Object gist features capture the structure of neural responses to objects

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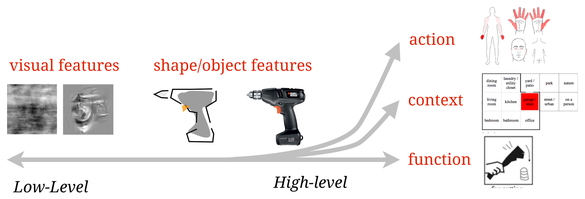
Introduction

Visual objects can be characterized by a variety of features



Small Tool-use T-shaped ...

Big Support Boxy ...

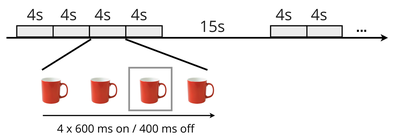
Challenge: Neural differences between two categories have many possible causes

Aim: Explore how different object properties predict neural responses

Stimuli & Neural Measures

200 inanimate objects, 72 item subset for fMRI

Obtain reliable patterns for individual items using fMRI

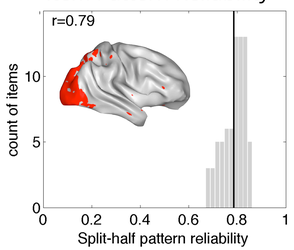


72 "mini-blocks" / run
4 x 15s rest periods
8 runs (6 min each), N=10

Task: detect framed object

Task by Run: think about ...
... how you interact with the object
... where you find the object
... what it's for
... its physical properties

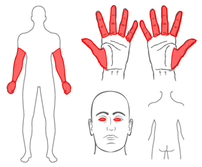
Item Pattern Reliability



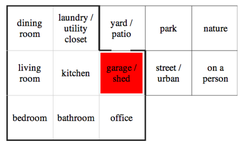
Define Possible Feature Spaces

What object properties might explain neural coding dimensions?
(i.e. in what ways can objects be similar and different?)

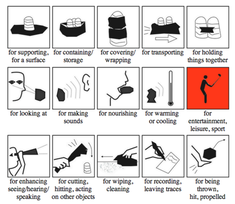
Action



Context

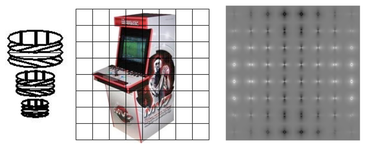


Function



Mturk, N= 20 ratings/item

Gist



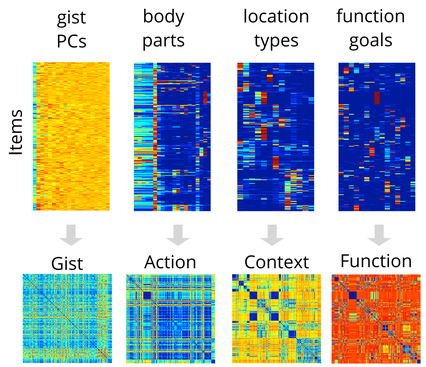
Scene statistics model of Oliva & Torralba (2001)

Object gist features capture global form properties of the objects

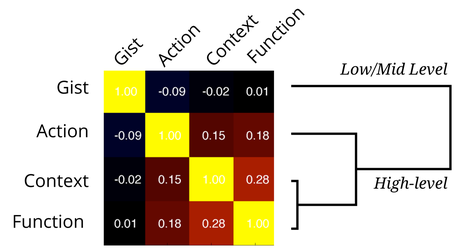
Results:

Feature Spaces...

... and corresponding dissimilarity matrices



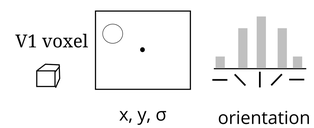
How similar are these spaces to each other?

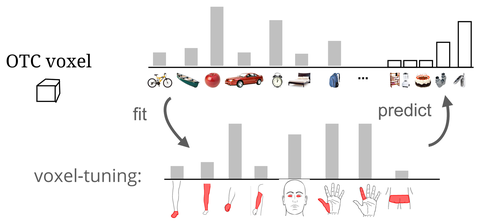


Object gist features have a distinctive geometry from the other features spaces

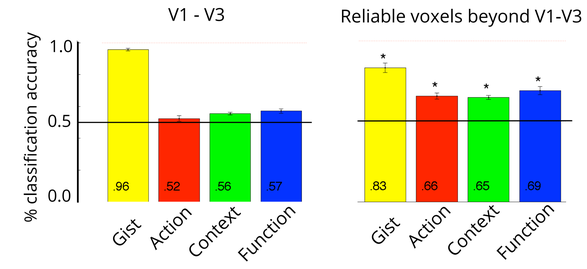
Explore Neural Response Tuning

Fit a tuning function for each voxel (e.g. Mitchell et al., 2008; Huth et al., 2012)





How well can we predict and classify patterns for new objects?



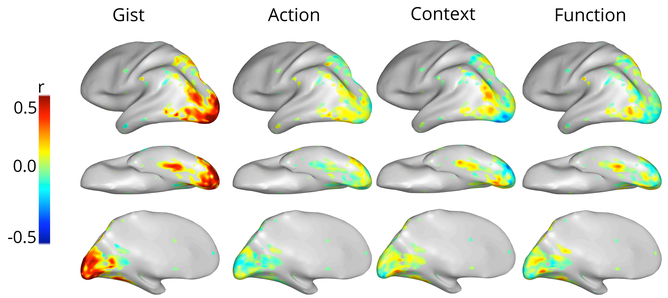
Leave 2 items out

Fit tuning for each voxel

Classify test items using predicted and actual multi-voxel patterns

Gist tuning predicts object responses

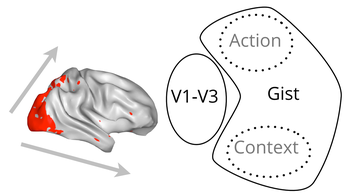
Which voxels have the highest prediction performance?



Leave 1 item out

Predict that item's response with fit from other 71 items

Correlate predicted/ actual values over all iterations

Conclusions

Of the models tested, **object gist features** predict neural responses better than the high-level feature spaces, even beyond retinotopic cortex