Real-world objects acquire basic-level advantage in occipito-temporal cortex

Marius Cătălin Iordan¹, Michelle R. Greene¹, Diane M. Beck², Li Fei-Fei¹

¹Department of Computer Science, Stanford University  
²Beckman Institute and Department of Psychology, University of Illinois at Urbana-Champaign

mci@cs.stanford.edu  mrgreene@stanford.edu  dmbeck@illinois.edu  feifeili@cs.stanford.edu

Background

basic-level advantage:  a mid-level of generality (basic-level, e.g. dog), is named, learned, and recognized faster than subordinate (Shar-Pei) or superordinate (animal) levels

the mechanism behind the basic-level advantage is unknown

Object hierarchy that mirrors real-world category organization

Our taxonomy exhibits a behavioral basic-level advantage

fMRI Experiment

methods: 32 images from each subordinate, block design, no explicit categorization task

key idea: members of a category should elicit neural activity patterns that are simultaneously more similar to each other and more distinct from members of other categories

analysis: use MVPA to characterize similarity of activity patterns across taxonomic levels

Neural activity patterns group most strongly at the basic-level in higher visual areas

Basic-level strikes the best balance between category cohesion and category distinctiveness

Object-selective cortex favors basic-level organization and is the brain region most correlated with perceptual judgments

Summary

the basic-level advantage increases as we ascend the visual pathway, with the strongest effect in lateral occipital complex (LOC)

in object-selective cortex, basic-level categories maximize within-category similarity and between-category similarity

our results suggest that successive levels in the visual system may optimize basic-level categorizations

References


Acknowledgements: This work was funded by a William Hewlett Stanford Graduate Fellowship (to M.C.), an NSF Grant NEE32010916815 (to M.R.G.), and a National Institutes of Health Grant 1F31EY019429 (to D.M.B and L.F.-F.)