Category Cohesion and Distinctiveness Favor Different Taxonomic Levels Across Human Visual Cortex

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SfN 2014

How do category representations change across taxonomic levels in human visual cortex ?

General

SUPERORDINATE — natural object

BASIC — dog

SUBORDINATE — border collie

Specific

Rosch et al. (1976)

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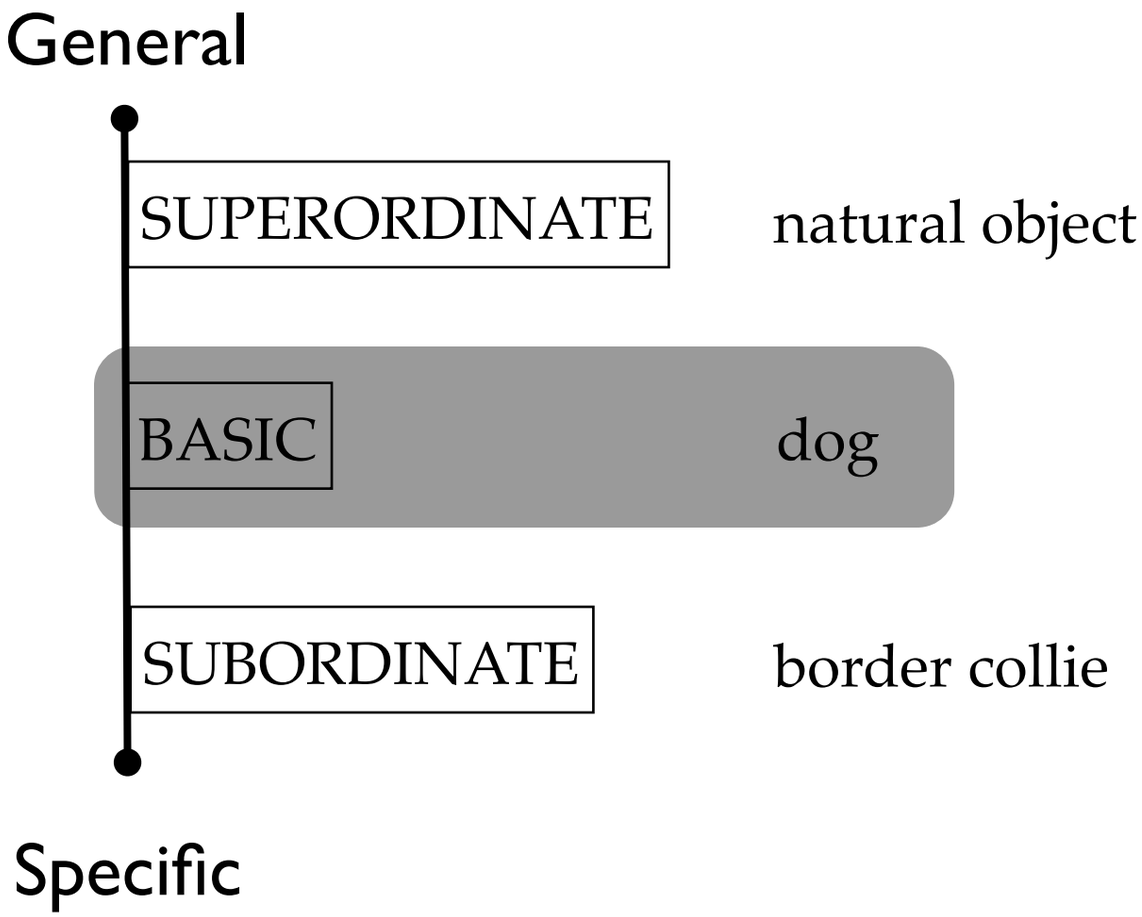
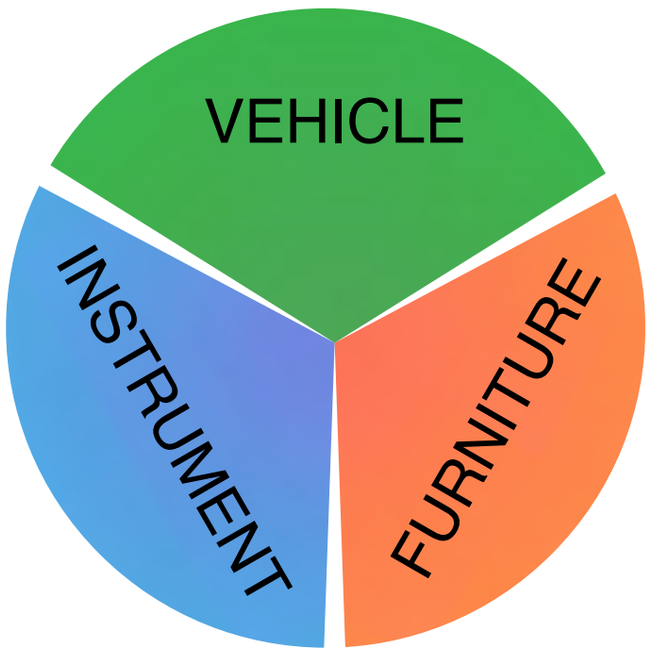


1. Experimental Setup
2. Similarity of Neural Patterns
3. Category Information at Each Taxonomic Level

Is there a privileged taxonomic level ?

big, inanimate objects

subset of Rosch et al. (1976)



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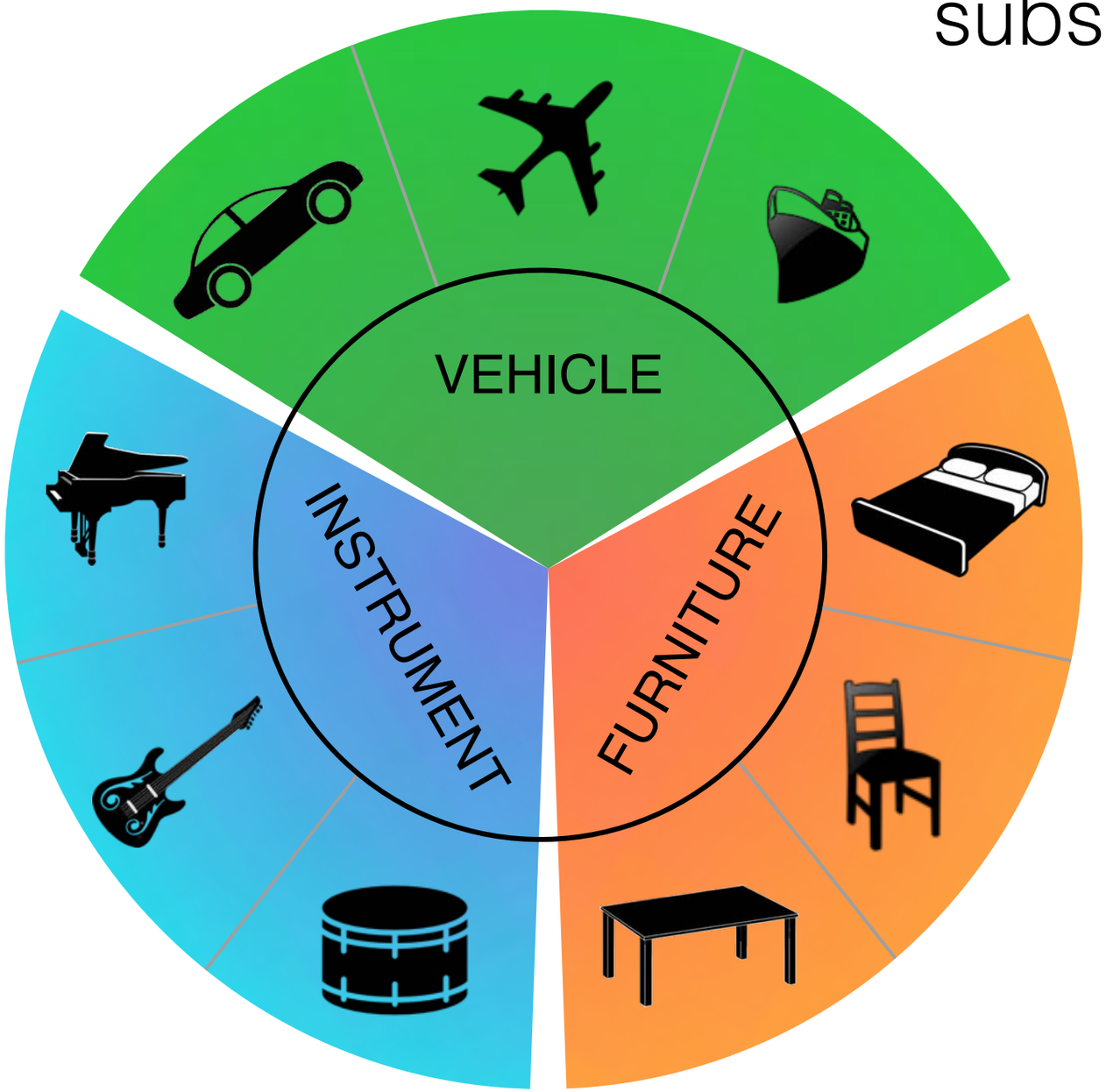
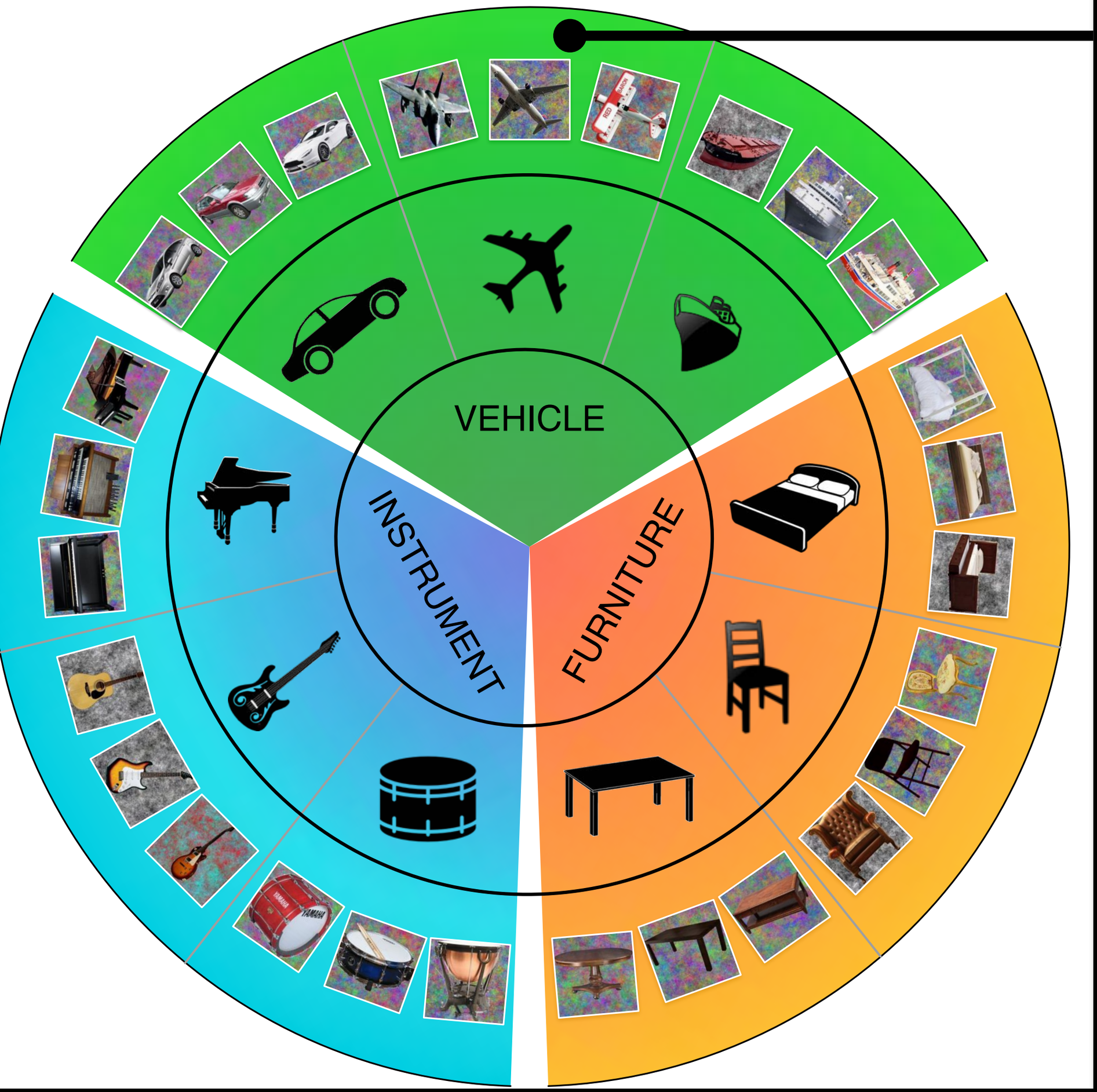
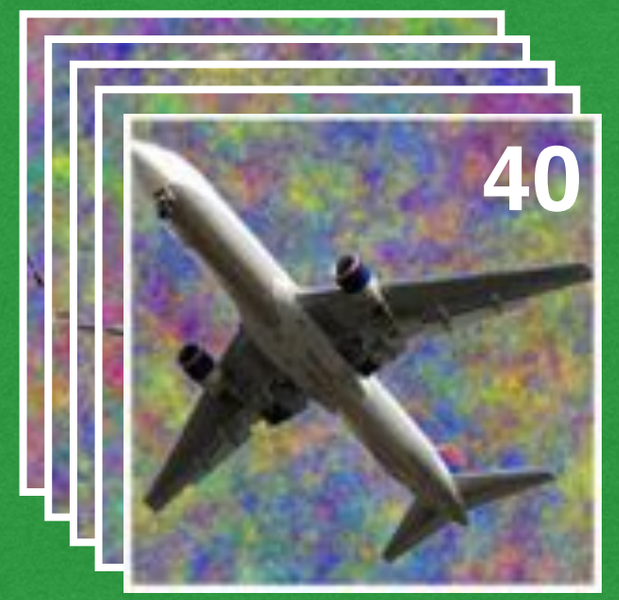



VEHICLE
INSTRUMENT
FURNITURE


40

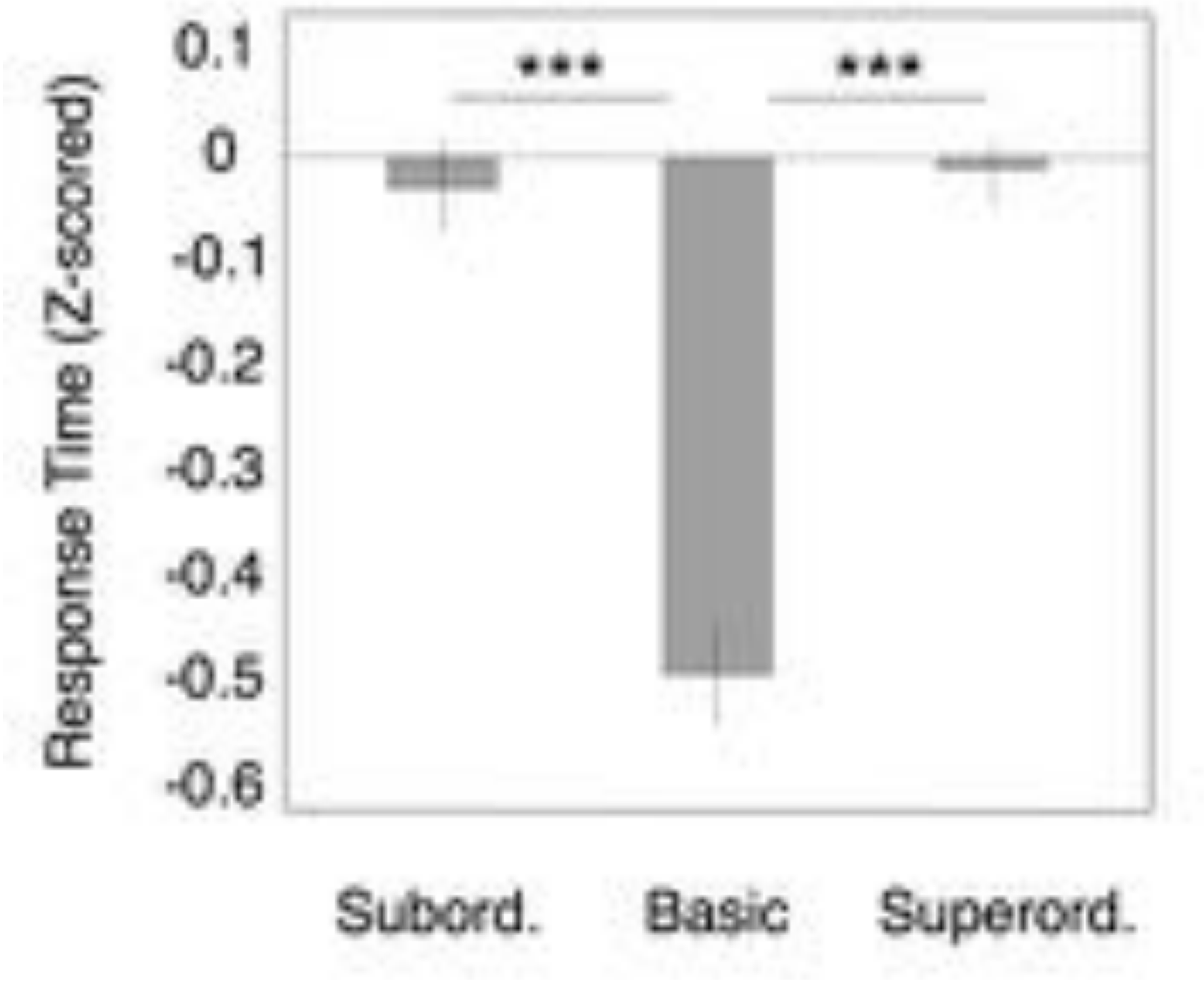

40


40
BARON
RED

Match-to-Category Behavioral Experiment

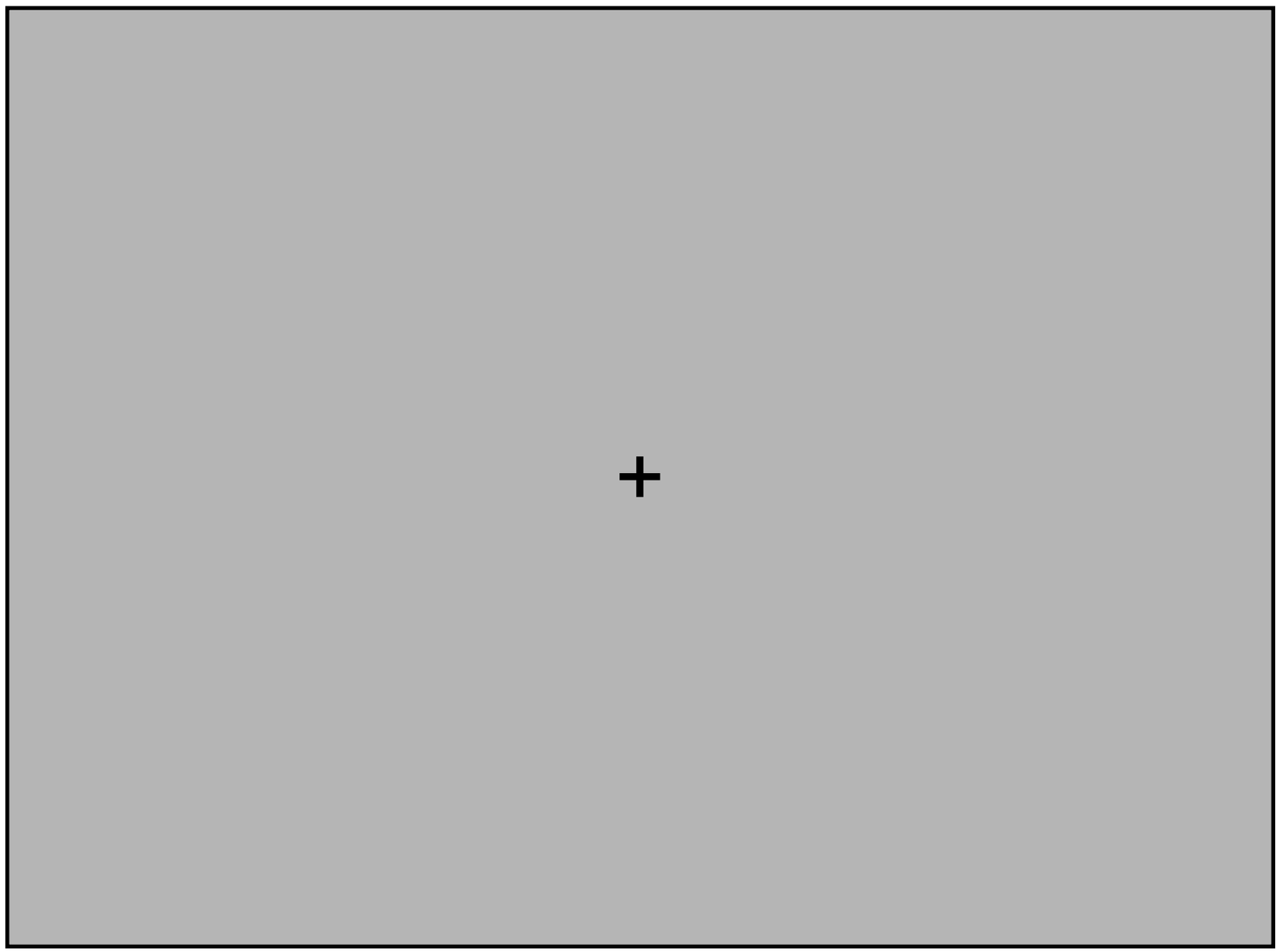
is this a “fighter plane” / “plane” / “vehicle” ?

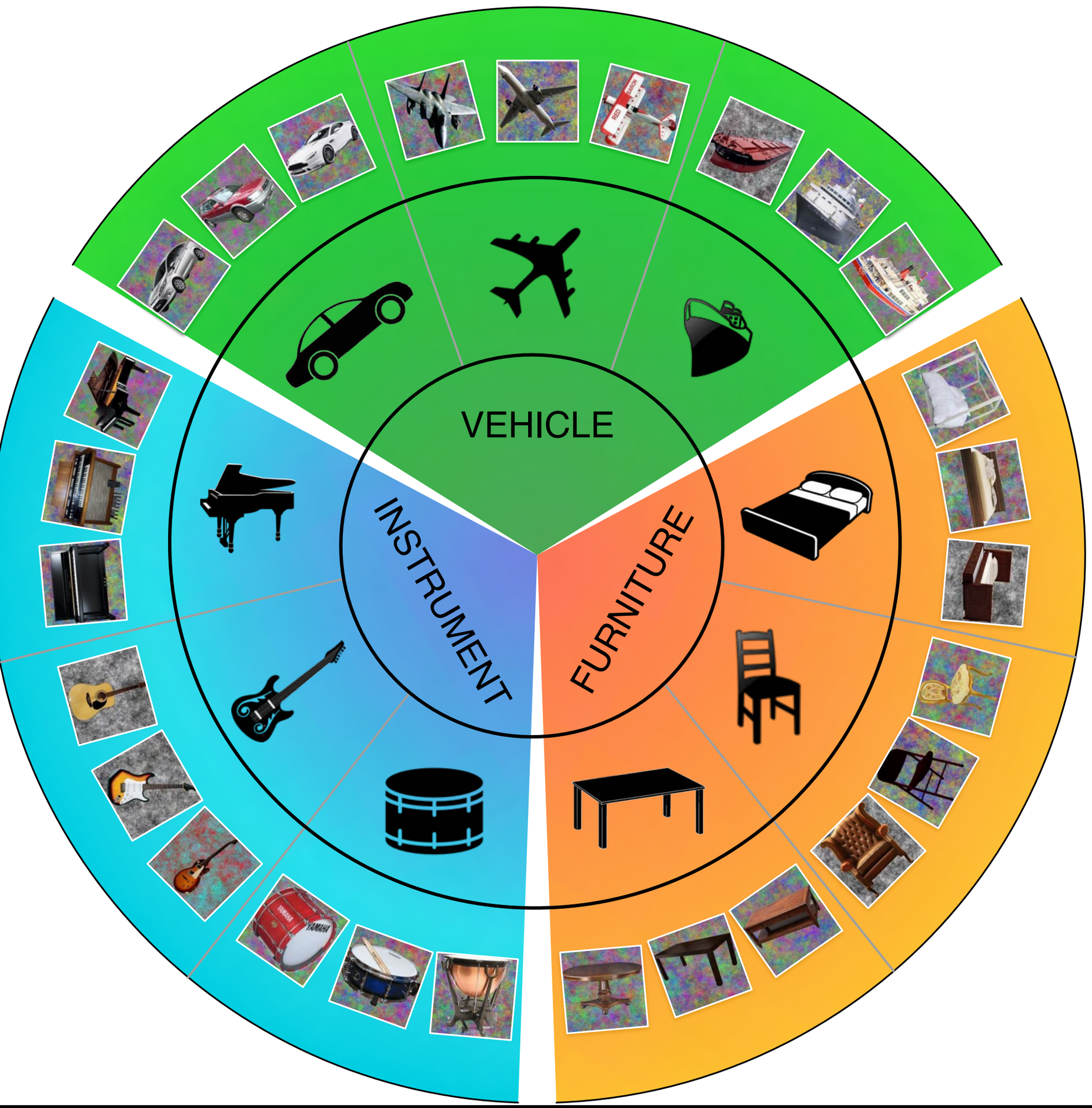
Match-to-Category Behavioral Experiment



fMRI Experiment: Example “Fighter Plane” Block

8 images per block ⁎ 5 blocks per category ⁎ 27 categories

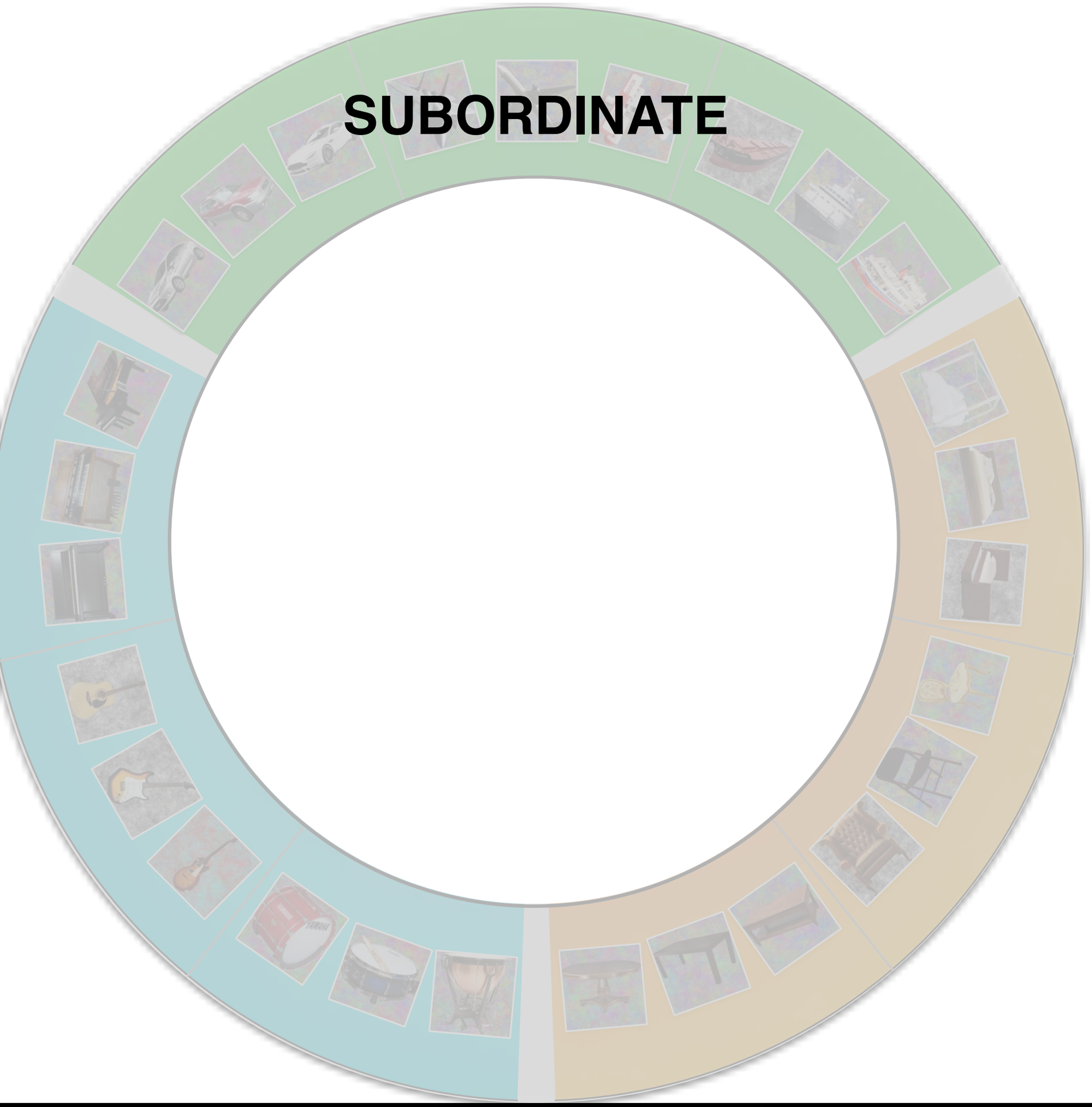




27 categories
x
40 images each

passive viewing
fMRI
experiment

3
taxonomic
levels



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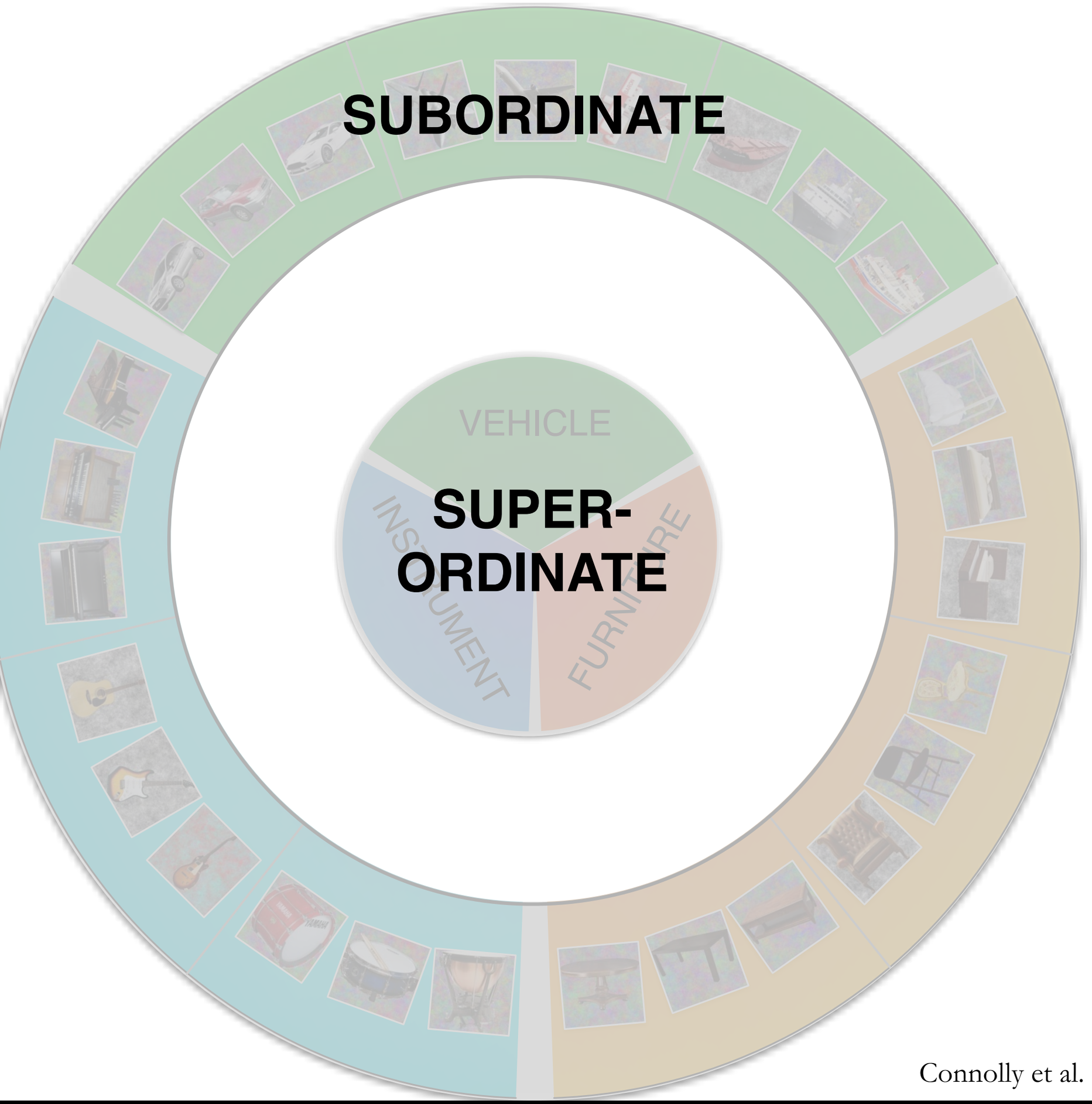

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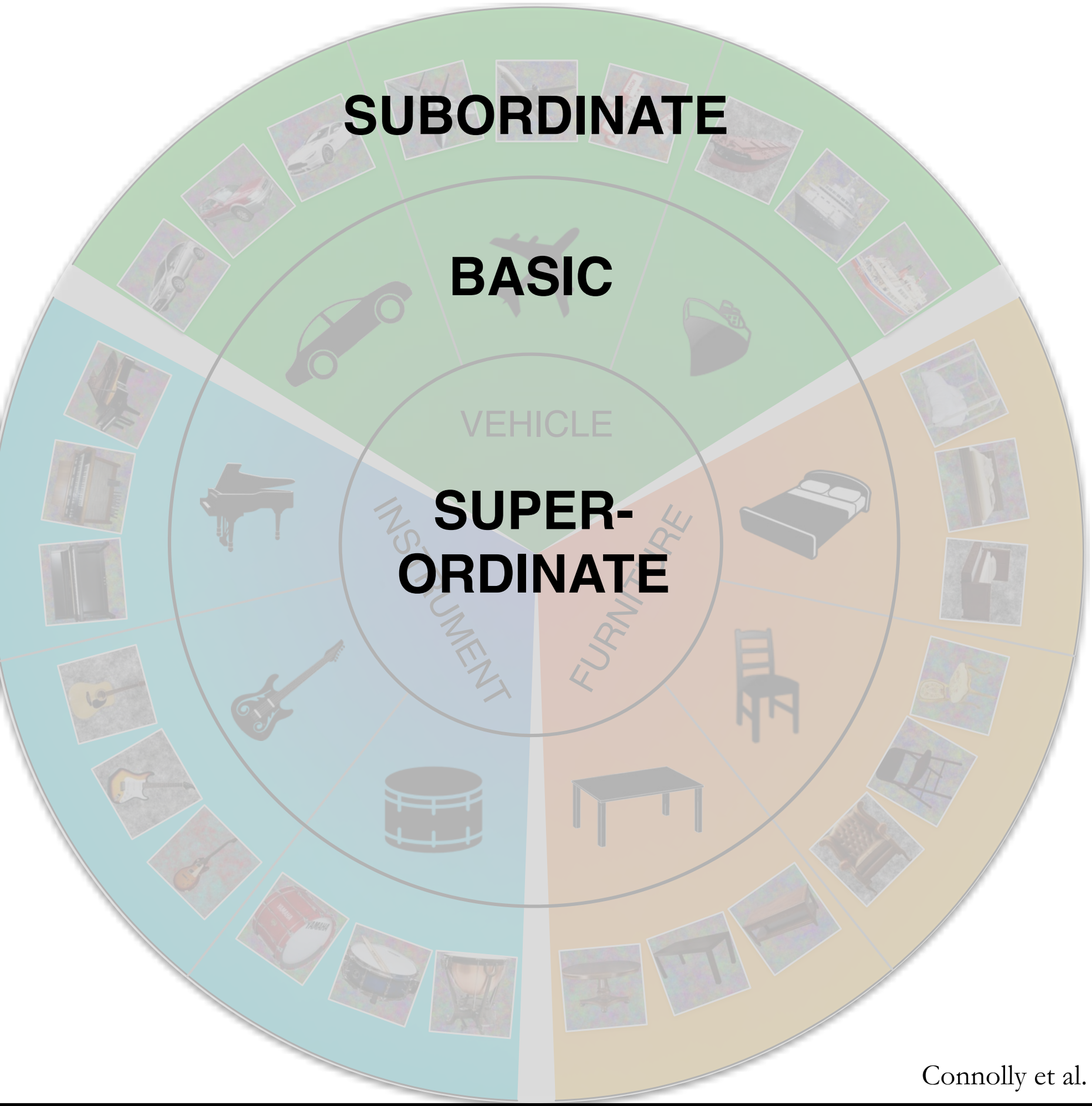
Connolly et al. (2012), Konkle & Caramazza (2013)



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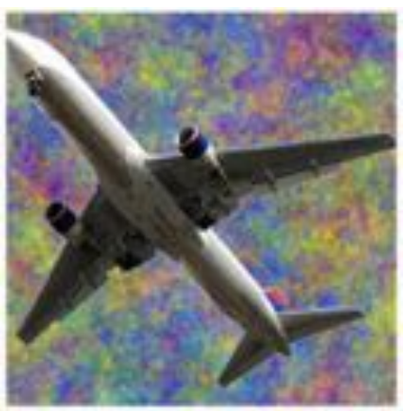
How category representations change across taxonomic levels in human visual cortex

1. **Experimental Setup**
    - stimulus sets & fMRI scanning
2. **Similarity of Neural Patterns**
    - within- and between-category similarity
3. **Category Information at Each Taxonomic Level**
    - MVPA decoding

Category Boundary Effect: Basic Level Example



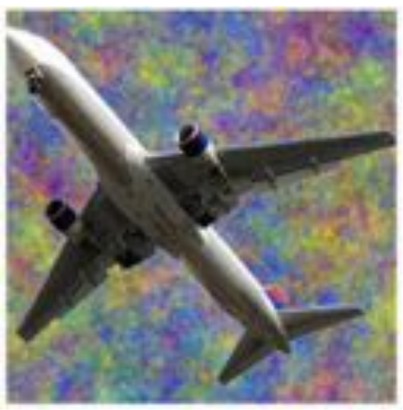
Within-Category Similarity

A

Cohesion

Category Boundary Effect
=
mean(A) – mean(B)

computed separately
for each
taxonomic level



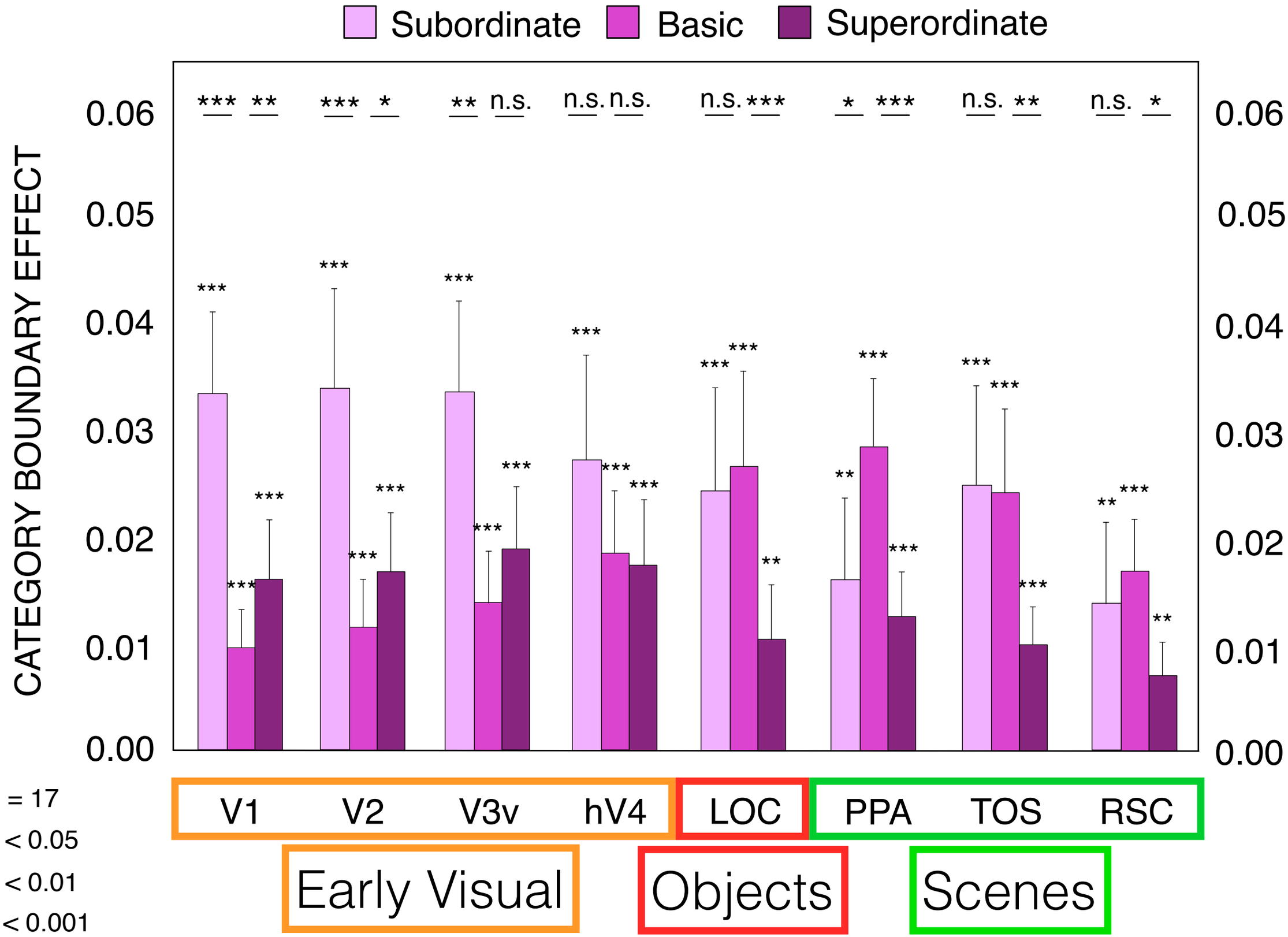
Between-Category Similarity

B

Distinctiveness

Kriegeskorte et al. (2008)

Category Boundary Effect: Results



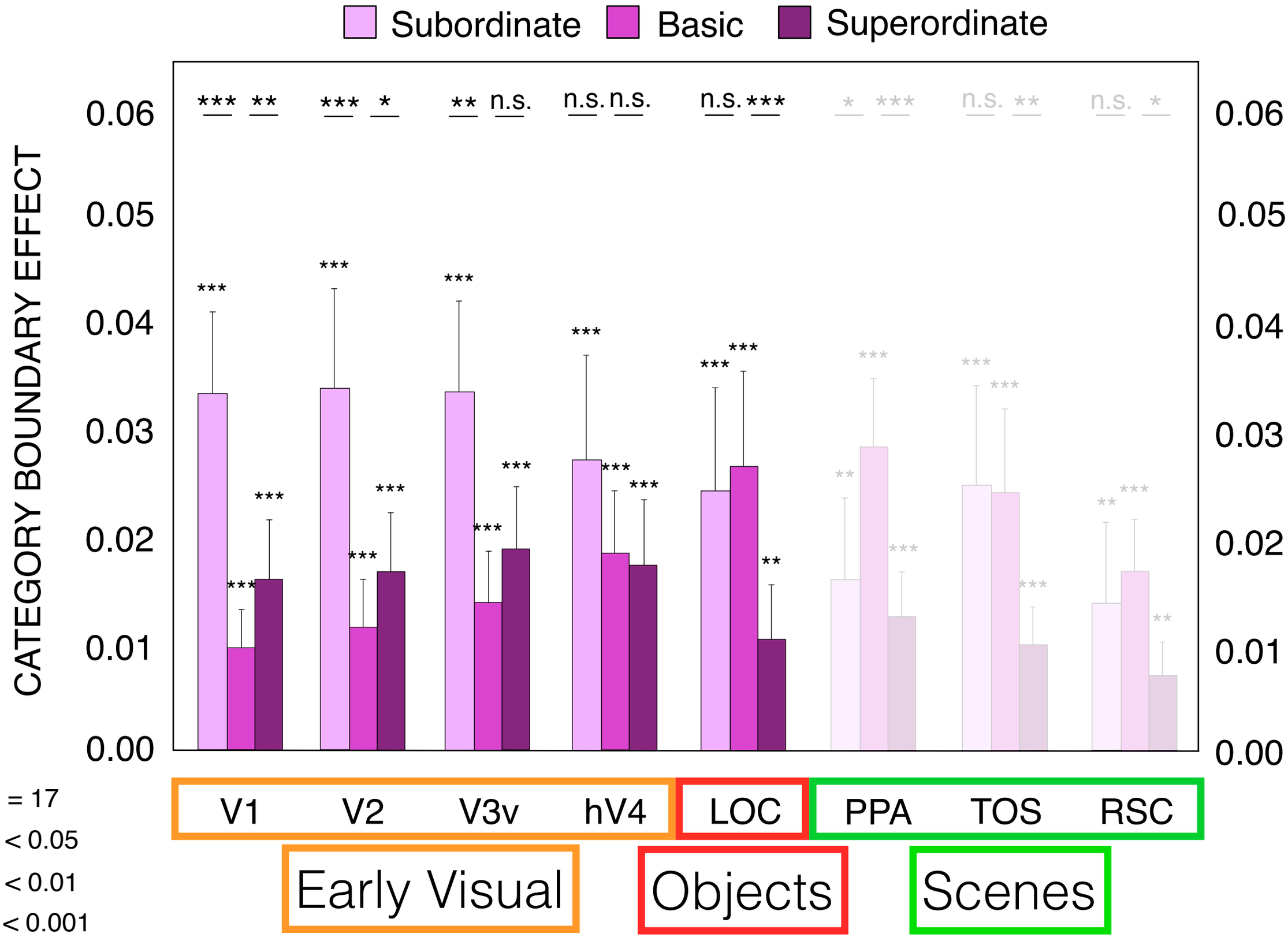
n = 17

* p < 0.05

** p < 0.01

*** p < 0.001

Gradual trade-off in favor of the basic level



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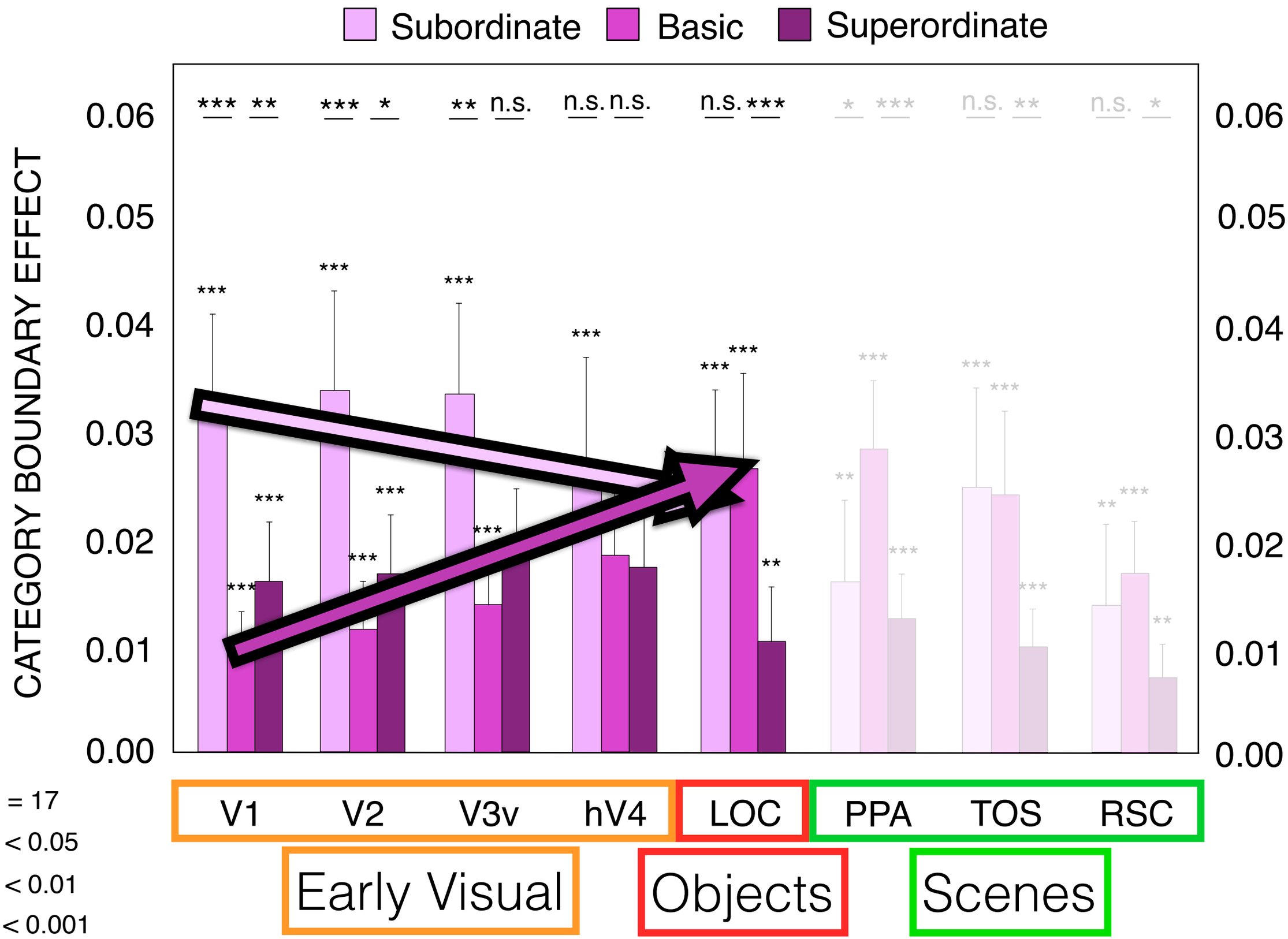

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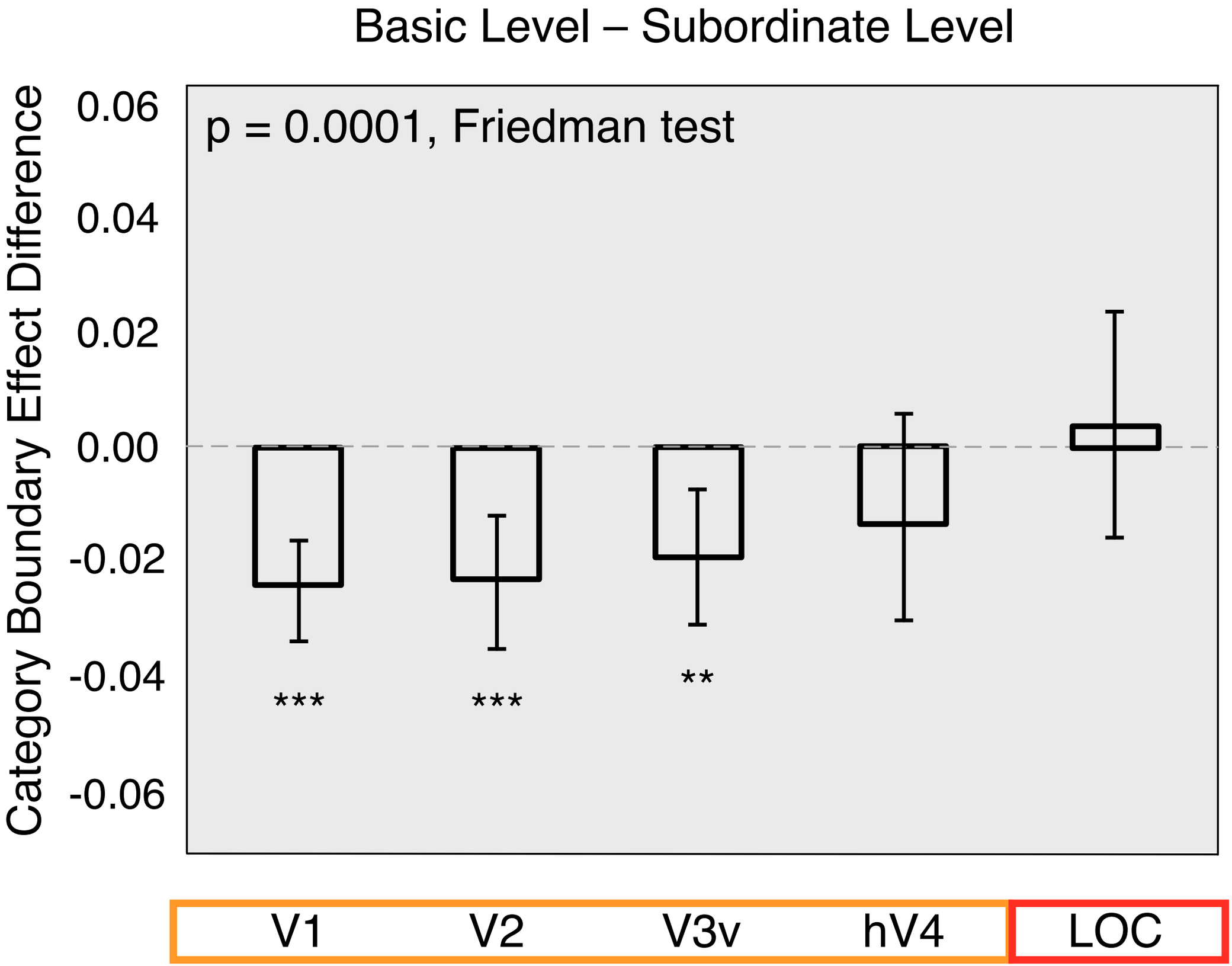

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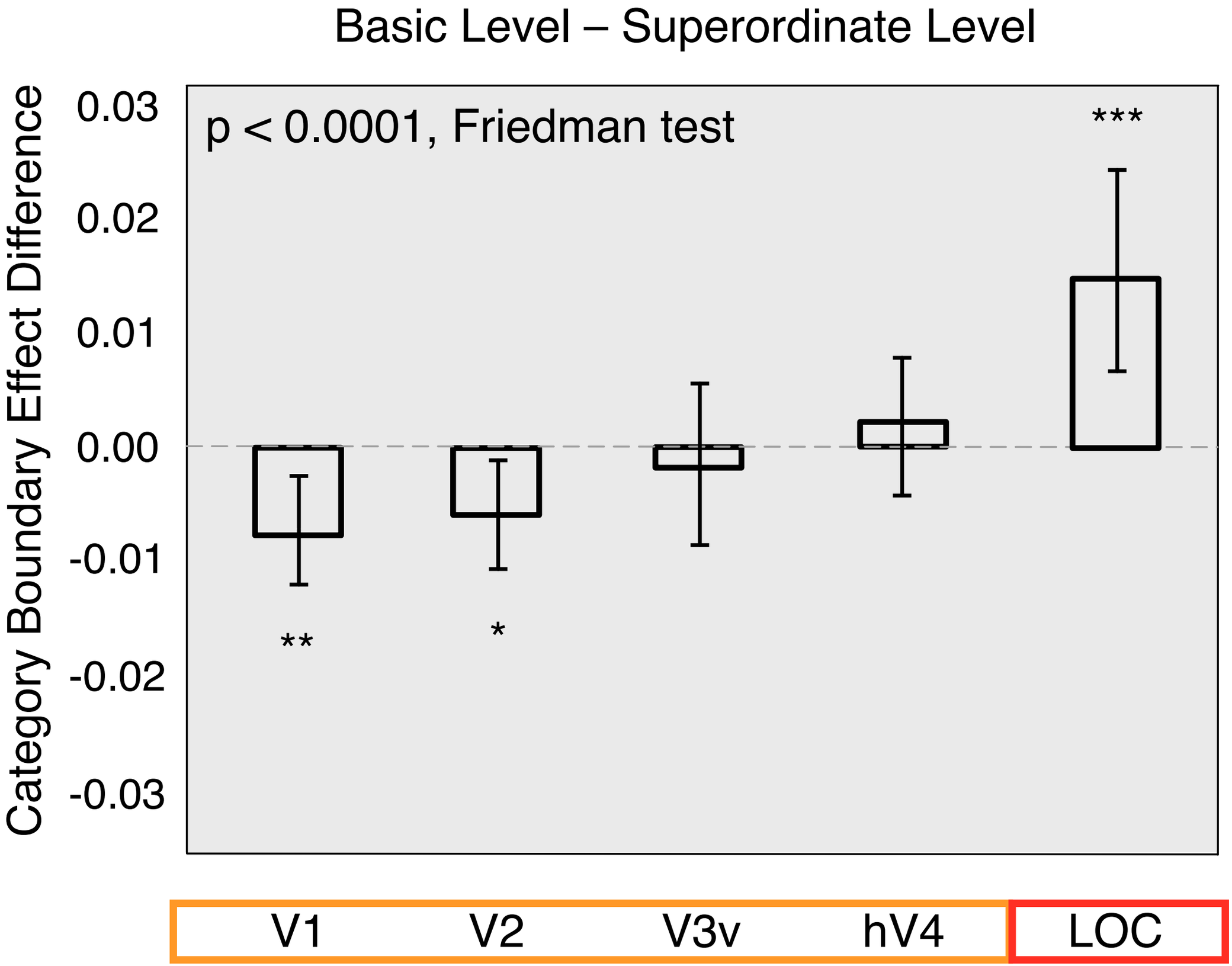

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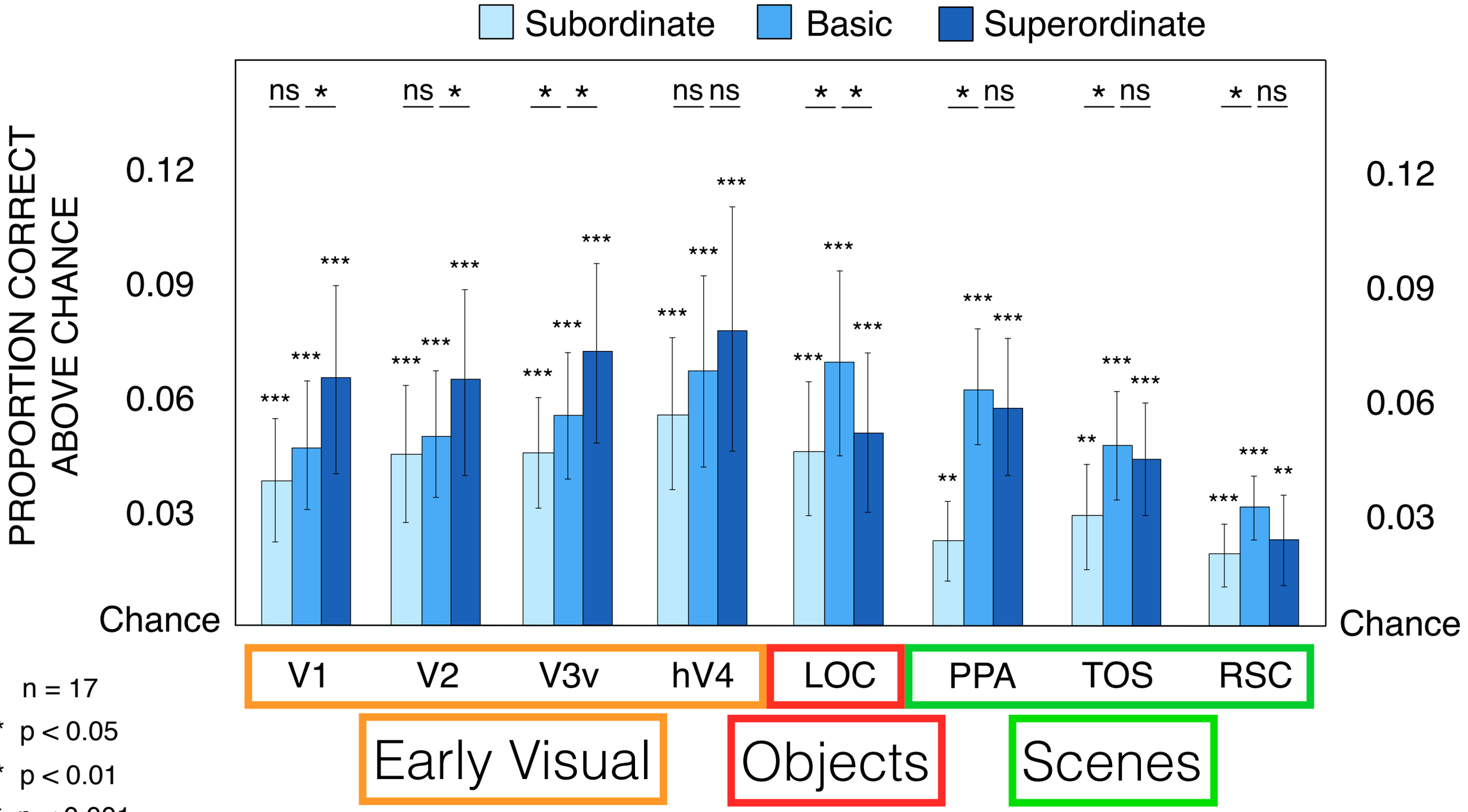
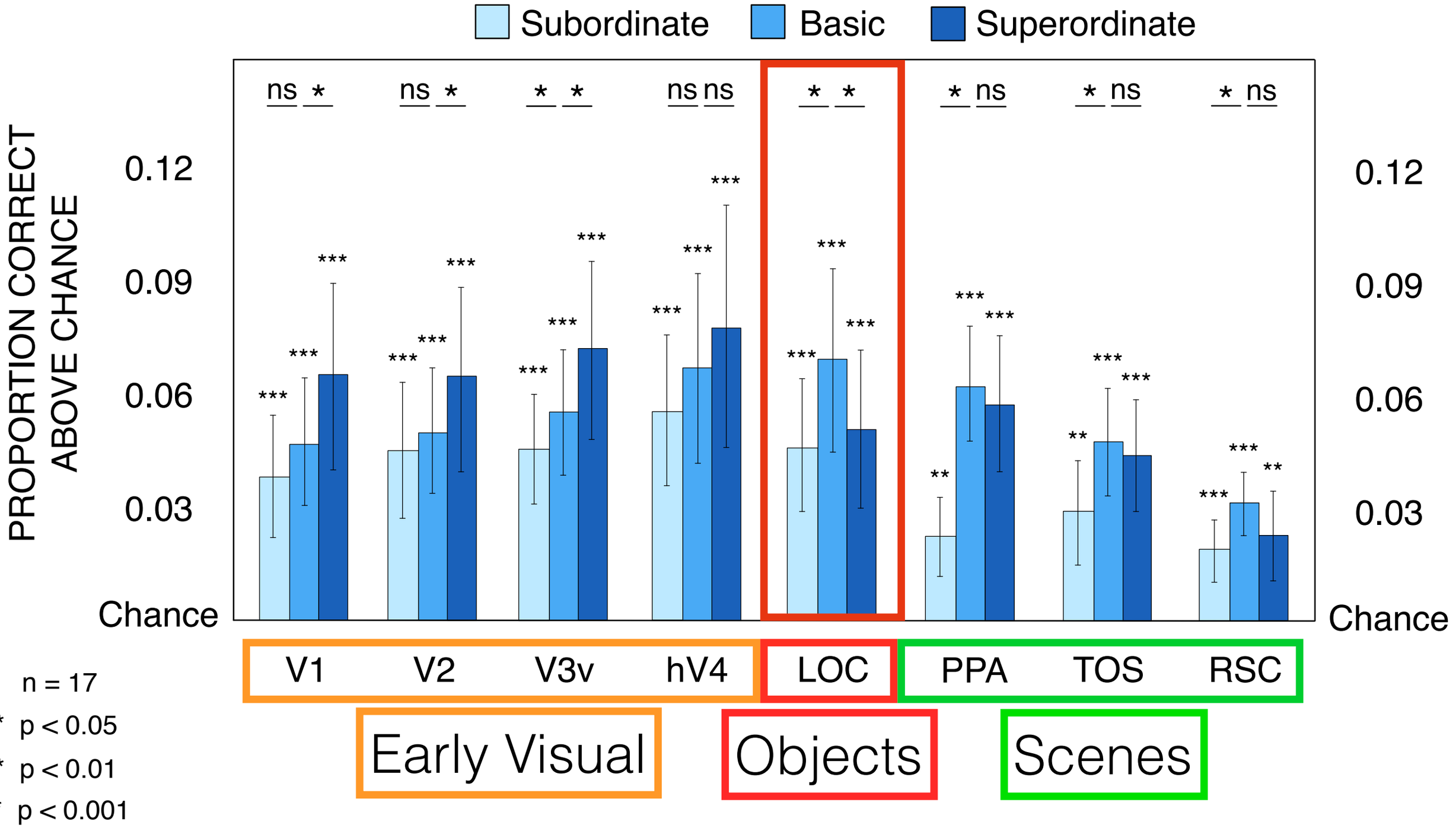
MVPA Decoding: Results

decode category at each taxonomic level independently



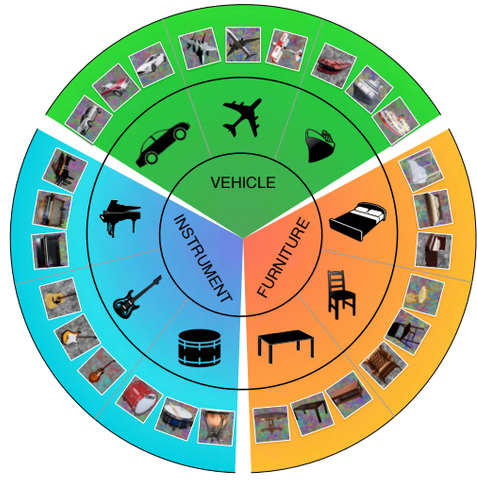
Basic level is the optimal level of specificity in LOC

decode category at each taxonomic level independently



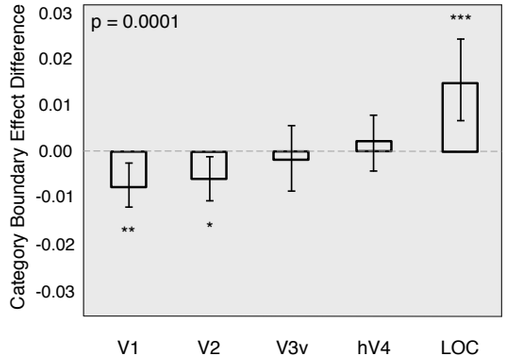
How category representations change across taxonomic levels in visual cortex

real-world object taxonomy
with behavioral basic level advantage

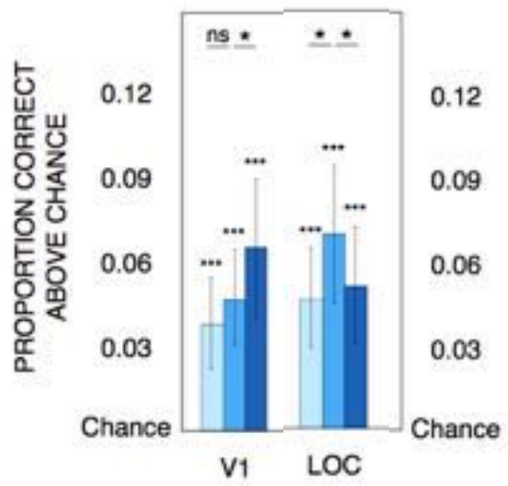


Basic Level – Superordinate Level

gradual trade-off between basic and other levels
in favor of the former

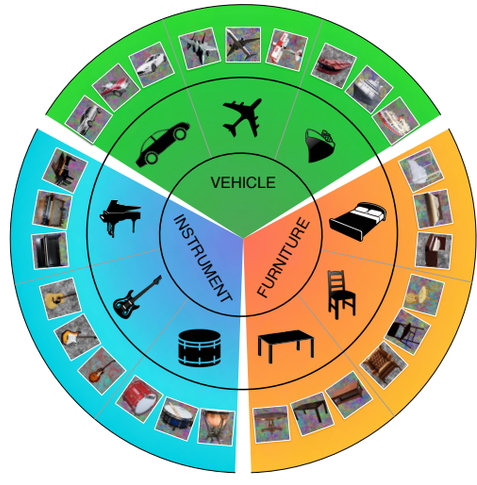


basic level is optimal level of specificity
decodable from LOC patterns



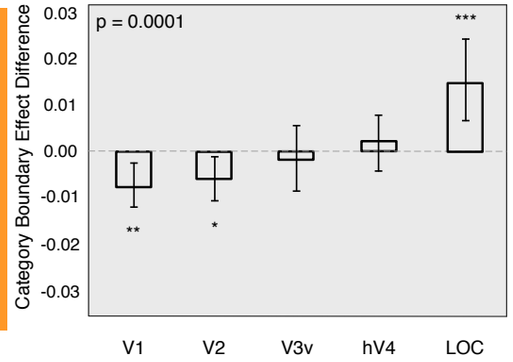
How category representations change across taxonomic levels in visual cortex

basic level representation may be an emergent property of the visual system

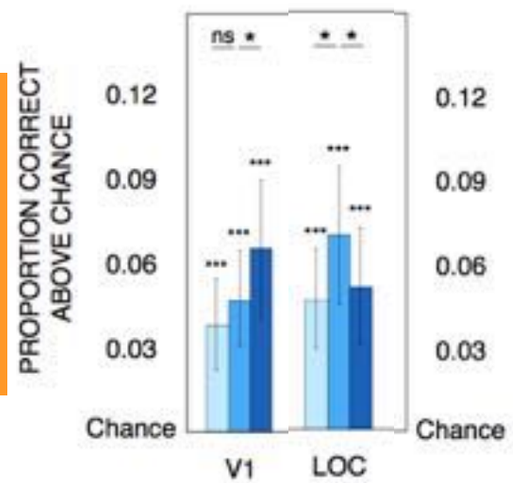


Basic Level – Superordinate Level

high-level visual areas may share computations geared at specifically separating categories



categorization may be part of visual processing



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