

# Repulsion of Similar Memories Measure via Natural Language Processing of Verbal Recall

Anisha S. Babu<sup>1</sup>, Zhifang Ye<sup>1</sup>, Brice A. Kuhl<sup>1</sup>

<sup>1</sup>Psychology Department, University of Oregon



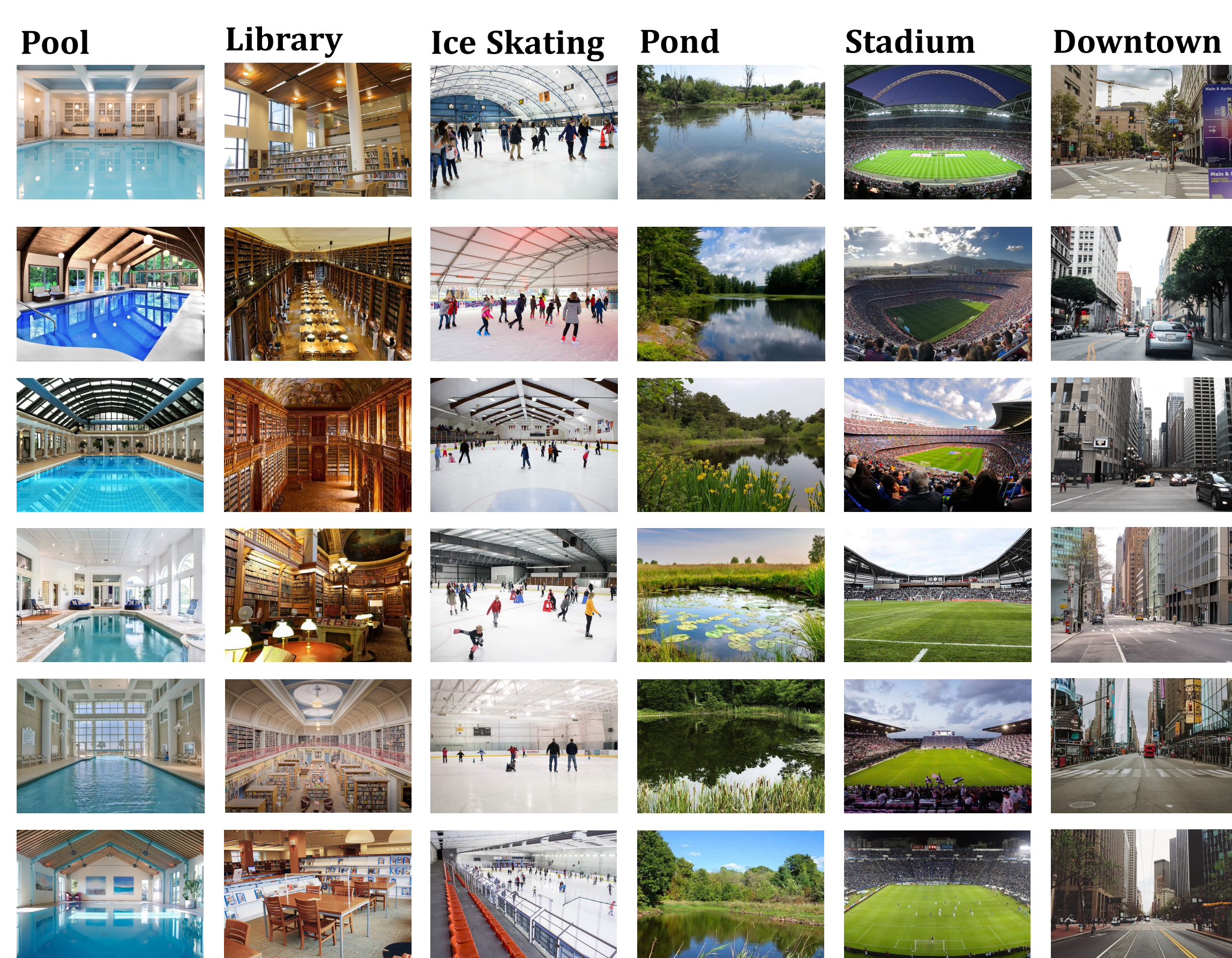
## Background

- ❖ Hippocampal representations for highly similar memories move apart with learning (i.e., repulsion)<sup>1</sup>
- ❖ It is not clear how these changes in hippocampal representations relate to *memory content*
- ❖ Evidence indicates that simple stimulus features (e.g., color) exhibit repulsion-like effects in behavioral expressions of memory<sup>2,3,4</sup>

Goals of the current study

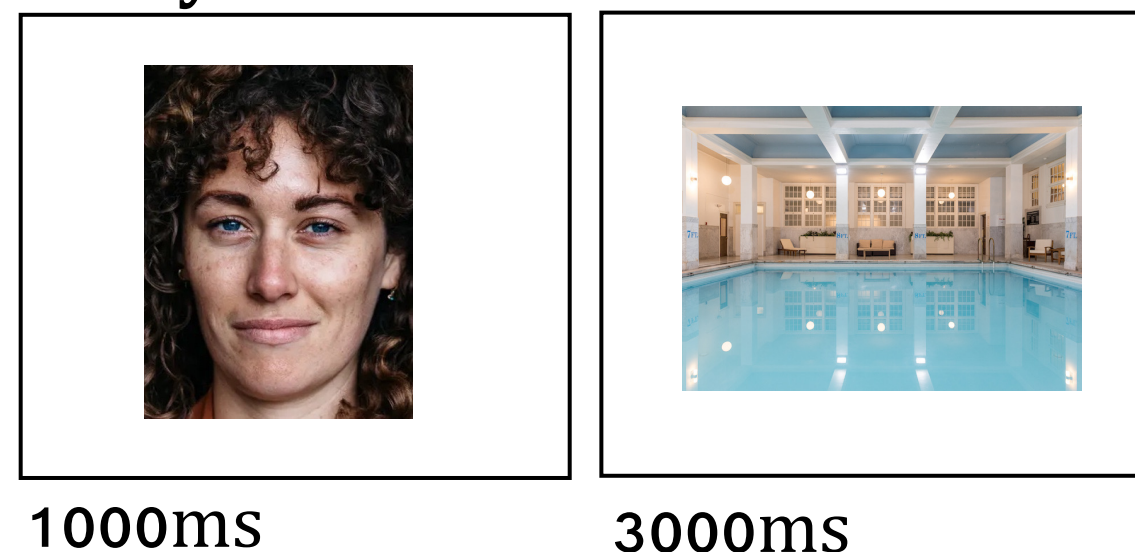
1. Use Natural Language Processing (NLP) algorithms to test for repulsion effects in verbal recall of similar memories (**Study 1**)
2. Use fMRI to test for repulsion in hippocampal representations and potential relationship to repulsion in verbal recall (**Study 2**)

## Study 1: Behavioral Experiment



↑ Column: Competitive Condition  
→ Row: Non-Competitive Condition

Study Trial:



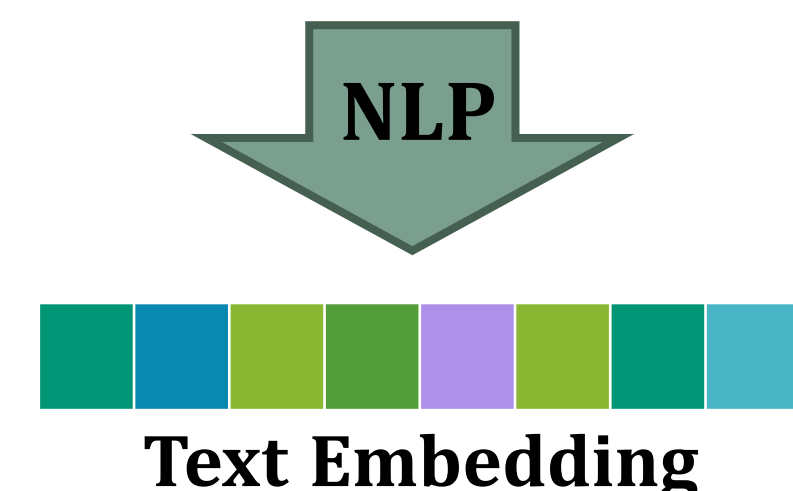
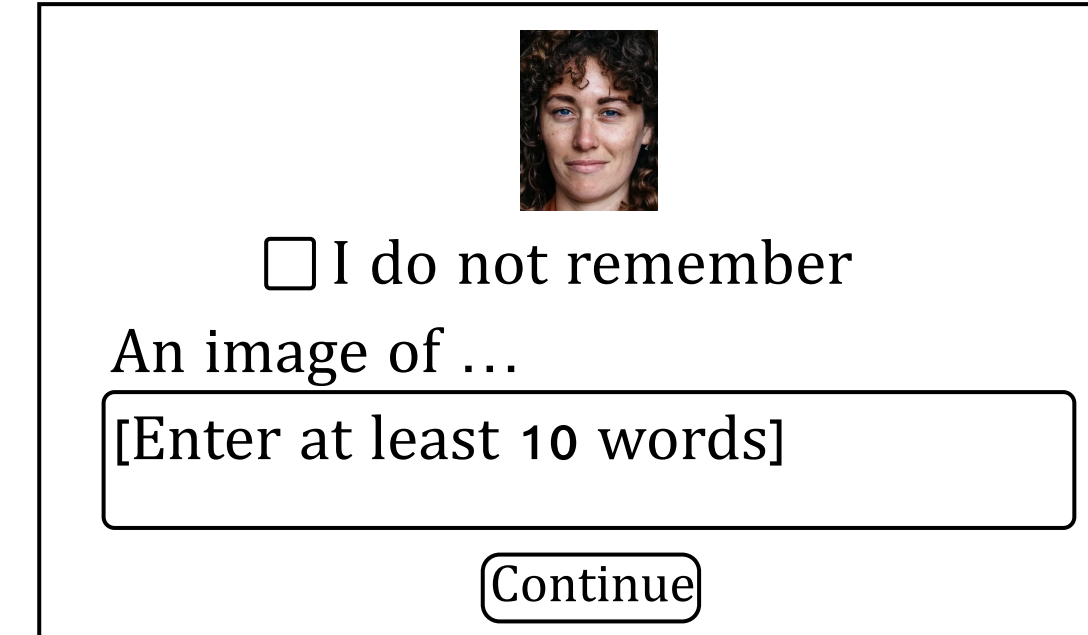
1000ms 3000ms

Vividness Trial:

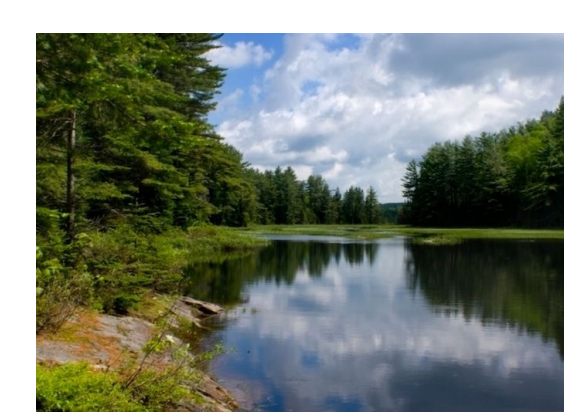


1000ms 1500ms  
(Vivid/Weak/No Memory)

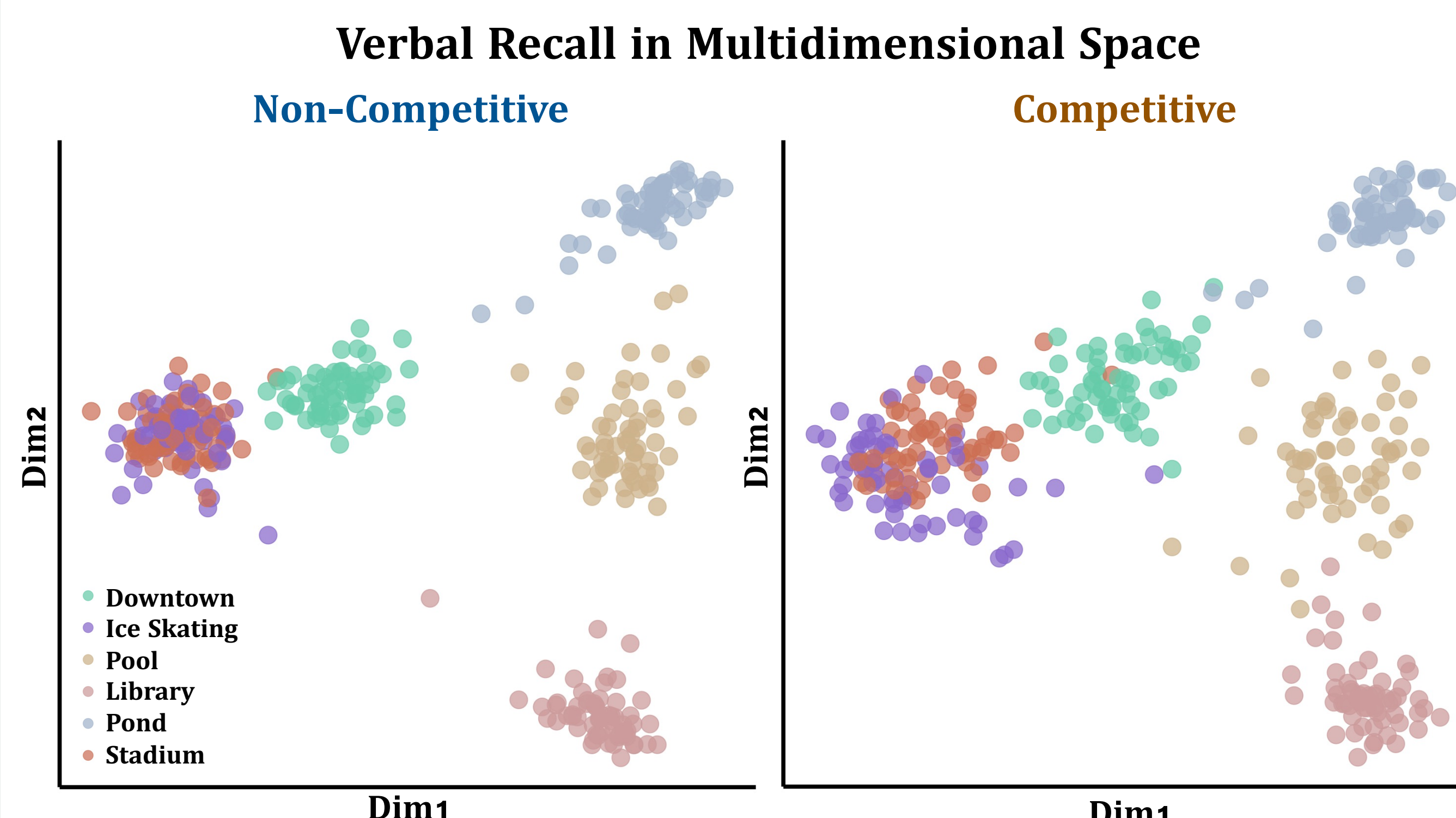
Written Recall Test:



## Study 1: Verbal Recall

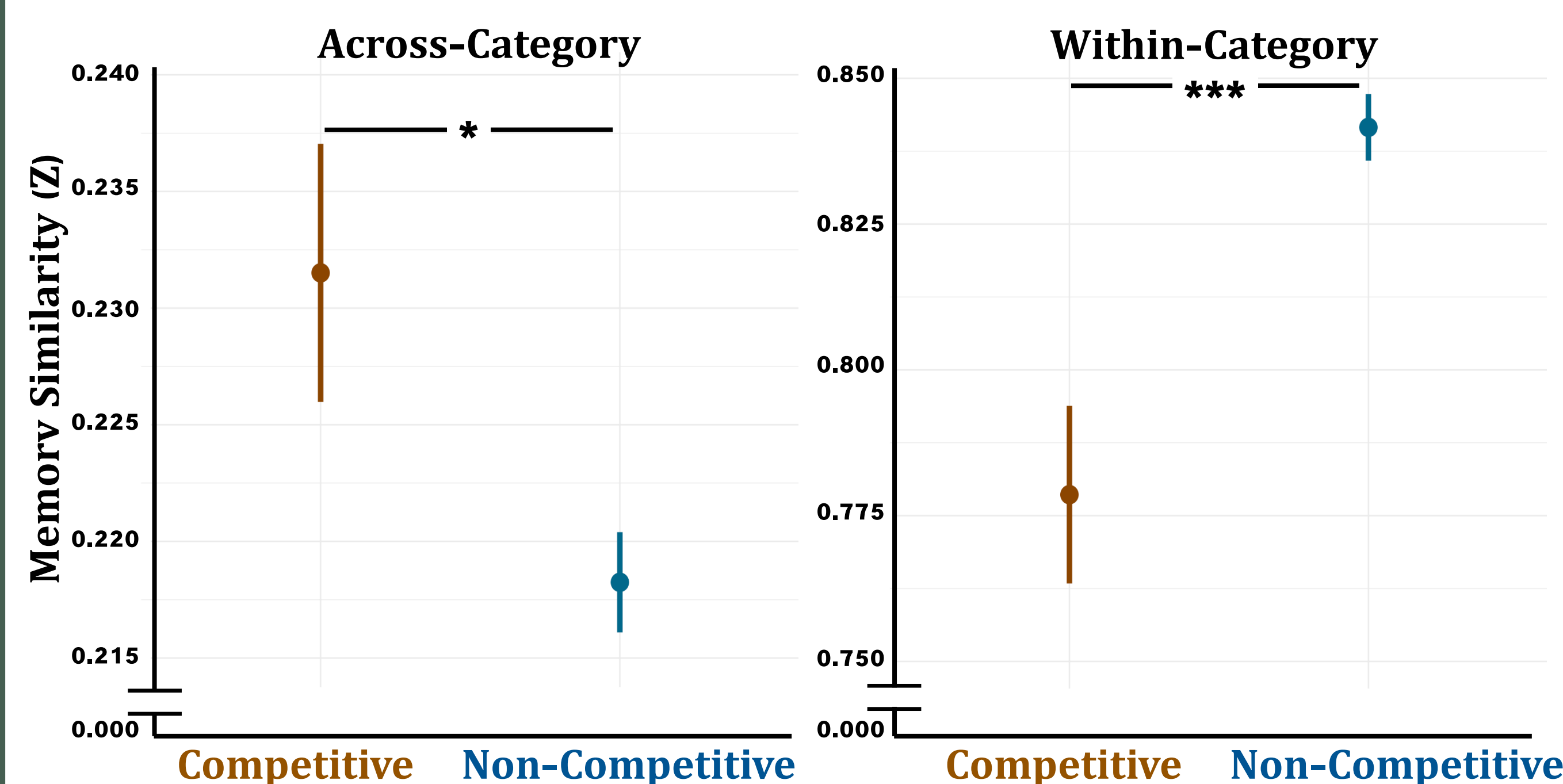
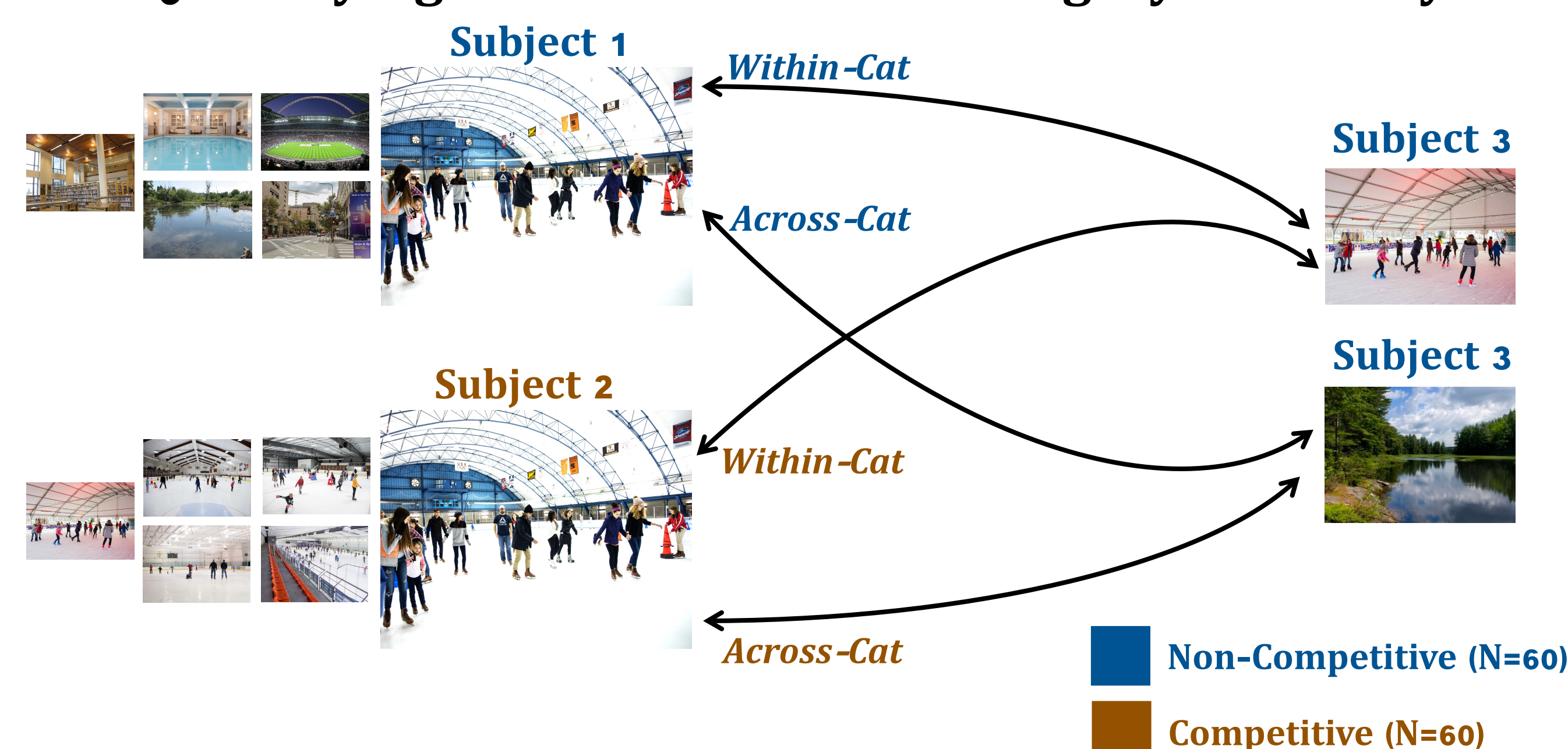


Representative Description:  
"A large lake with a flat rock on the bottom left, algae near the top as well as trees surrounding the lake."



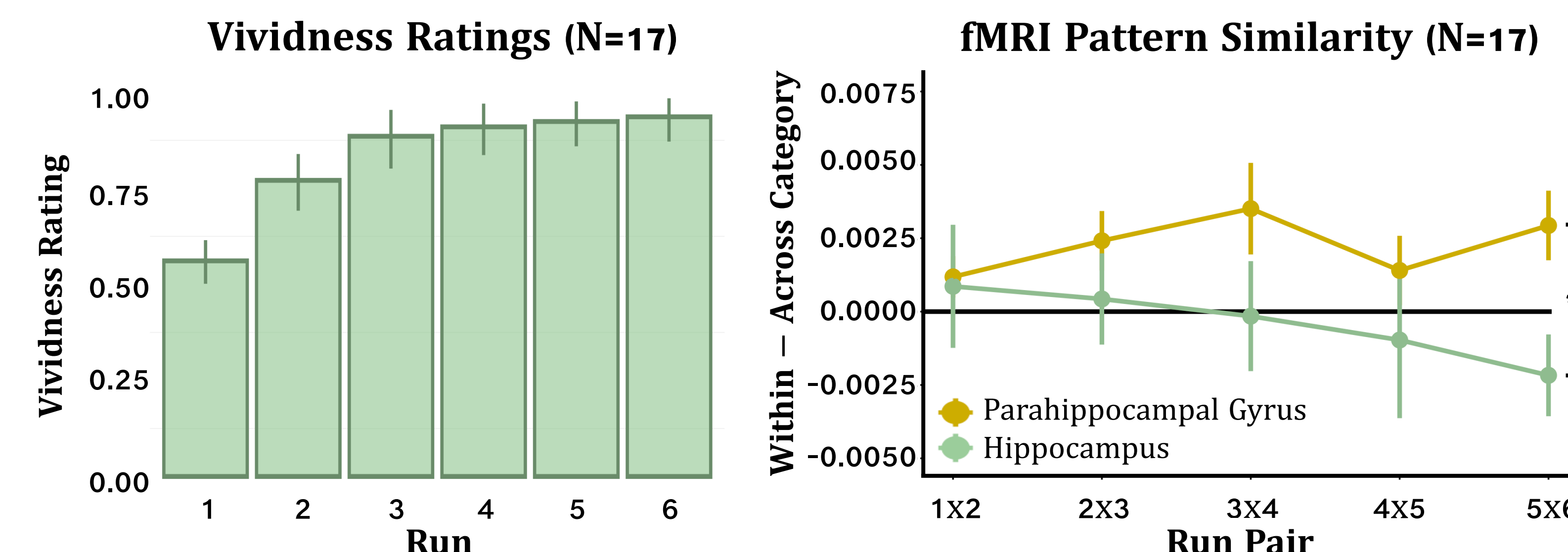
Increased dispersion within categories for competitive compared to non-competitive verbal recall

## Quantifying Within- vs. Across-Category Similarity



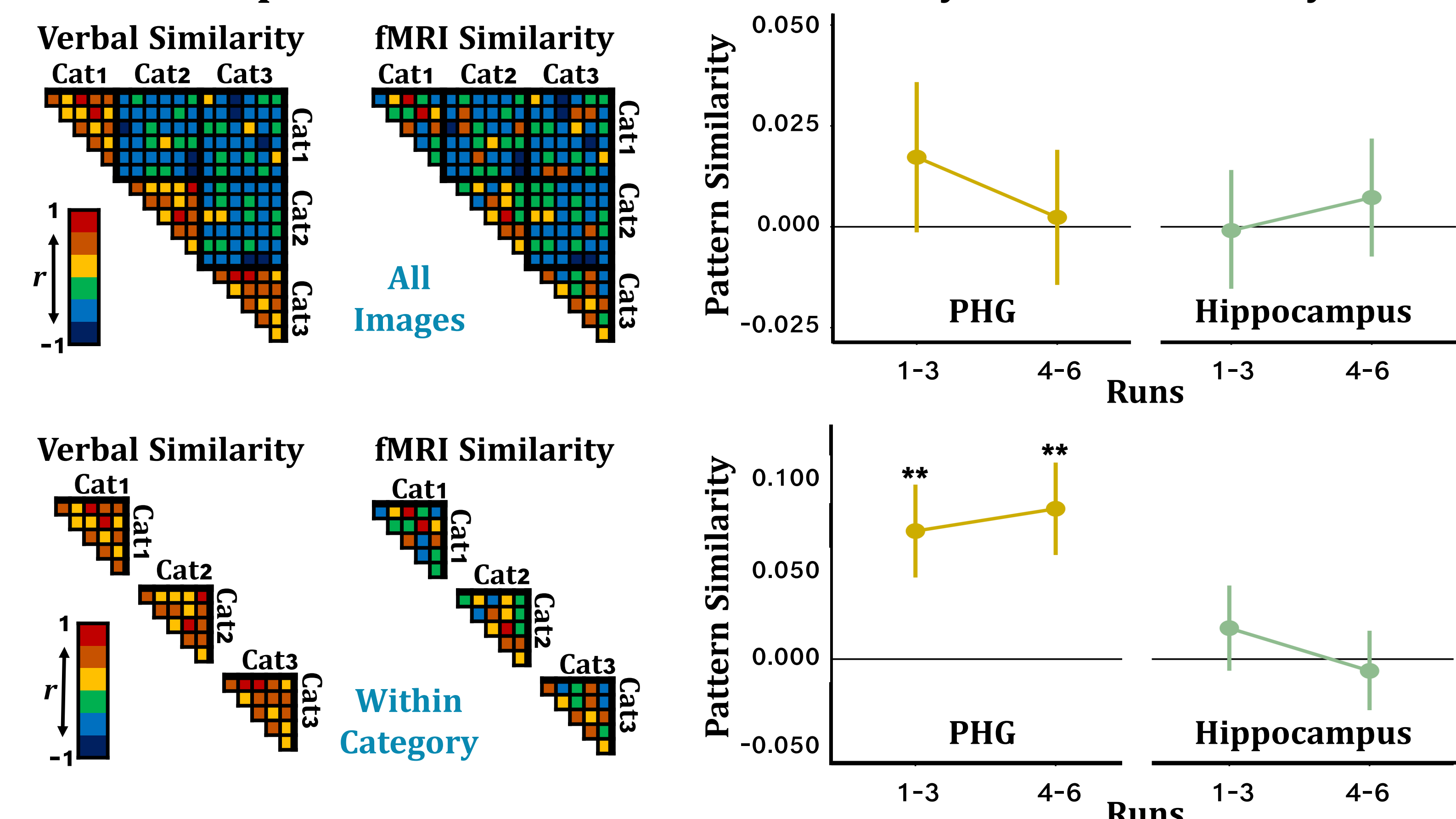
Lower within-category similarity for competitive condition compared to non-competitive condition indicates repulsion effect in verbal recall

## Study 2: fMRI + Verbal Recall



Across learning: increase in subjective memory vividness coincides with relative decrease in within-category similarity in hippocampus

## Relationship Between Verbal Recall Similarity & fMRI Similarity (N = 14)



Within-category representational structure of verbal recall is related to representational structure in parahippocampal gyrus, but not hippocampus

## Summary

- ❖ Natural Language Processing (NLP) can be used to quantify overlap in verbal recall for naturalistic scene stimuli
- ❖ Competition increases the representational distance between images within the *same* category – opposite to an interference or confusion effect
- ❖ Representational structure in the hippocampus diverges from parahippocampal gyrus with learning
- ❖ Representational structure of verbal recall (memory content) is related to structure in parahippocampal gyrus, but not in hippocampus
- ❖ It remains an open question how/whether hippocampal repulsion relates to the contents of memory

## References

[1] Wanjia G, Favila SE, Kim G, Molitor RJ, Kuhl BA. Nature Communications. 2021 Aug 10; 12(1):4816. [2] Chanales AJH, Tremblay-McGaw AG, Drascher ML, Kuhl BA. Psychol Sci. 2021 May;32(5):705-720. [3] Drascher ML, Kuhl BA. Psychon Bull Rev. 2022 Oct;29(5):1898-1912. [4] Zhao Y, Chanales AJH, Kuhl BA. J Neurosci. 2021 Mar 31;41(13):3014-3024.

Funding: R01 #NS107727 and R01 #NS089729 to B.A.K., F31 #1F31MH135686-01 to A.S.B.