

# Top-down modulation of multi-step anticipation in changing environments

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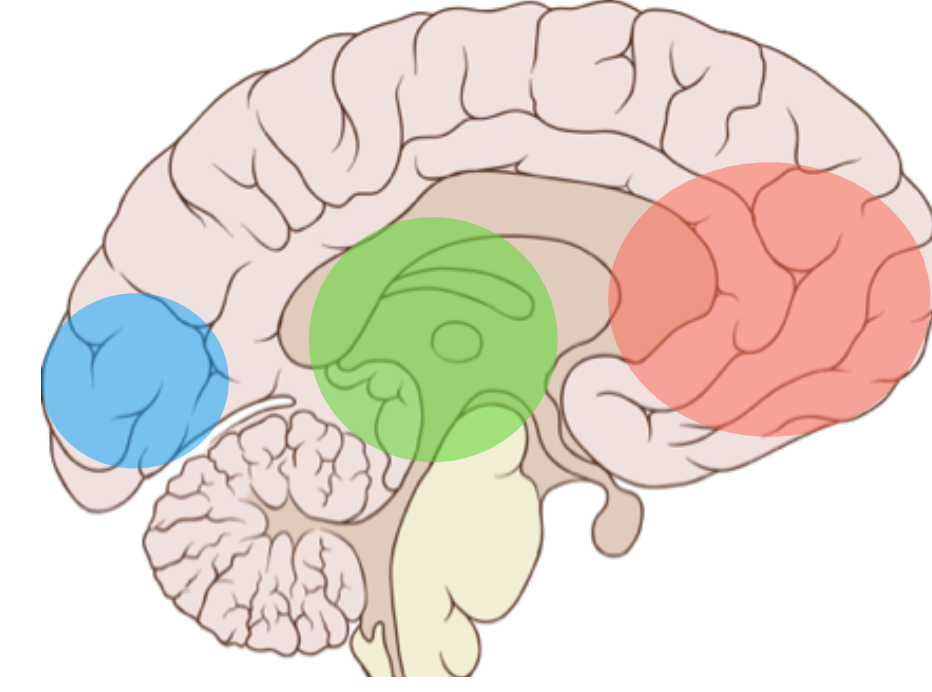
## Introduction

Memory for the past serves a **prospective** function: to predict future events<sup>1</sup>.

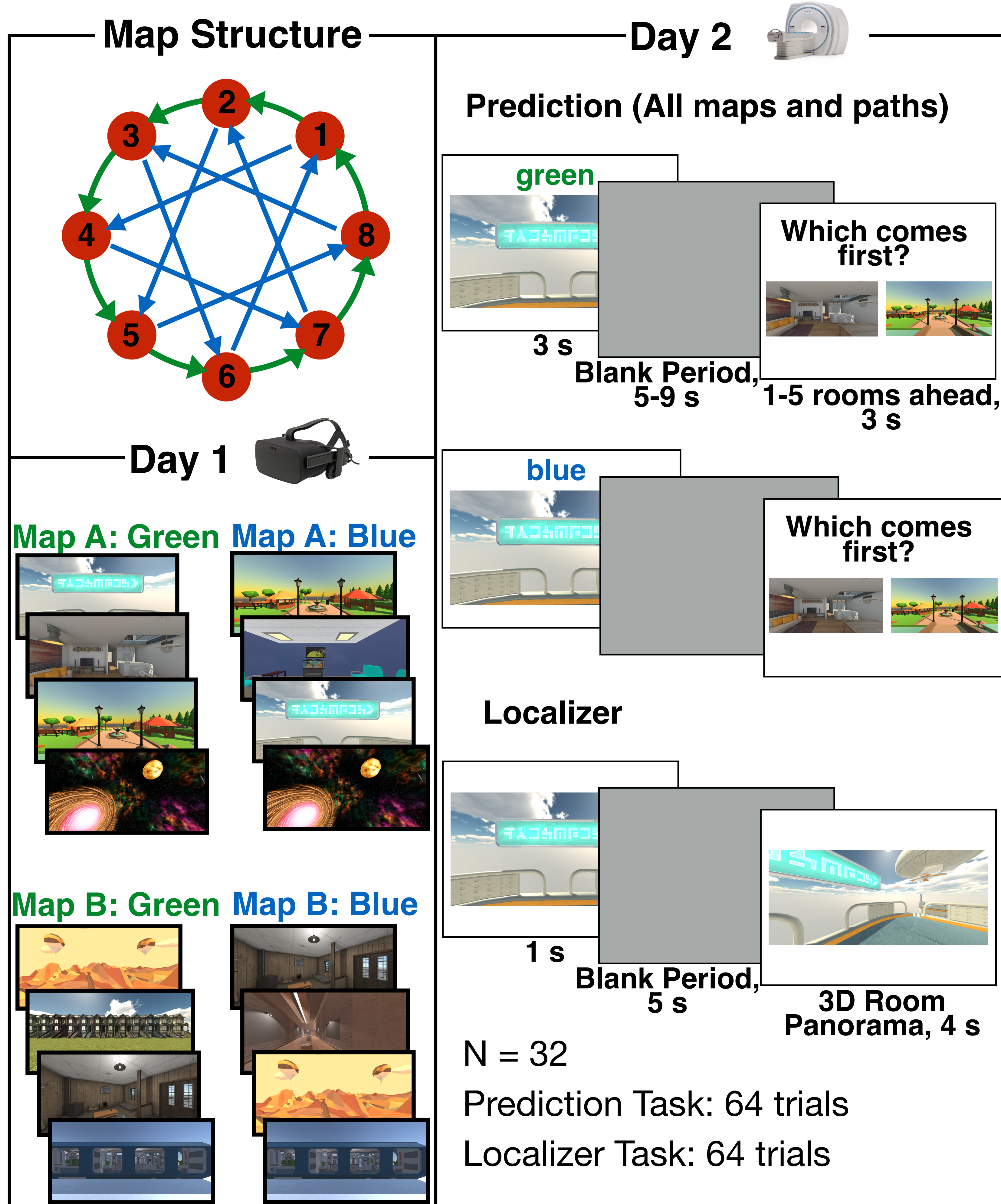
Predictions can be made at multiple timescales<sup>2,3,4</sup>.

**Question 1: How do we generate predictions at multiple timescales in overlapping environments?**

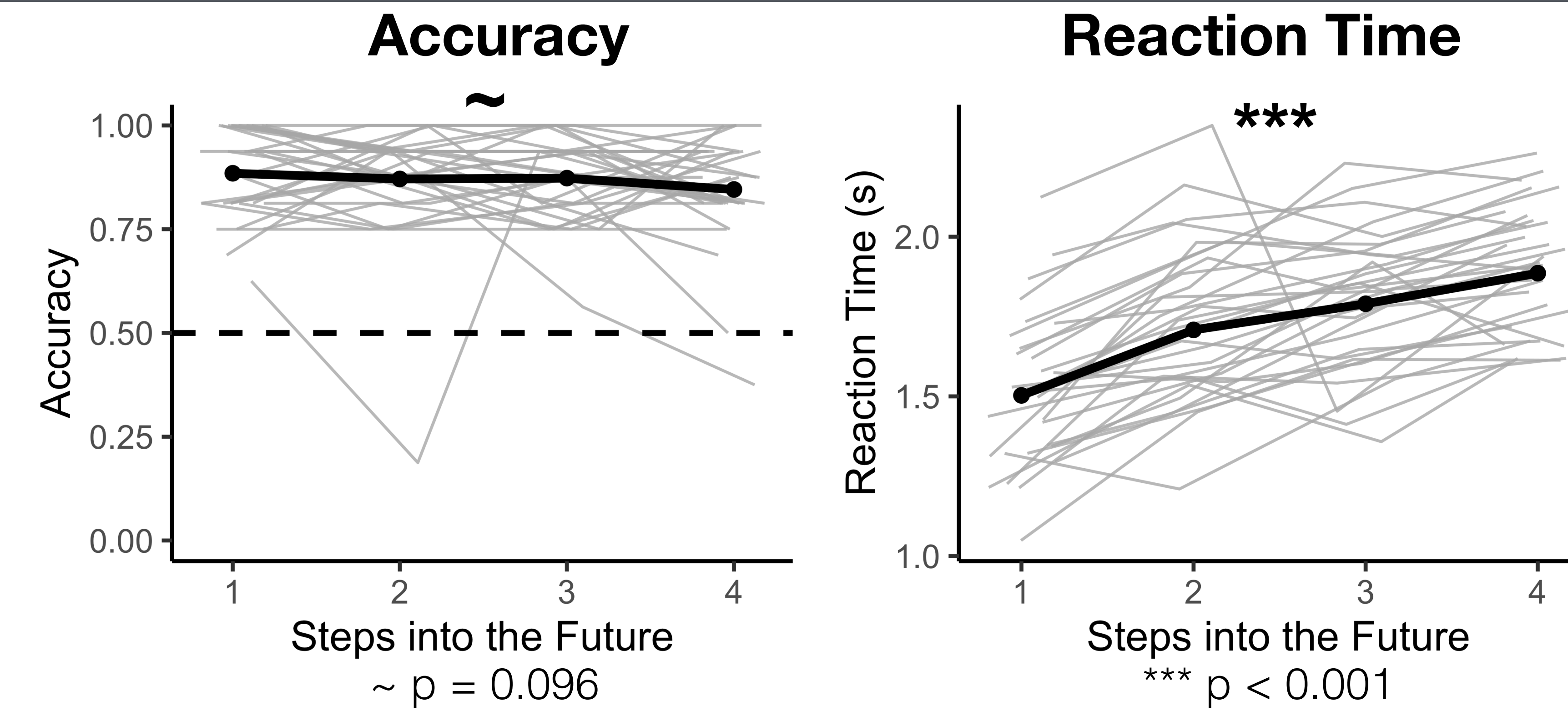
**Question 2: How do neural representations of overlapping environments effect flexible predictions?**



## Experimental Design

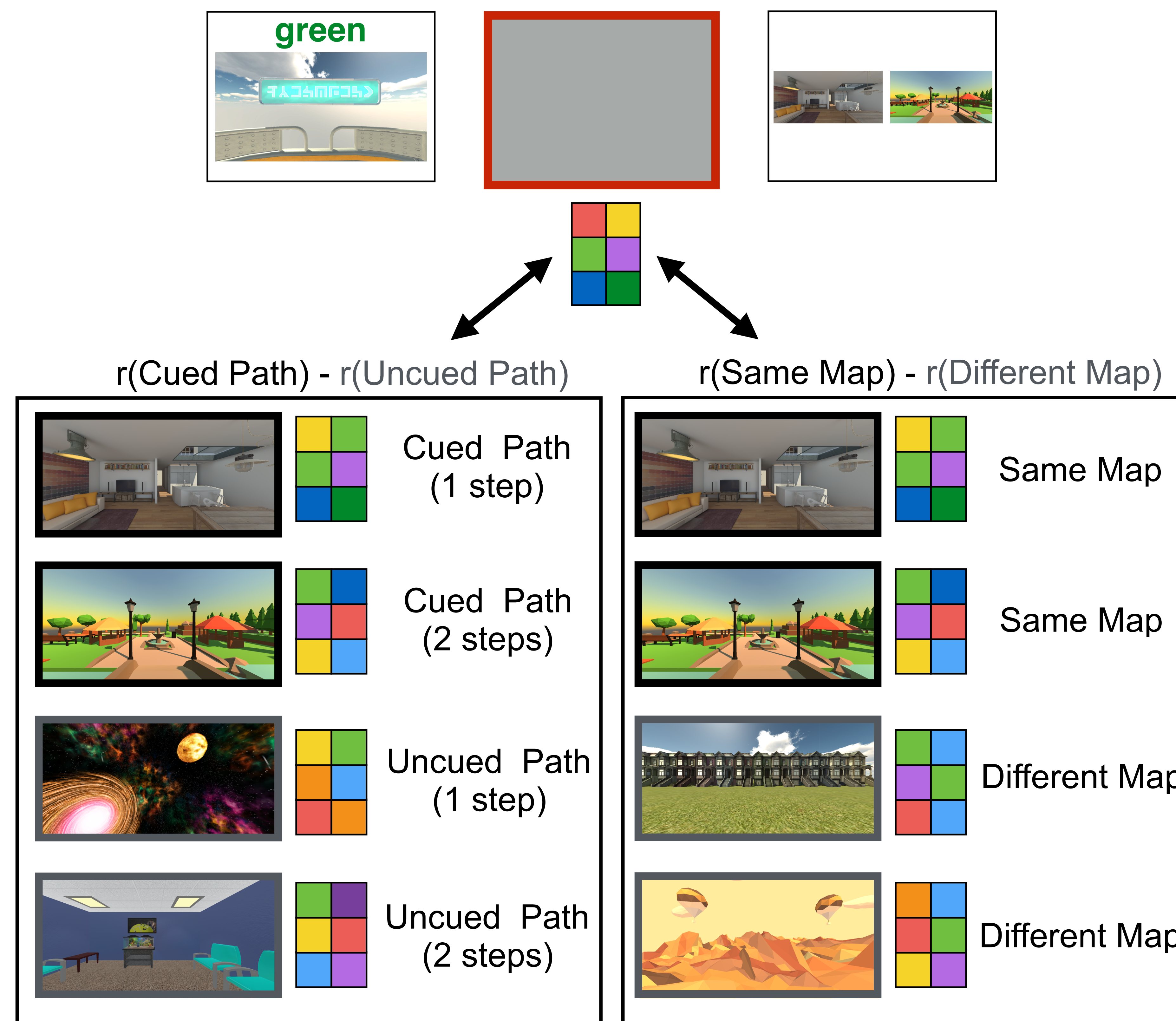


## Prediction at Multiple Timescales



Participants predicted upcoming events along multiple timescales with comparable accuracy, but were slower for further rooms.

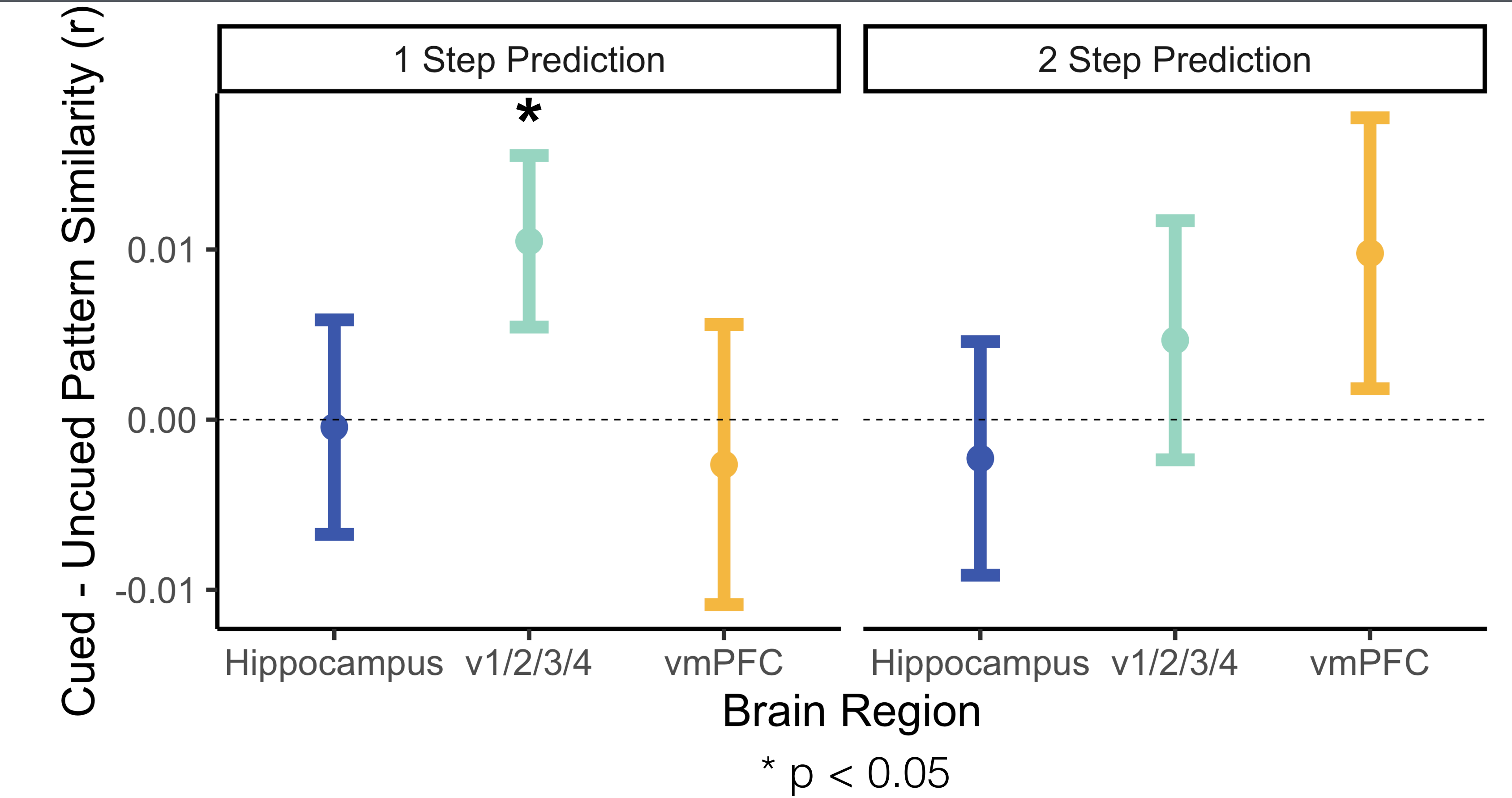
## Neuroimaging Analyses



## References

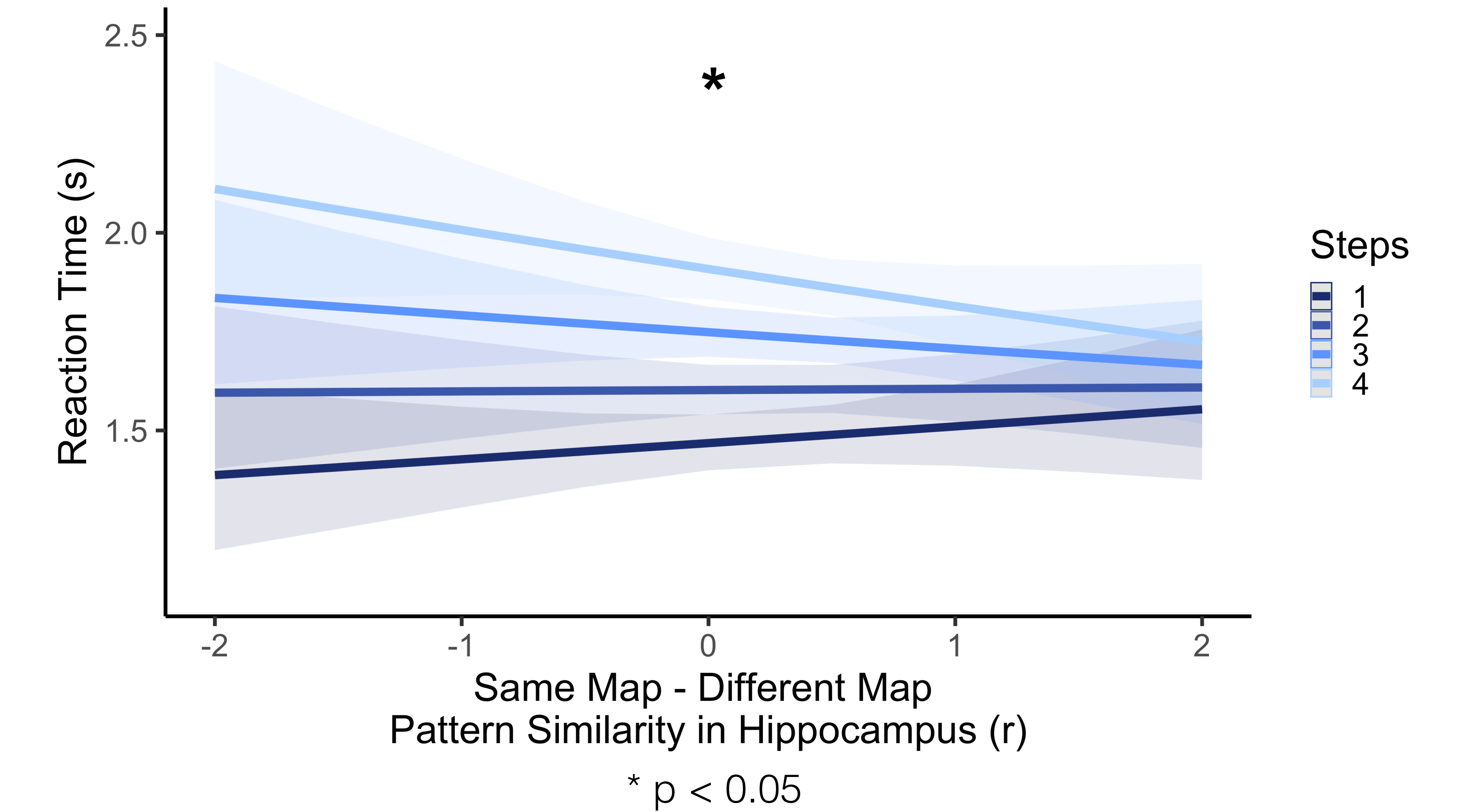
- <sup>1</sup>Buckner, R.L. (2010). The role of the hippocampus in prediction and imagination. *Annual Review of Psychology*, 61, 27-48.
- <sup>2</sup>Wimmer, G.E., & Büchel, C. (2019). Learning of distant state predictions by the orbitofrontal cortex in humans. *Nature communications*, 10(1), 1-11.
- <sup>3</sup>Lee, C. S., Aly, M., & Baldassano, C. (2021). Anticipation of temporally structured events in the brain. *Elife*, 10, e64972.
- <sup>4</sup>Brune, I. K., & Momennejad, I. (2022). Predictive representations in hippocampal and prefrontal hierarchies. *Journal of Neuroscience*, 42(2), 299-312.

## Representations of Flexible Multi-Step Predictions



Visual cortex predictions 1 step into the future were greater on the cued compared to the uncued path. vmPFC showed a numeric trend toward representing 2 step predictions, but was not significant. Error bars represent SEM.

## Hippocampal Representations Predict Behavior



In the hippocampus, more similar activity patterns for the same map compared to the different map predicted more similar reaction times with further steps into the future.

## Summary

- Individuals can accurately make flexible predictions at a range of timescales, but are slower for further predictions.
- Flexible, context-dependent predictions one step into the future are represented in visual cortex.
- Evidence for general map reactivation in hippocampus during anticipation facilitates reaction times for further predictions.
- Future analyses will investigate predictions for further steps into the future along the cortical hierarchy.