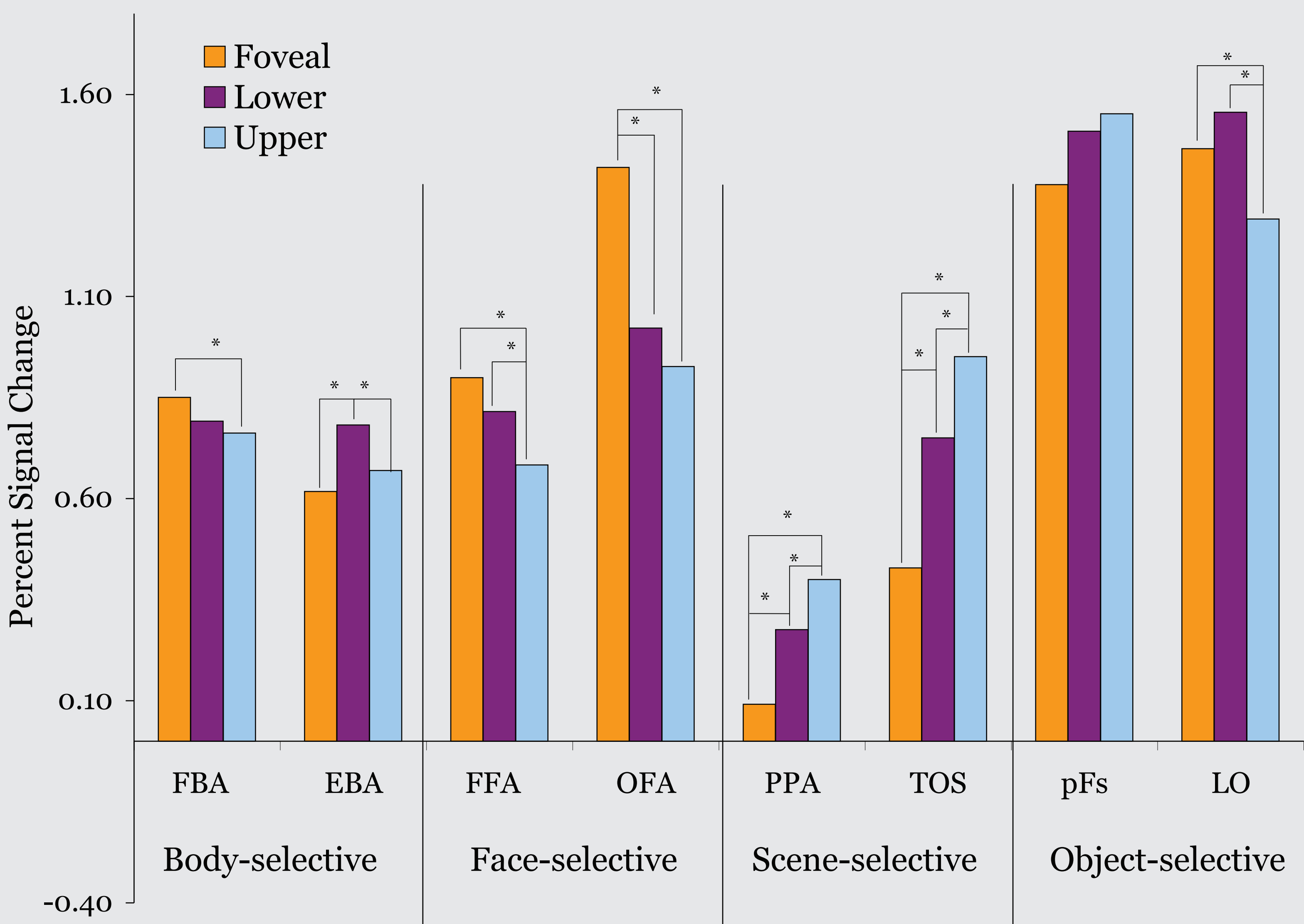
Experimental scans: blocks of faces, headless bodies, cars, and outdoor scenes presented at each of three locations: at fixation or 5.25° above or below fixation.



## Results

### Mean response across voxels within each ROI

- Replication of eccentricity findings reported by Malach and colleagues.
- New elevation biases found in 5 out of 8 ROIs.
- Category-selective ROIs contain substantial location information.



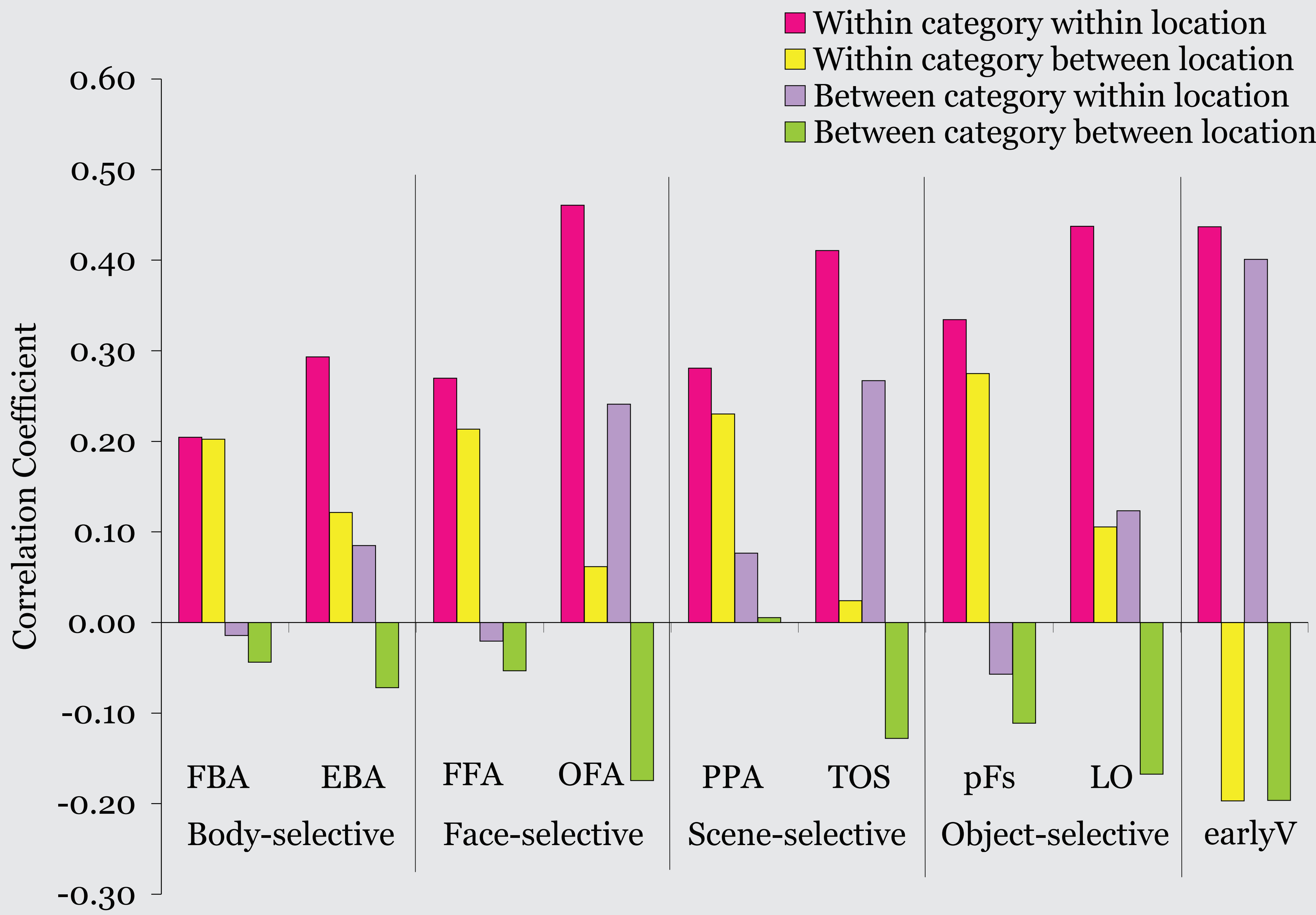
### Multivariate pattern analysis

Following the method of Haxby et al (2001), we split the data in half and computed voxel-wise correlations on the normalized patterns of response. A higher correlation across data halves within than between category indicates the presence of category information, and a higher correlation within than between location indicates location information.

- Replication of prior findings of category information.
- Location information found in all regions except FBA (p=0.40).
- All ROIs demonstrated position-invariant category information and all except FBA (p=0.23) and FFA (p=0.07) demonstrated significant category-invariant position information.

We next paired ROIs by category preference (e.g. body areas FBA and EBA) and tested how the amount of category and location information differs by cortical surface (ventral temporal versus lateral occipital).

- No significant difference in the amount of category information found in lateral versus ventral ROIs.
- Substantially more location information found in lateral than ventral ROIs.



## Conclusions

Location information is widespread in occipitotemporal category-selective areas.

- Nearly all ROIs contain substantial information about object location.
- All ROIs contain position-invariant category information and most also contain category-invariant position information.
- Lateral ROIs contain more location information than ventral ROIs.

### Reference

Haxby JV, Gobbini MI, Furey ML, Ishai A, Schouten JL, Pietrini P (2001) Distributed and overlapping representations of faces and objects in ventral temporal cortex. Science 293: 2425-2430.