Similarities and differences in the semantic representations of words and objects: Evidence from multi-voxel pattern analyses

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Methods

Glm on unsmoothed native-space data to obtain β image for each of the 60 items in both modalities (Kriegeskorte et al. 2008)

Representational Similarity Analysis (RSA)

Multi-voxel searchlight mapping (Kriegeskorte et al. 2008)

Compare dissimilarity structure in activation searchlight spheres to three computational models:

Object Visual Model

Word Visual Model

Semantic Category Model

Group-level statistics: Statistical non-Parametric Mapping (SnPM).

Voxel level FWE p < 0.05 reported

Representational Cluster Analysis (RCA)

k-means cluster analysis to identify regions in both modalities where representational dissimilarity patterns are similar

Results

RSA for Pictures

Visual Silhouette RDM

RSA for Words

Visual Silhouette RDM

Overlap of semantic model representations for words and pictures in LpMTG, L AG and L intraparietal sulcus (L IPS). No overlap in fusiform or lateral occipital cortex

RCA Results – Commonalities and differences

Model-free analysis. 10 clusters explain >80% of RDM variance. Three of the 10 clusters contain RDMs drawn from both modalities:

RCA for Pictures

LpMTG, L AG, L IPS

RCA for Words

LpMTG, L AG

Conclusions

• Core network of regions (including LpMTG, L AG & L IPS) involved in semantic processing for both words and objects
• Although LpMTG, L AG and L IPS involved for both modalities, cluster analyses revealed subtle differences for words and pictures:
  • LpMTG and L AG representations are not similar across modalities (not found in the 3 clusters that span words and pictures)
  • In LpMTG and L AG, representations capture semantic category similarity for both words and pictures, but specific word and picture similarity structures are uncorrelated:
  • Suggests different functional roles for these regions in word and object processing

Experiment

60 concepts (10 from each of 6 semantic categories)

Task: what kind of thing is the word/object? (Similar semantic demands for words and pictures)

Session 1: words

Session 2: pictures

hammer
tool

carrot
vegetable

animal

6 runs of words and pictures, random order on each run

Clusters may reflect representational structure unique to one modality (e.g. visual processing, Cluster 3), invariant across modalities (e.g. Cluster 1), or occurring in non-overlapping areas across modalities (e.g. Cluster 2)