Rapid context changes at encoding disrupt hippocampal autocorrelation and reduce temporal clustering of free recall

Lindsay I. Rait, Wanjia Guo, Zhifang Ye, Sarah DuBrow, & Brice A. Kuhl

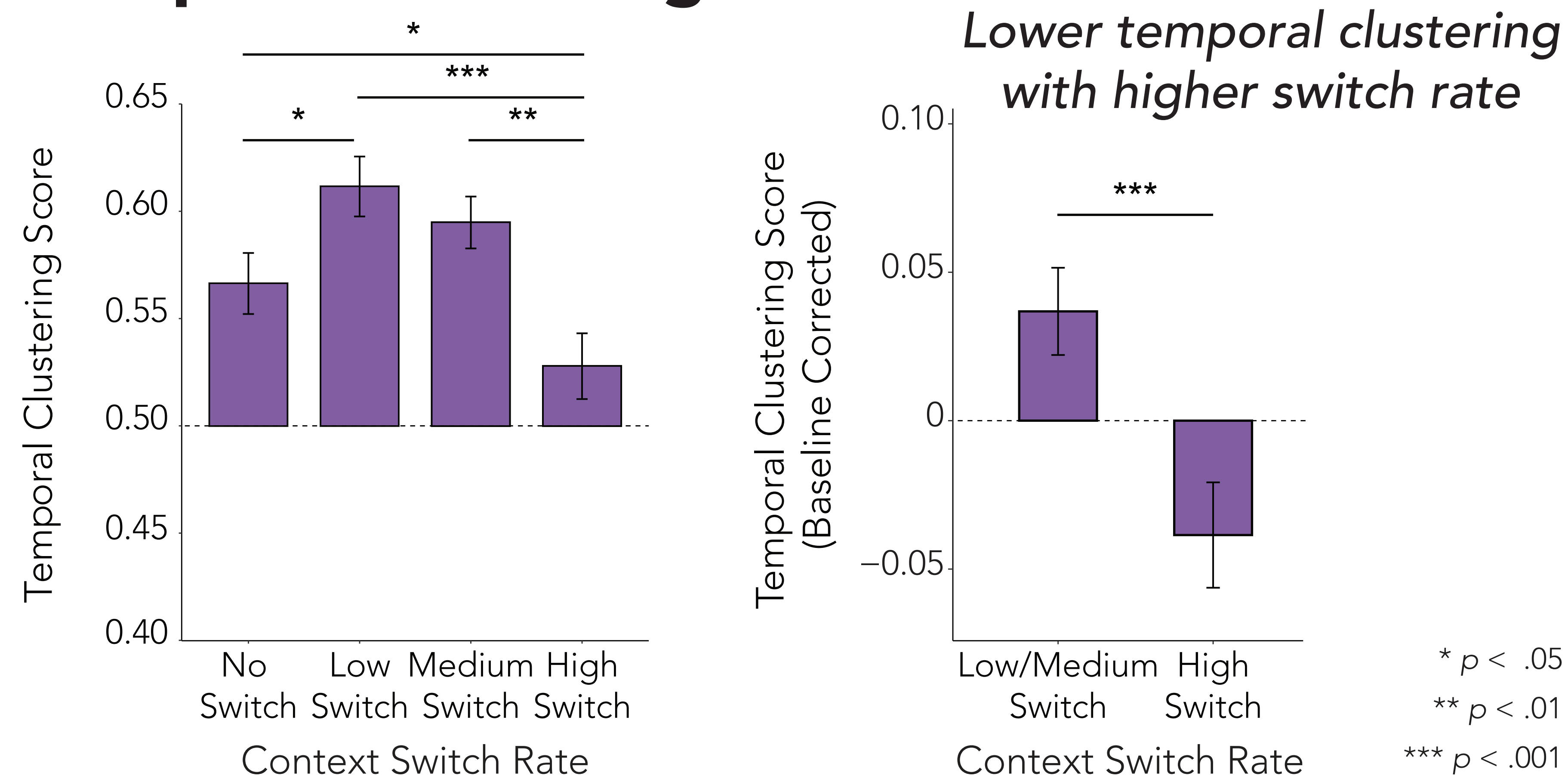Department of Psychology, University of Oregon

Background

Events are stamped into an **internal temporal context that drifts slowly** over time[1,2]

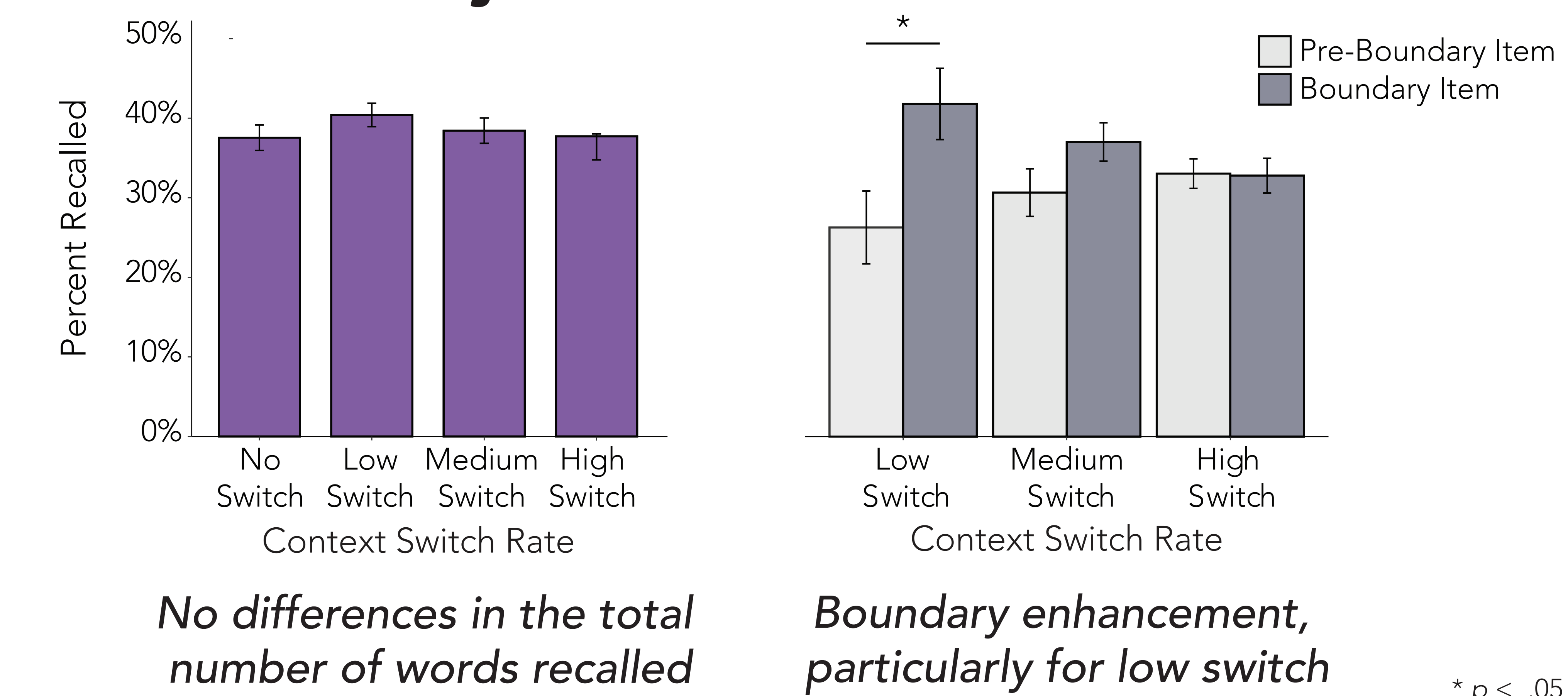This has been shown to be reflected by gradually changing patterns of activity in the **hippocampus**[3,4]

Events that are experienced nearby in time tend to be recalled together, known as **temporal clustering**[5]

> **There is limited evidence directly linking drifting context representations in the hippocampus to temporal clustering in recall**

Experimental Design
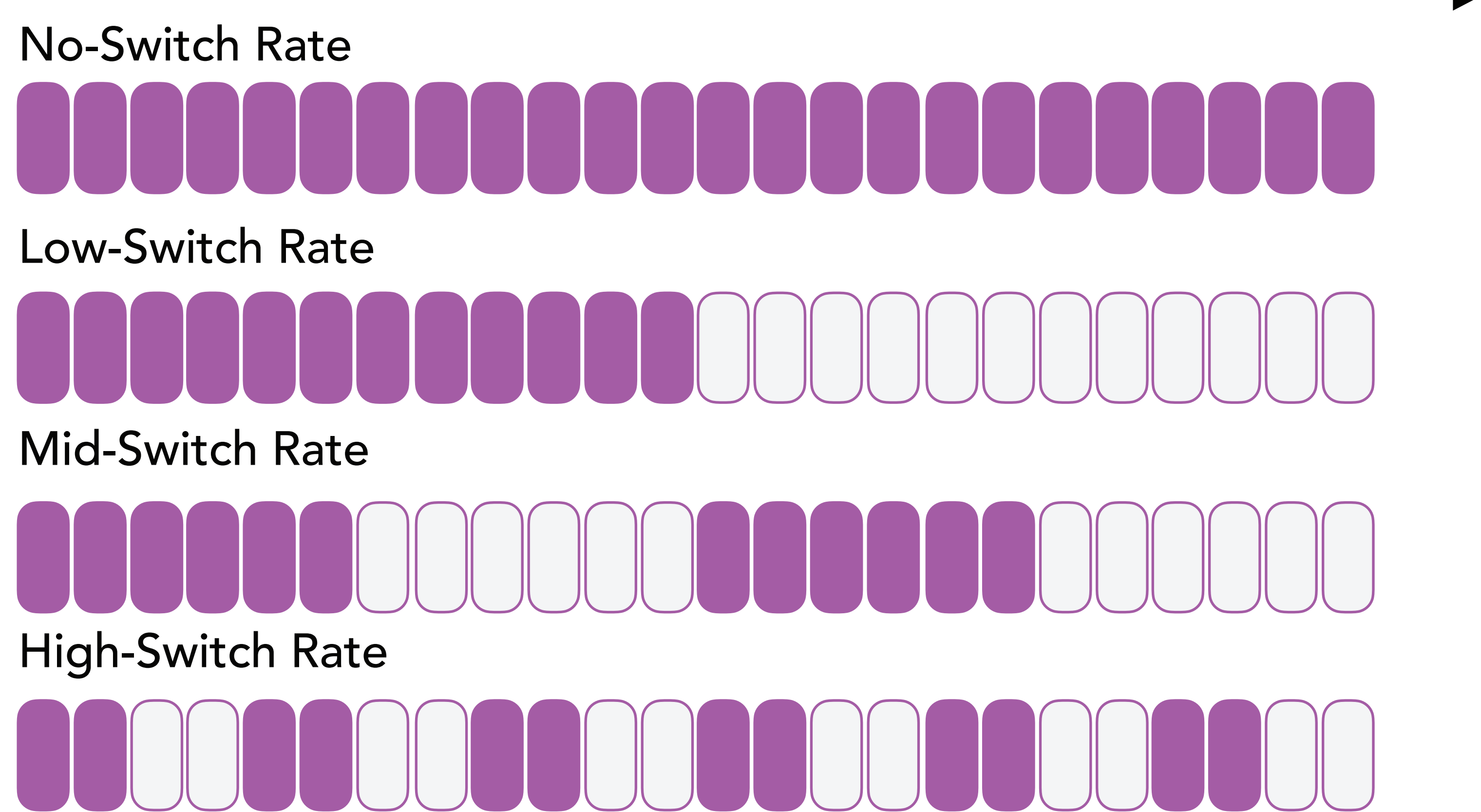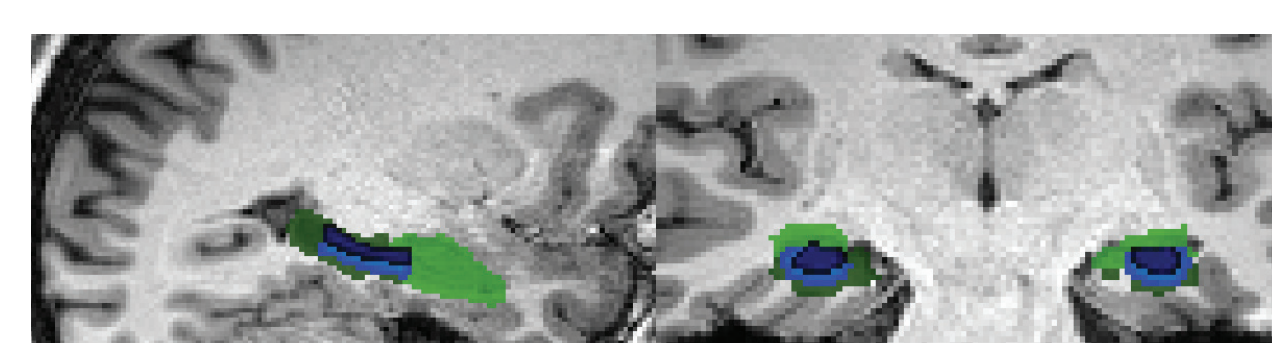
Task: Could you find the item in the scene (y/n)?

1s Cue   2.5s Word

Context Change → time

No-Switch Rate

Low-Switch Rate

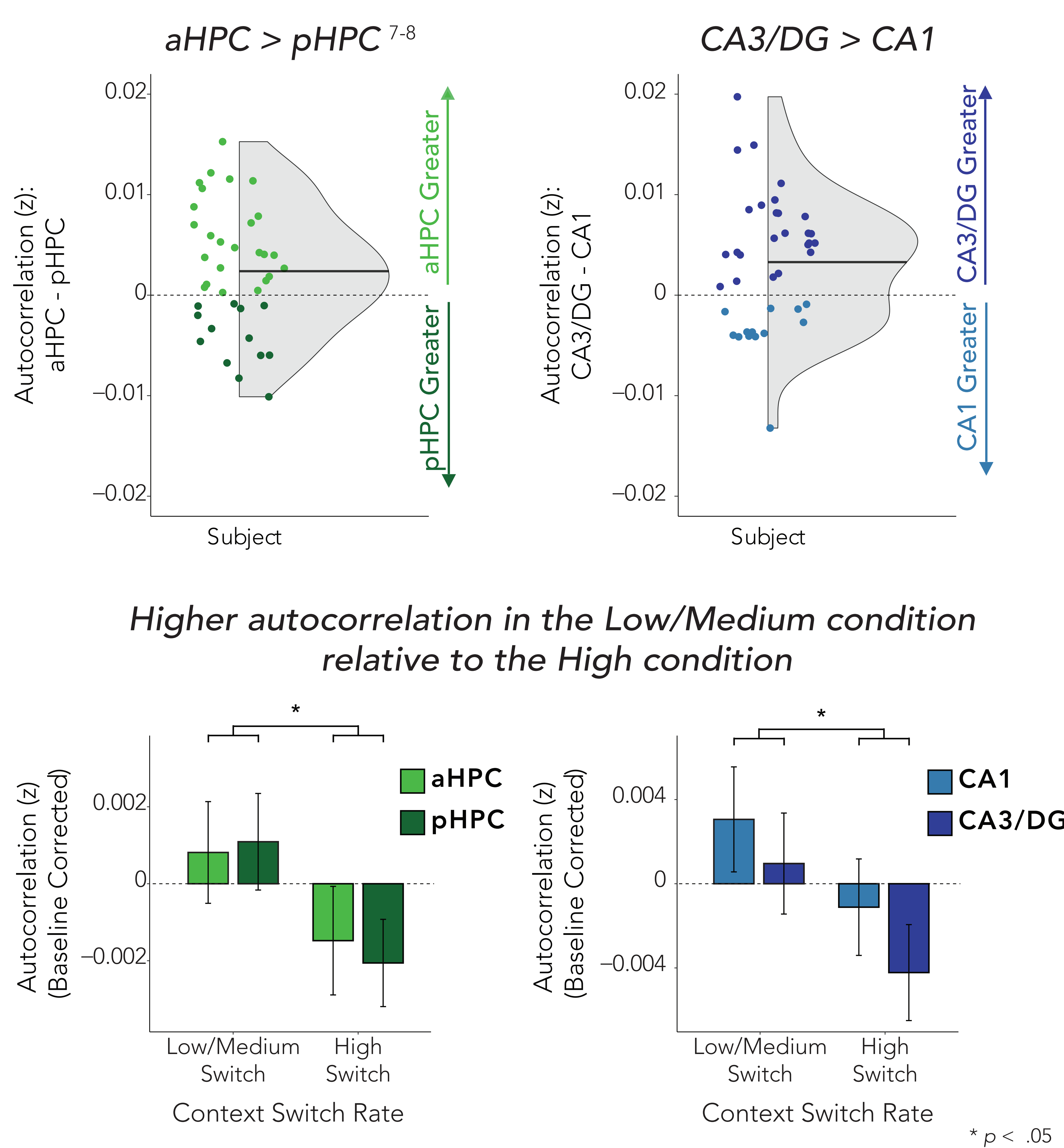Mid-Switch Rate

High-Switch Rate

ROIs
aHPC pHPC CA1 CA3/DG

- 38 human subjects
- within-subjects design with 8 blocks of study-test
- memory tested using verbal free recall

(adapted from Rait et al. 2024[6])

Temporal Clustering

Lower temporal clustering with higher switch rate

* *p* < .05
** *p* < .01
*** *p* < .001

Recall Accuracy

Pre-Boundary Item   Boundary Item

No differences in the total number of words recalled

Boundary enhancement, particularly for low switch

* *p* < .05

Temporal Autocorrelation

aHPC > pHPC [7-8]   *CA3/DG > CA1*

Higher autocorrelation in the Low/Medium condition relative to the High condition

aHPC pHPC   CA1 CA3/DG

* *p* < .05

Autocorrelation vs. Clustering

aHPC — *r = 0.27, p = 0.049**

pHPC — *r = 0.27 , p = 0.048**

CA1 — *r = -0.17, p = 0.845*

CA3/DG — *r = 0.39, p = 0.008***

Higher hippocampal autocorrelation → higher temporal clustering

Stronger relationship in CA3DG than CA1

* *p* < .05
** *p* < .01

Conclusions

Manipulating the rate of context change at encoding produces parallel changes in hippocampal autocorrelation and temporal clustering

These findings establish a critical link between context representations in the hippocampus and temporal clustering in free recall

Suggests that switching contexts at a high rate disrupts internal context representations in the hippocampus, which in turn reduces temporal clustering during recall
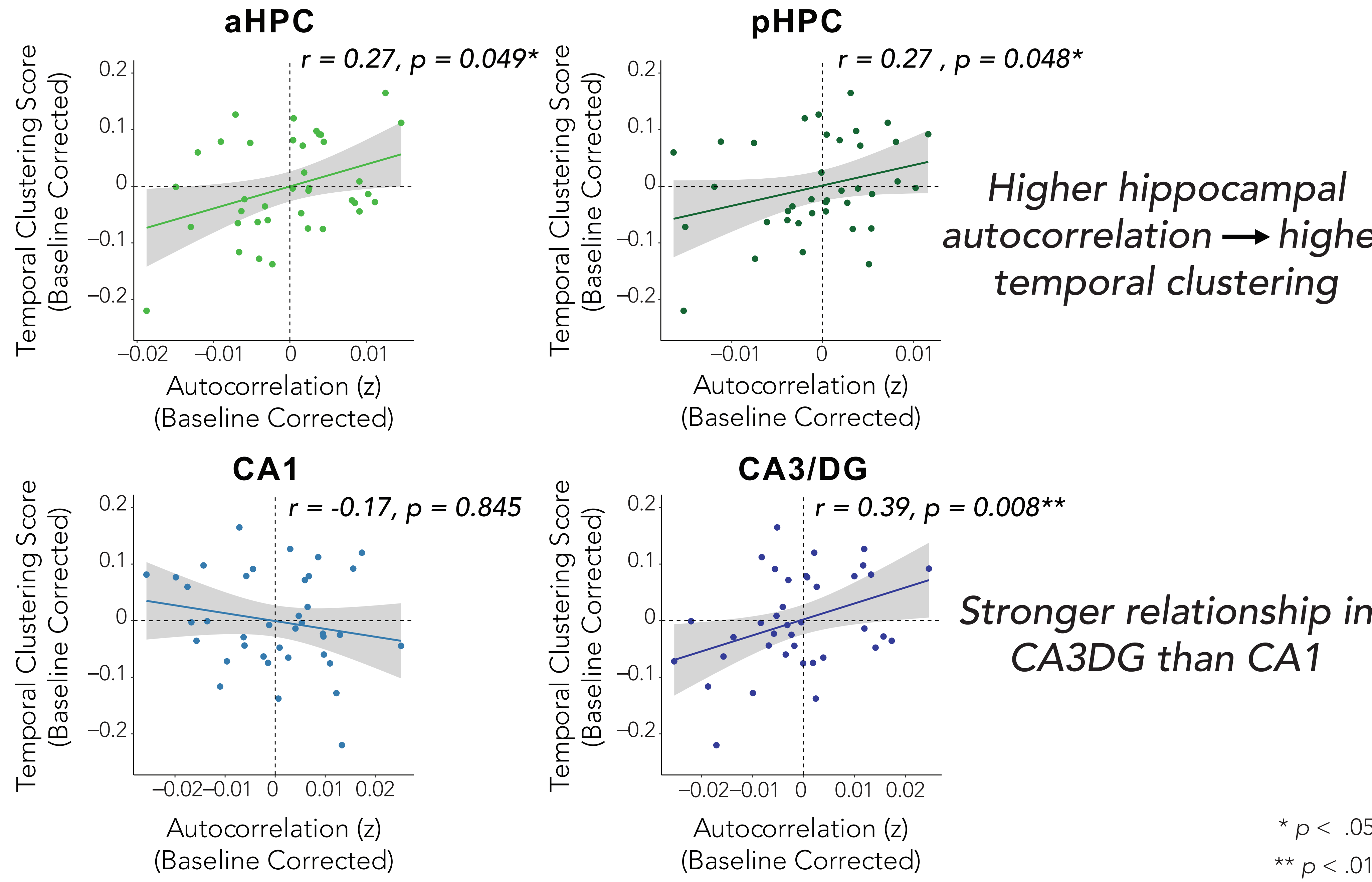
References

[1] Howard, M. W., & Kahana, M. J. (2002). J. of Mathematical Psych. [2] Polyn, S. M., et al. (2009). Psych. Review. [3] Manns, J. R., et al. (2007). Neuron. [4] MacDonald, C. J., et al. (2011). Neuron. [5] Kahana, M. J. (1996). Memory & Cognition. [6] Rait, L. I., et al. (2024). Psych. Bulletin & Review. [7] Bouffard, N. R., et al. (2023). Cerebral Cortex. [8] Brunec, I. K., et al. (2018). Current biology.