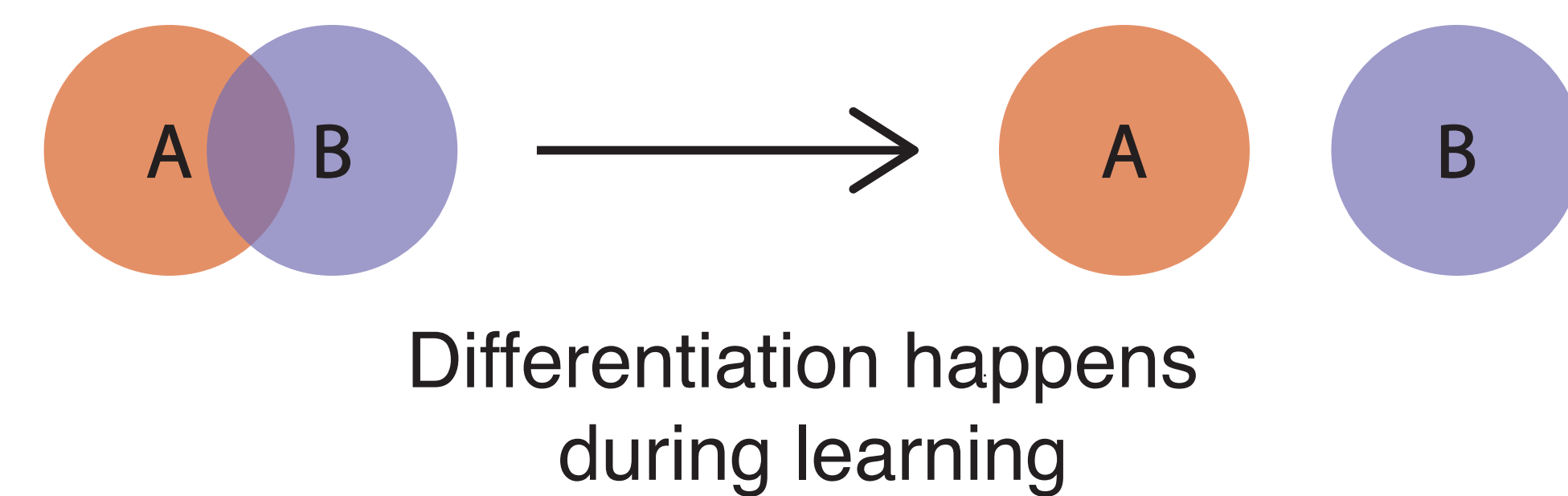# Competition induces exaggeration in human memory

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Introduction

- Feature overlap between memories triggers neural differentiation. [1,2,3]
  - Overlapping memories' neural representations can become less similar than non-overlapping memories'.
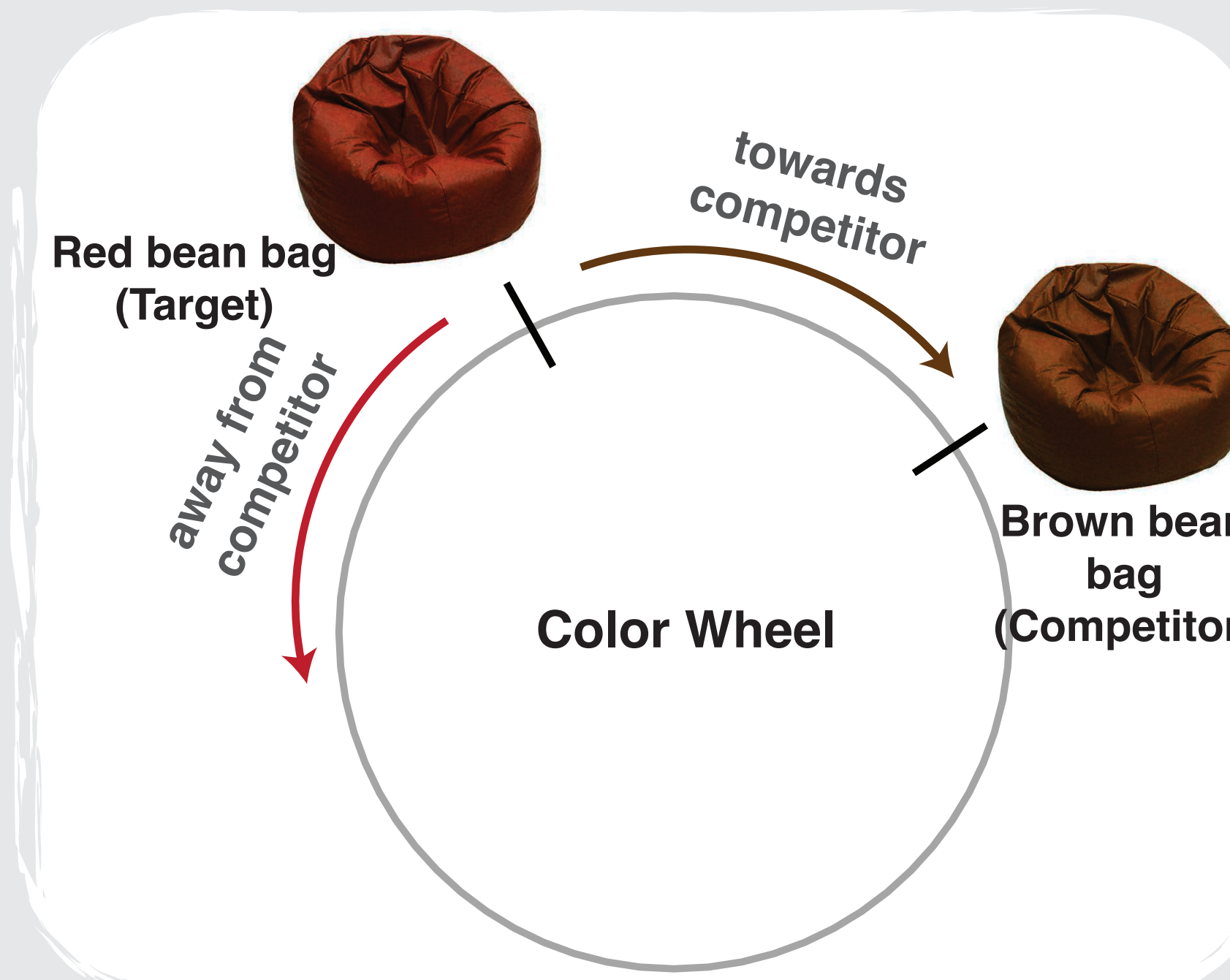- Differentiation is thought to be adaptive (less interference).[2]

Differentiation happens during learning

If neural representations are exaggerated, are the memory features exaggerated?

Method

Approach Use a memory feature that is continuous and can be reported

Stimuli

1. Select colors every 24 degrees along the color wheel
2. Create same-object-of-similar-colors pairs
3. Pair each object with a unique neutral male face

48 72 96 120 144 168
Color wheel(degree)

Procedure

Session 1
14 runs of study and test phase
Study phase

Associative memory test phase

D F J K
Other Target Other Competitor

Session 2
2 runs of surprise color memory test

Move the cursor to change the color of the object

Subjects

n = 34 after excluding 11 subjects who chose **other** faces on more than **2%** of trials in the last 4 runs of the associative memory phase

Behavioral Results

Measures for the color memory test

1. Color bias

Red bean bag (Target)
towards competitor
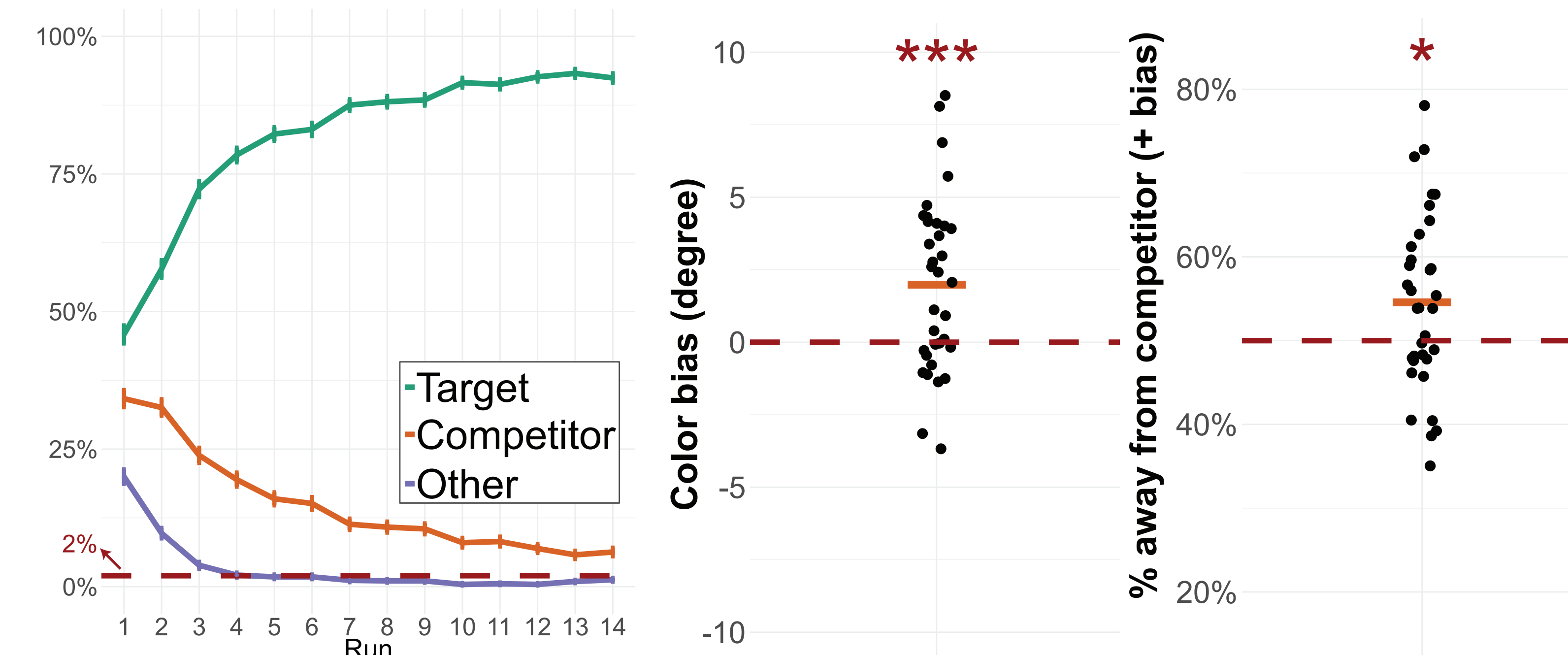away from competitor
Brown bean bag (Competitor)
Color Wheel

+ bias / away from competitor
Distance between the true color and the color chosen by the subject
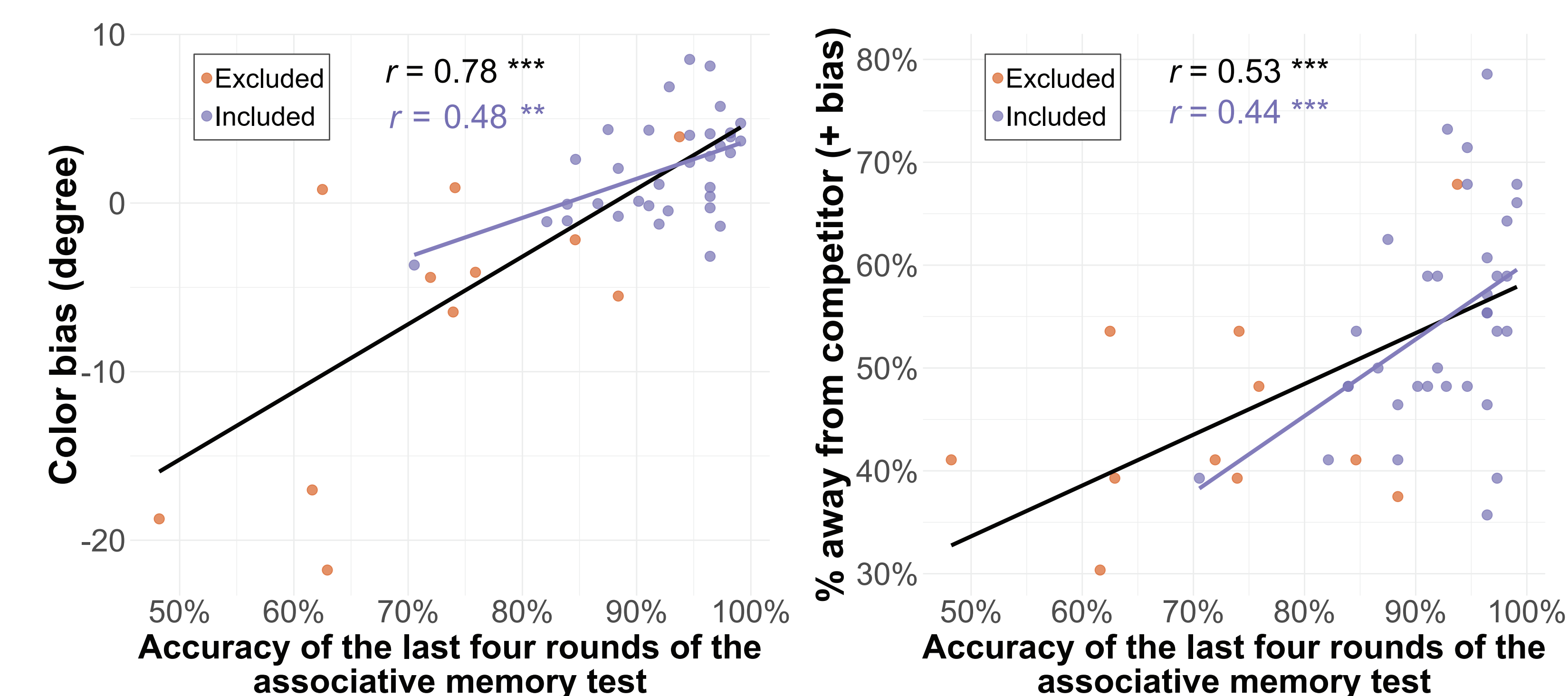0
- bias / towards competitor

2. Percentage of away from competitor (+ bias)

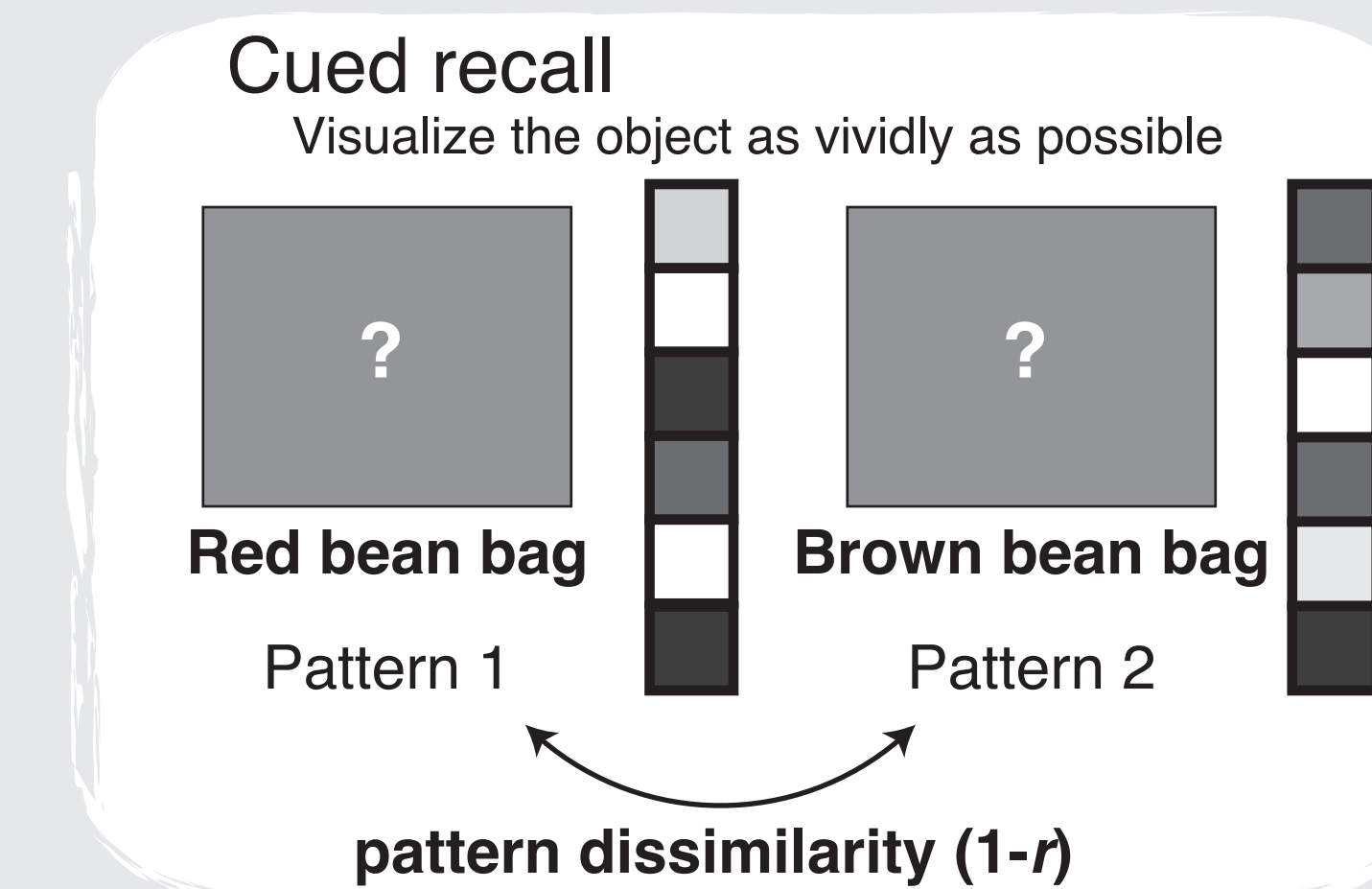- **Associative memory test**   **Color memory test**

***   *

- **Color repulsion is adaptive:**
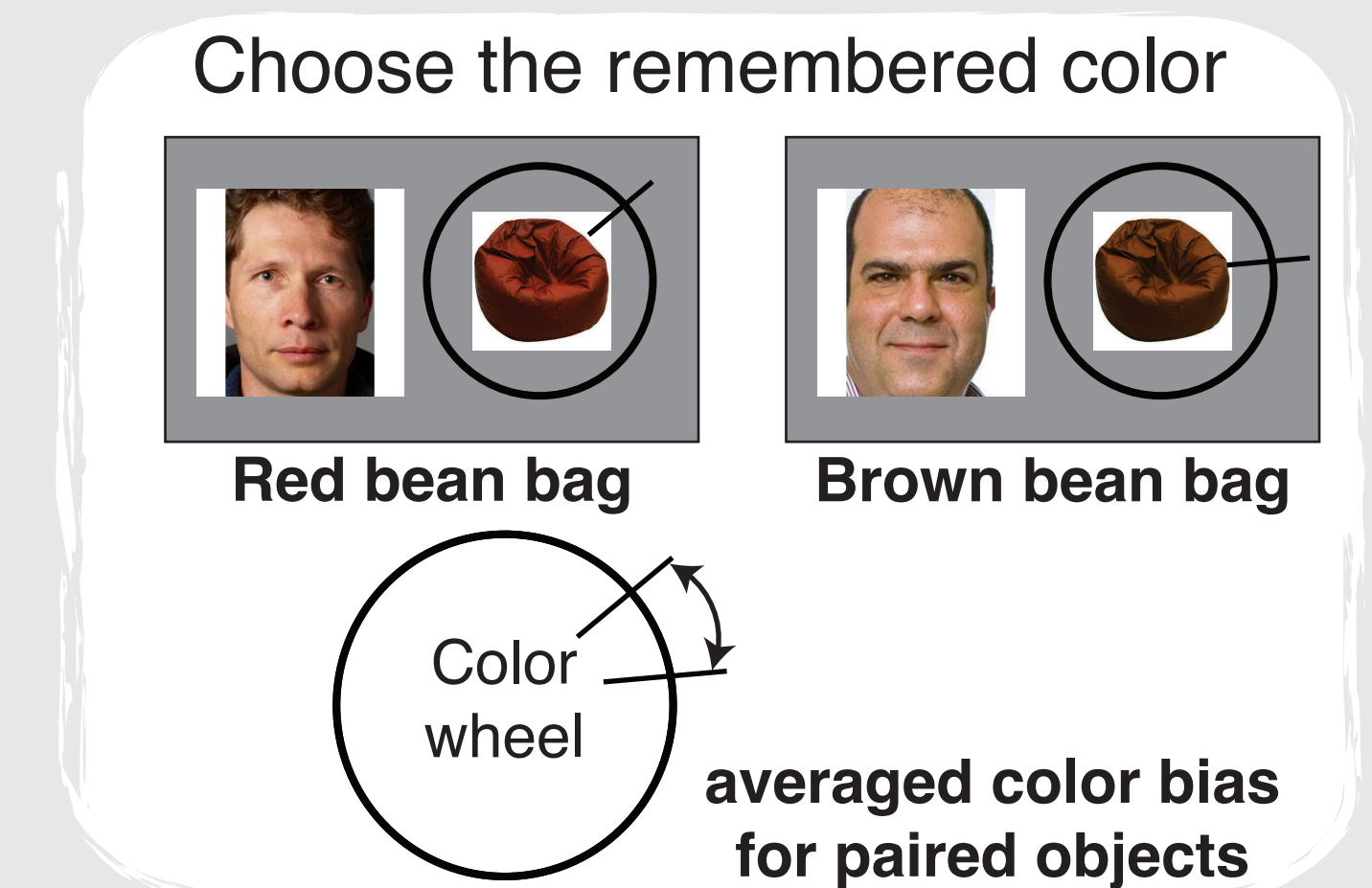 *Greater color repulsion = Better associative memory*

r = 0.78 ***
r = 0.48 **
Excluded Included

r = 0.53 ***
r = 0.44 ***
Excluded Included

Accuracy of the last four rounds of the associative memory test

fMRI study

Design

In scanner   **Post test**

Cued recall
Visualize the object as vividly as possible

Red bean bag Brown bean bag
Pattern 1 Pattern 2

pattern dissimilarity (1-*r*)

Choose the remembered color

Red bean bag Brown bean bag
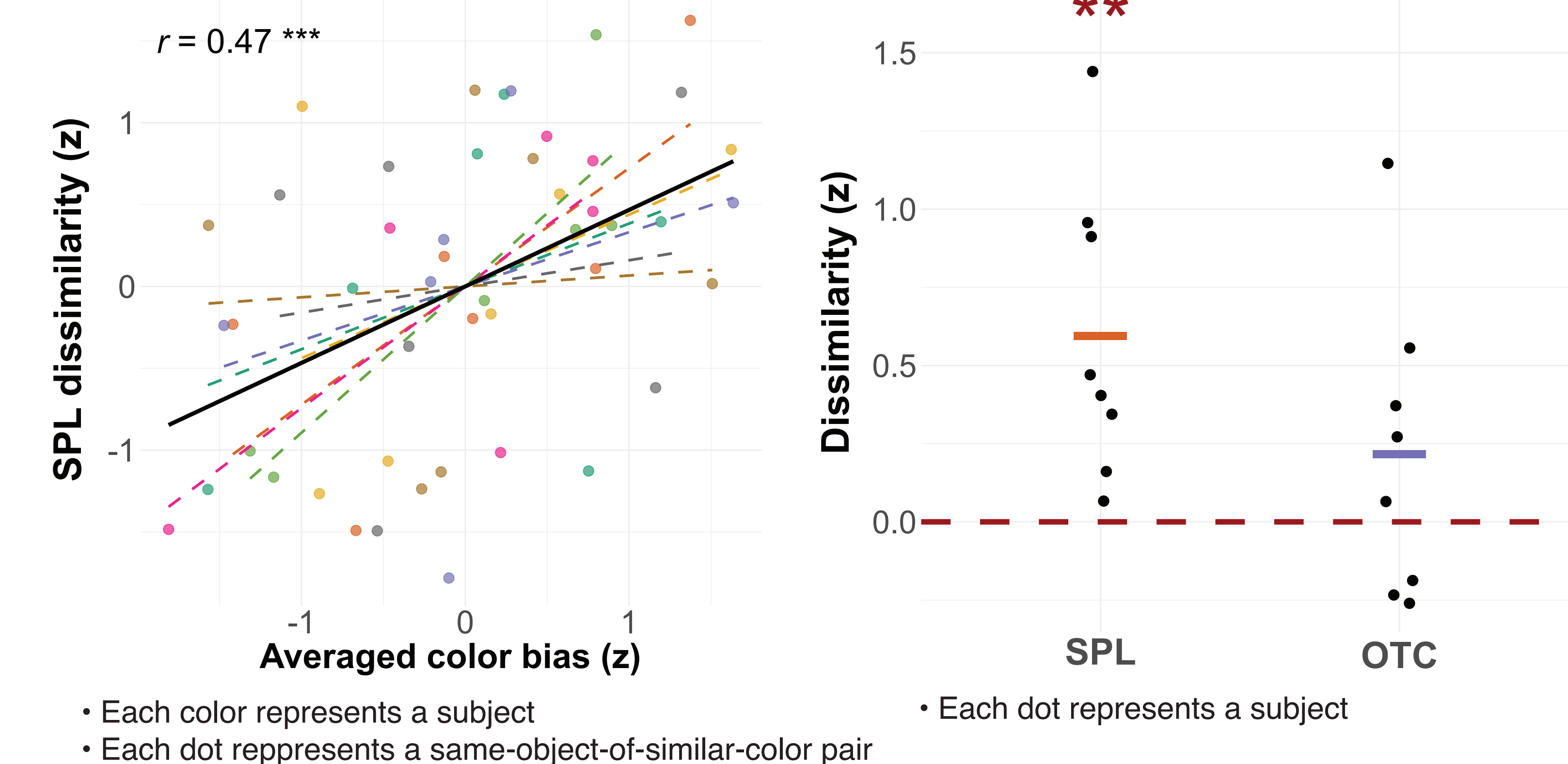
Color wheel
averaged color bias for paired objects

Subjects   n = 8

- **Color repulsion predicts dissimilarity in parietal cortex during retrieval**

SPL = Superior Parietal Lobule; OTC = Occipitotemporal Cortex

r = 0.47 ***

Averaged color bias (z)

**

SPL OTC

- Each color represents a subject
- Each dot reppresents a same-object-of-similar-color pair
- Each dot represents a subject

Greater color repulsion = Greater dissimilarity of SPL patterns

Discussion

- Overlap triggers repulsion of feature memory.
- Repulsion of features is adaptive.
- Parietal cortex tracks repulsion of retrieved memories.
  - Consistent with prior evidence at adaptive feature repulsion in parietal cortex.[4]

References

1. Hulbert & Norman (2014). *Cerebral Cortex*
2. Favila, Chanales & Kuhl (2016). *Nature communications*
3. Chanales, Favila & Kuhl (2017). *Current Biology*
4. Favila, Samide, Sweigart, & Kuhl (2018). *Journal of Neuroscience*
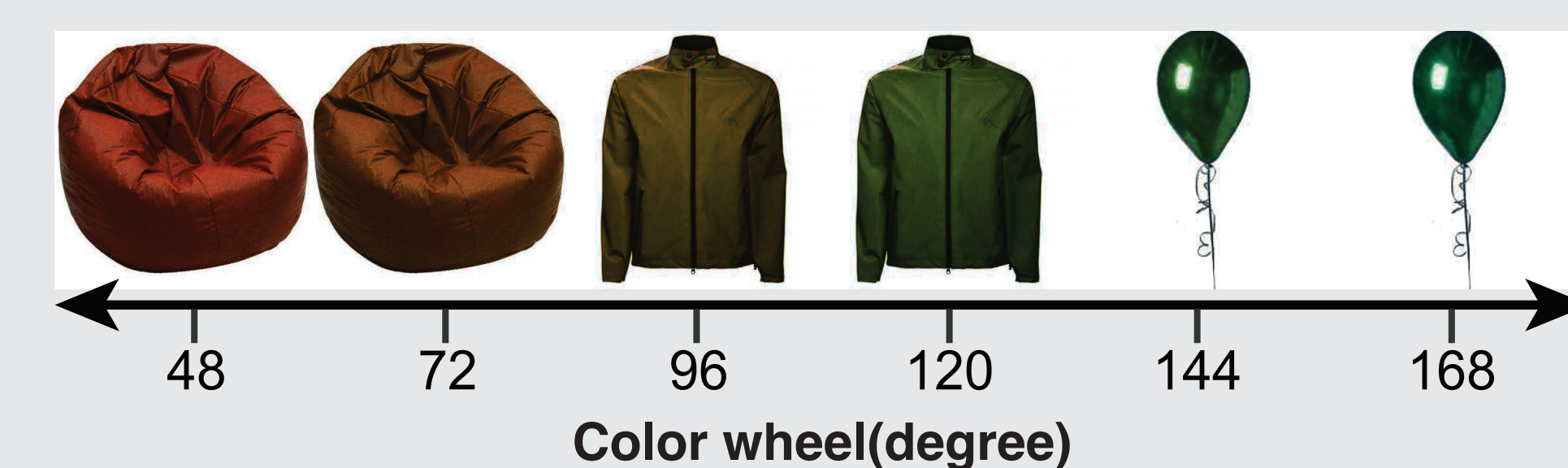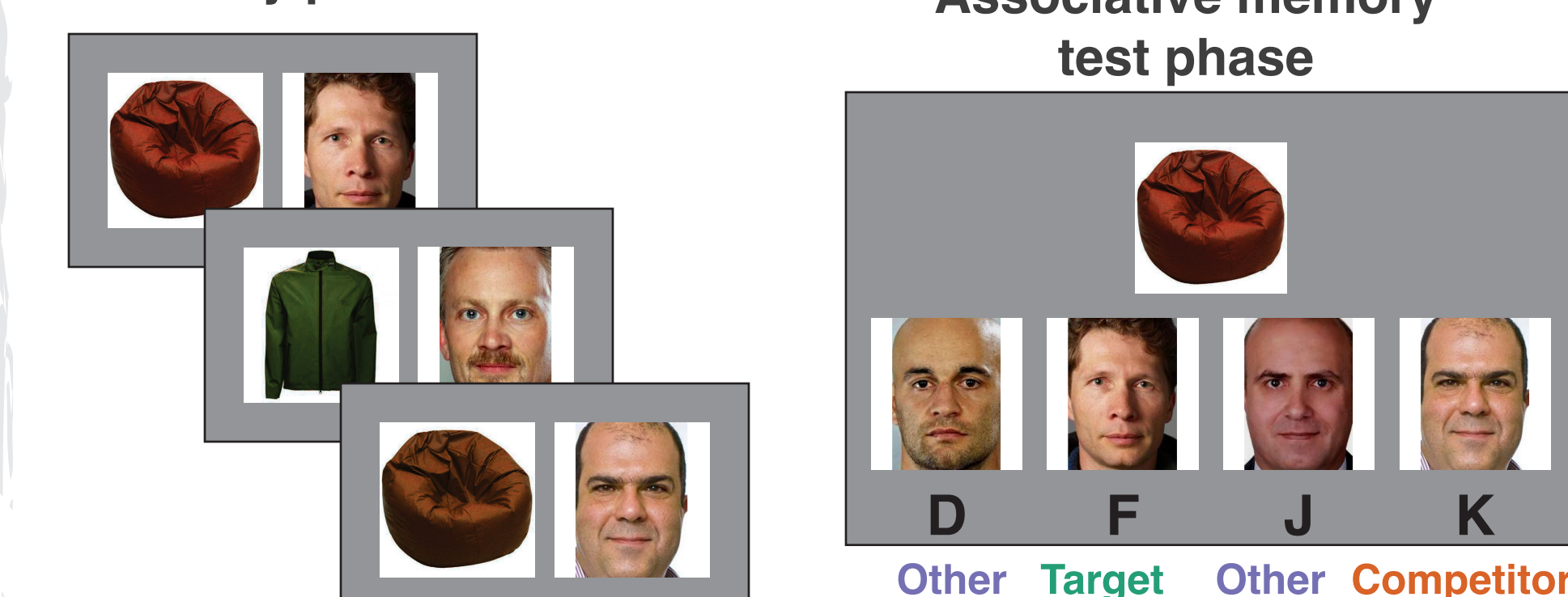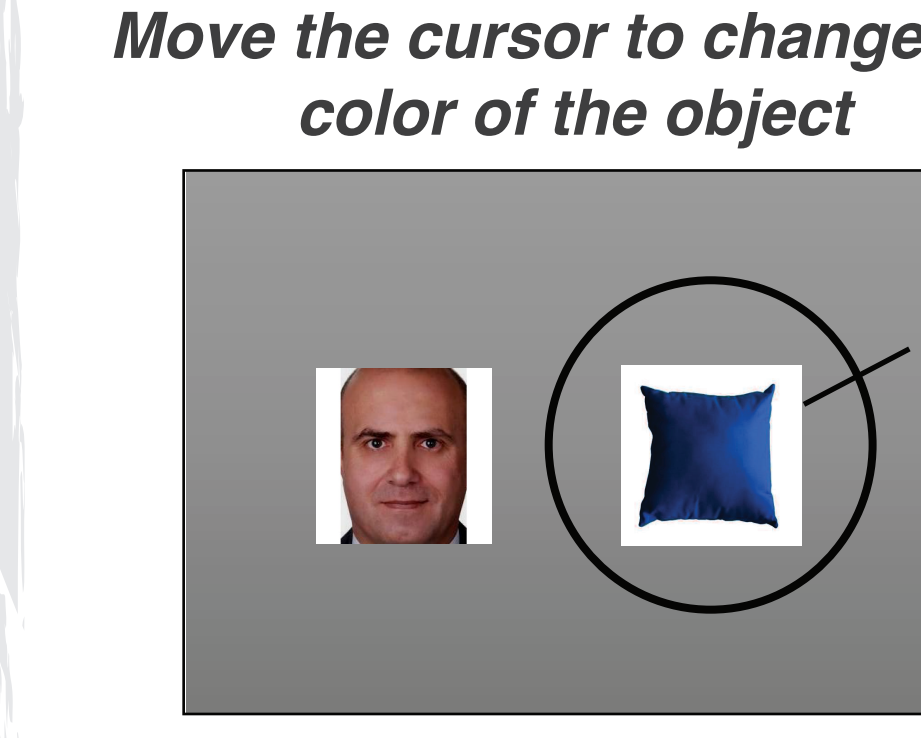
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