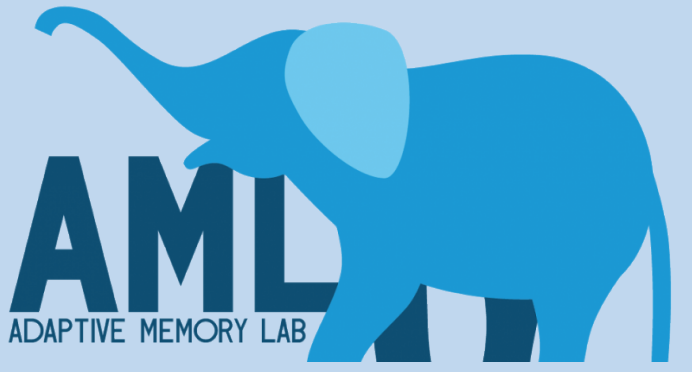


Dissociation in the specificity of functional networks centered on hippocampus and VTA following exposure to novelty

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Background

Adaptive memory consolidation prioritizes the retention of salient information^{1,2,3,4}, allowing for past experiences to help guide future decisions

Though this memory bias is often interpreted as evidence for a cellular consolidation process (e.g., enhancing LTP⁵), emerging evidence suggests systems consolidation might play a role in selecting and transforming new memories through cross-regional interactions^{6,7,8}

The mesolimbic dopamine system could support this selectivity through interactions with the hippocampus^{5,9}, for example by biasing replay¹⁰

Though dopamine seems to be important in facilitating the stability of information signaling in large-scale networks¹¹, it is unclear how such network dynamics are restructured with systems consolidation.

Research Questions

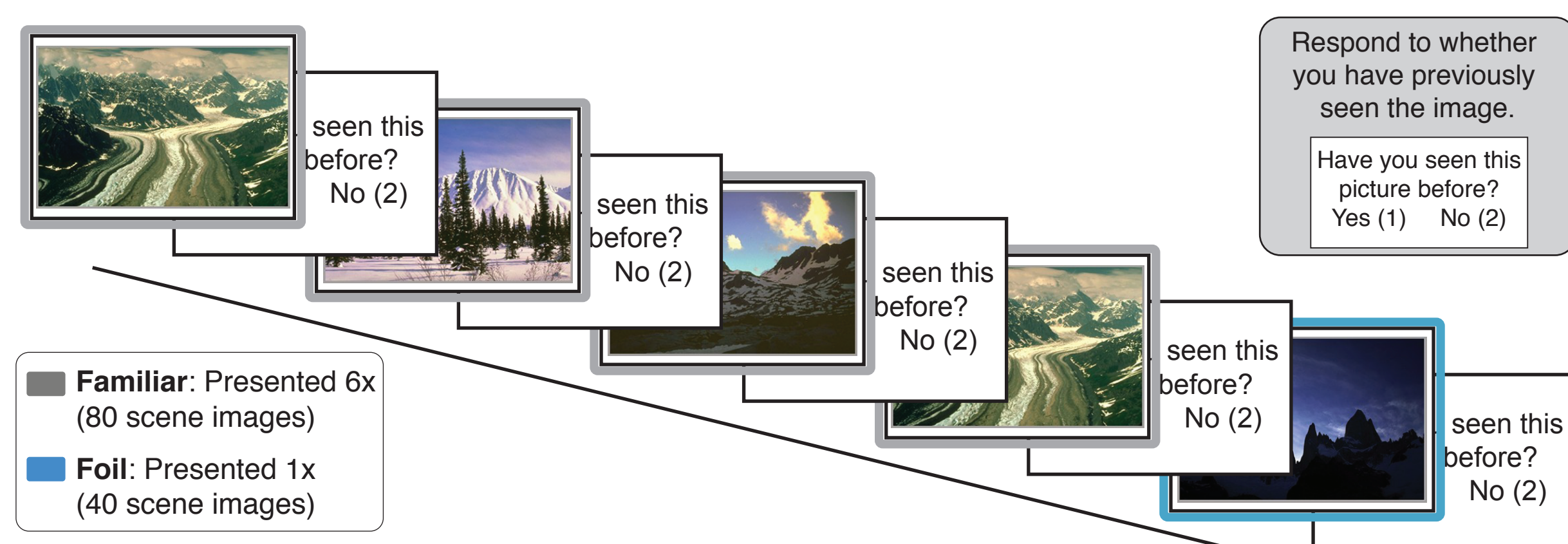
What cortical regions are targeted by systems consolidation?

Are changes in network dynamics targeted to specific task-related regions of the cortex, or more broadly involving memory-related networks across the entire cortex?

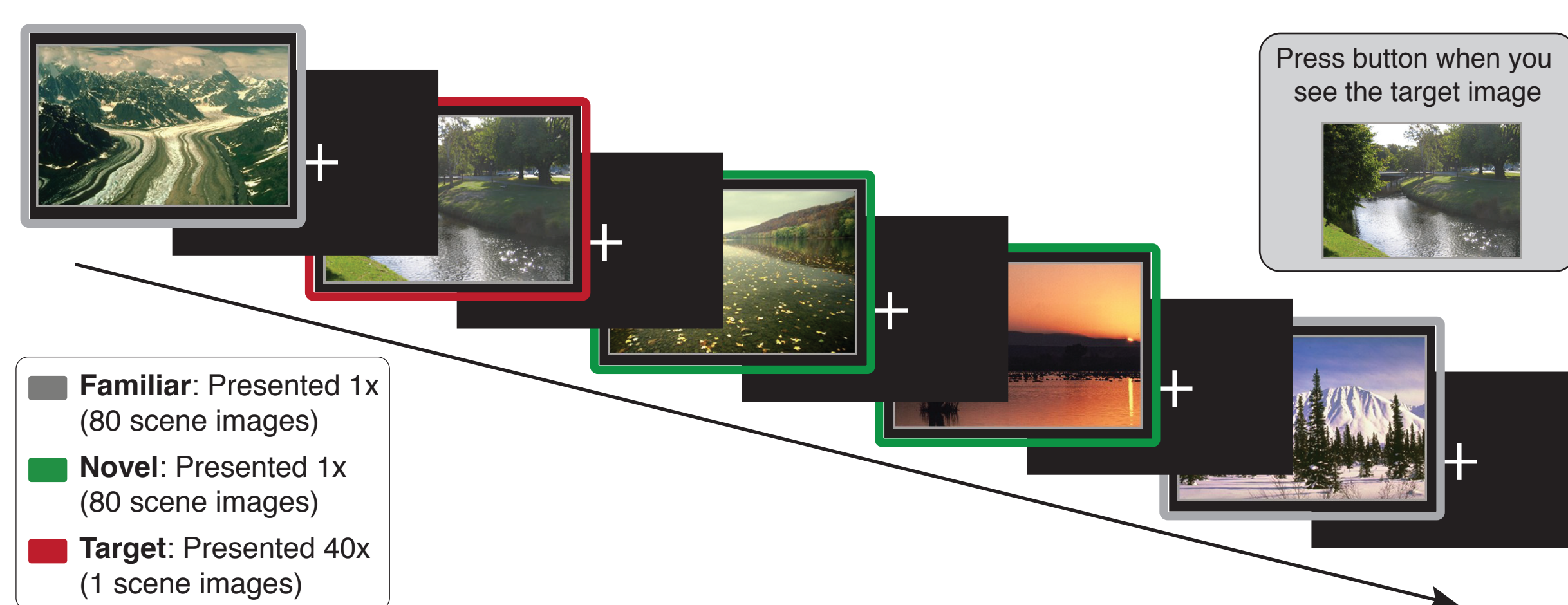
Task design



Familiarization: continuous recognition task



Novelty Exposure: target detection task

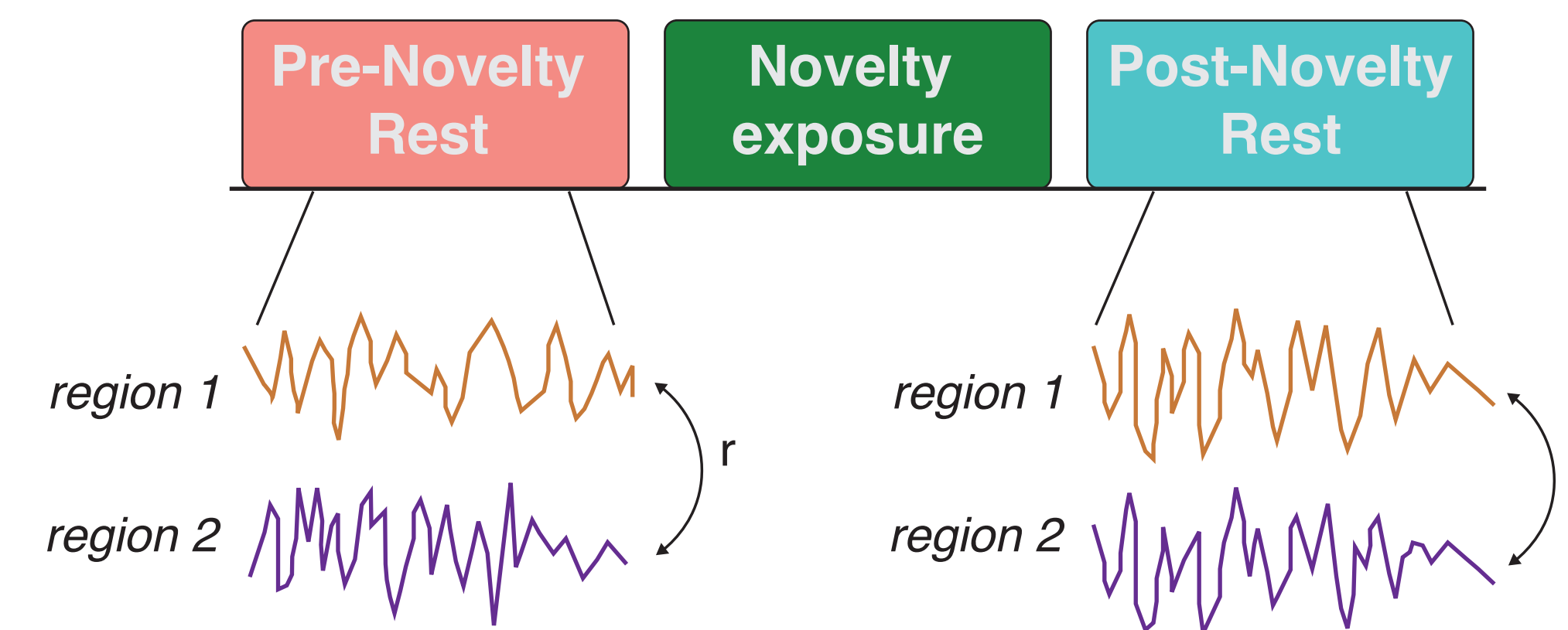


Methods

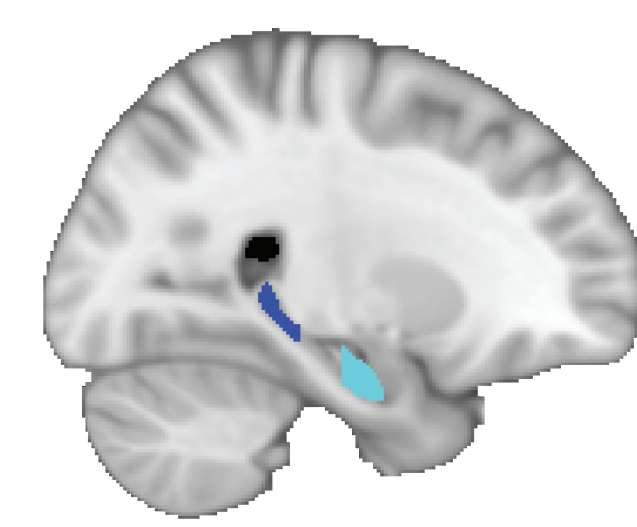
37 subjects

ROIs: Anatomical hippocampus from FSL's FIRST, split into thirds along long-axis; PhC¹² and PMAT¹³ regions defined as 6mm kernel sphere at coordinates of peak activation defined by prior studies; VTA defined using probabilistic atlas¹⁴

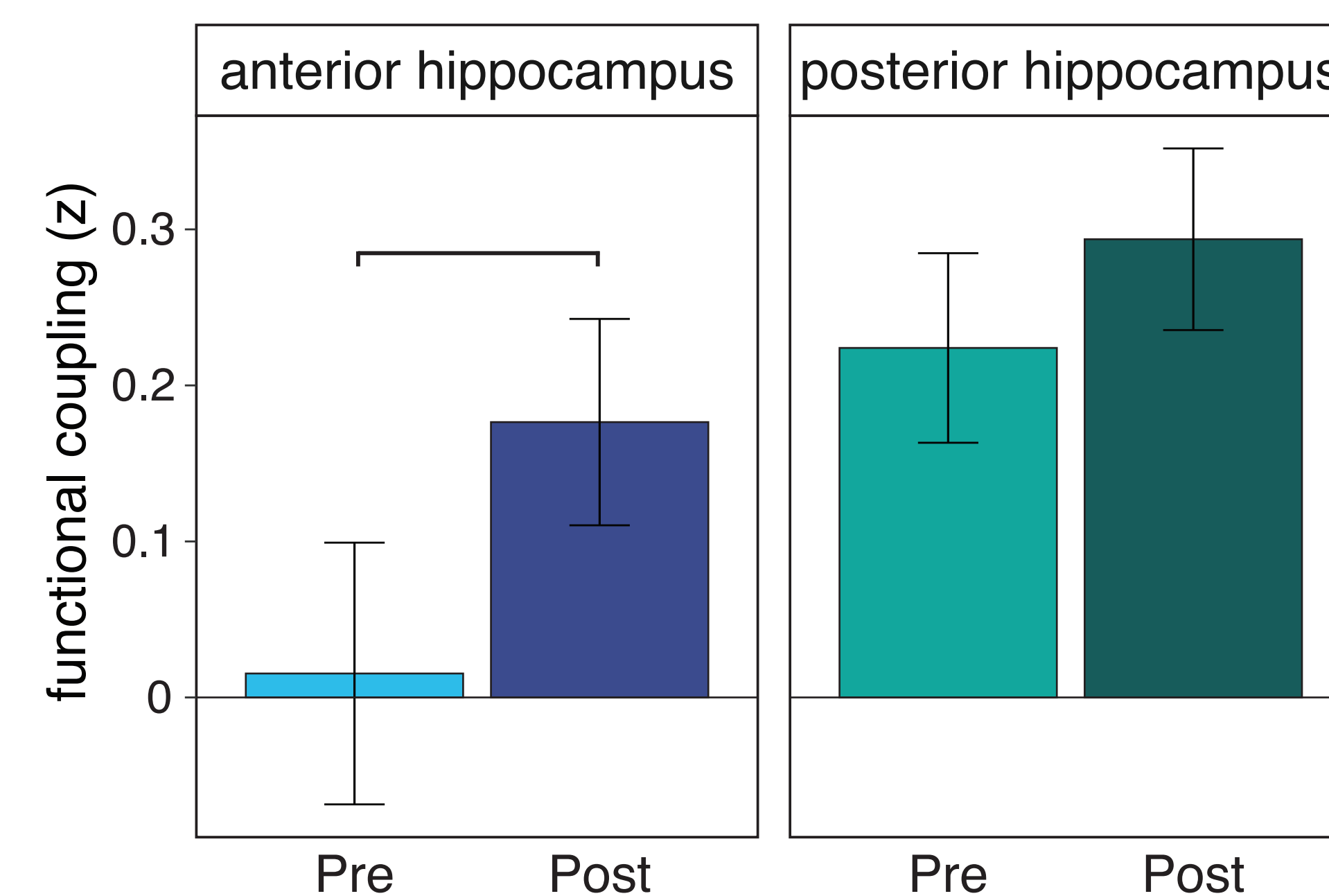
Resting state functional coupling analysis



Hippocampal-VTA functional coupling

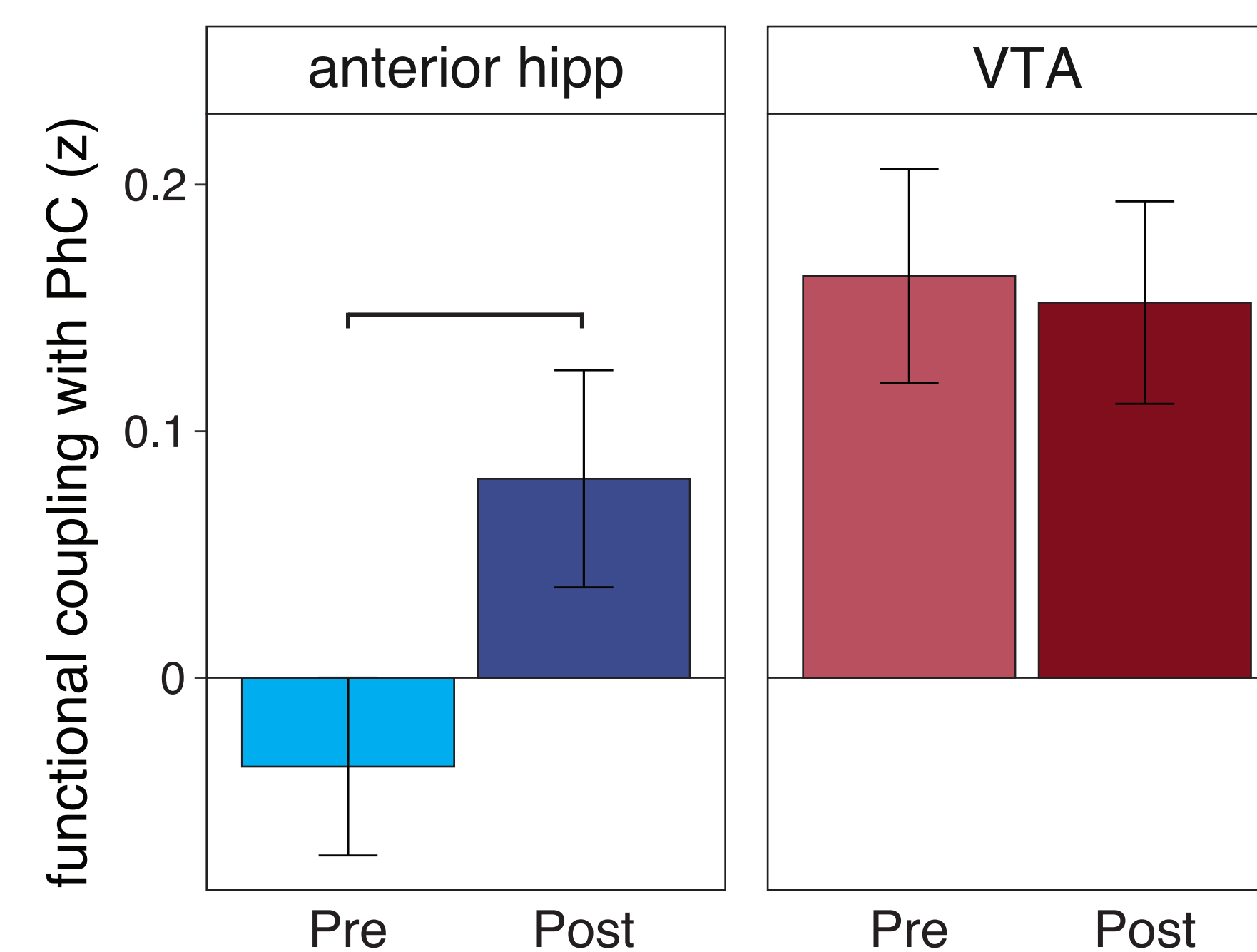


Functional coupling between anterior hippocampus and VTA is enhanced following novelty exposure



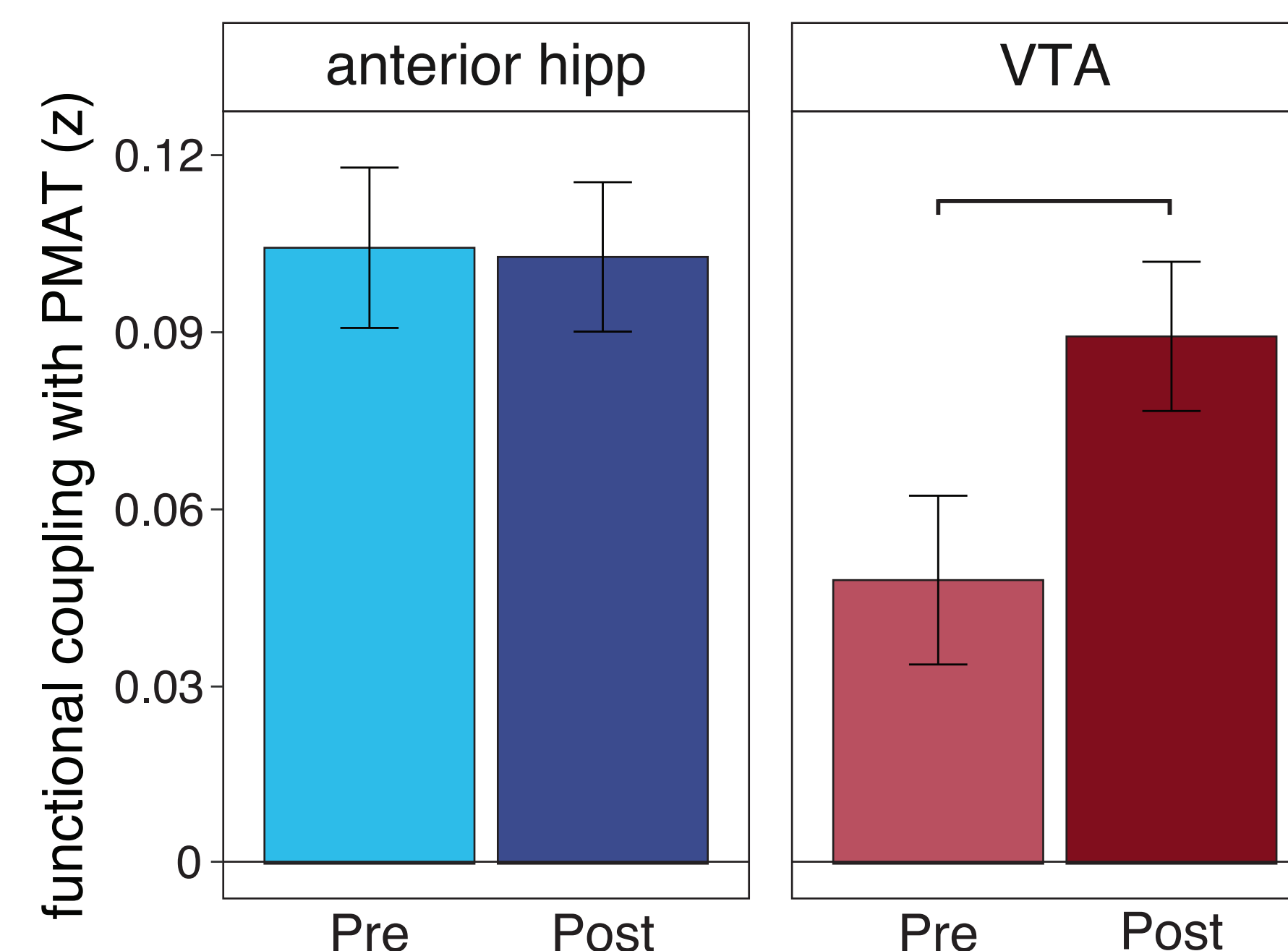
Dissociation in post-encoding network coupling changes

Anterior hippocampus targets task specific regions



Functional coupling between parahippocampal cortex and anterior hippocampus, but not VTA, is enhanced following novelty exposure

VTA targets diffuse cortical regions

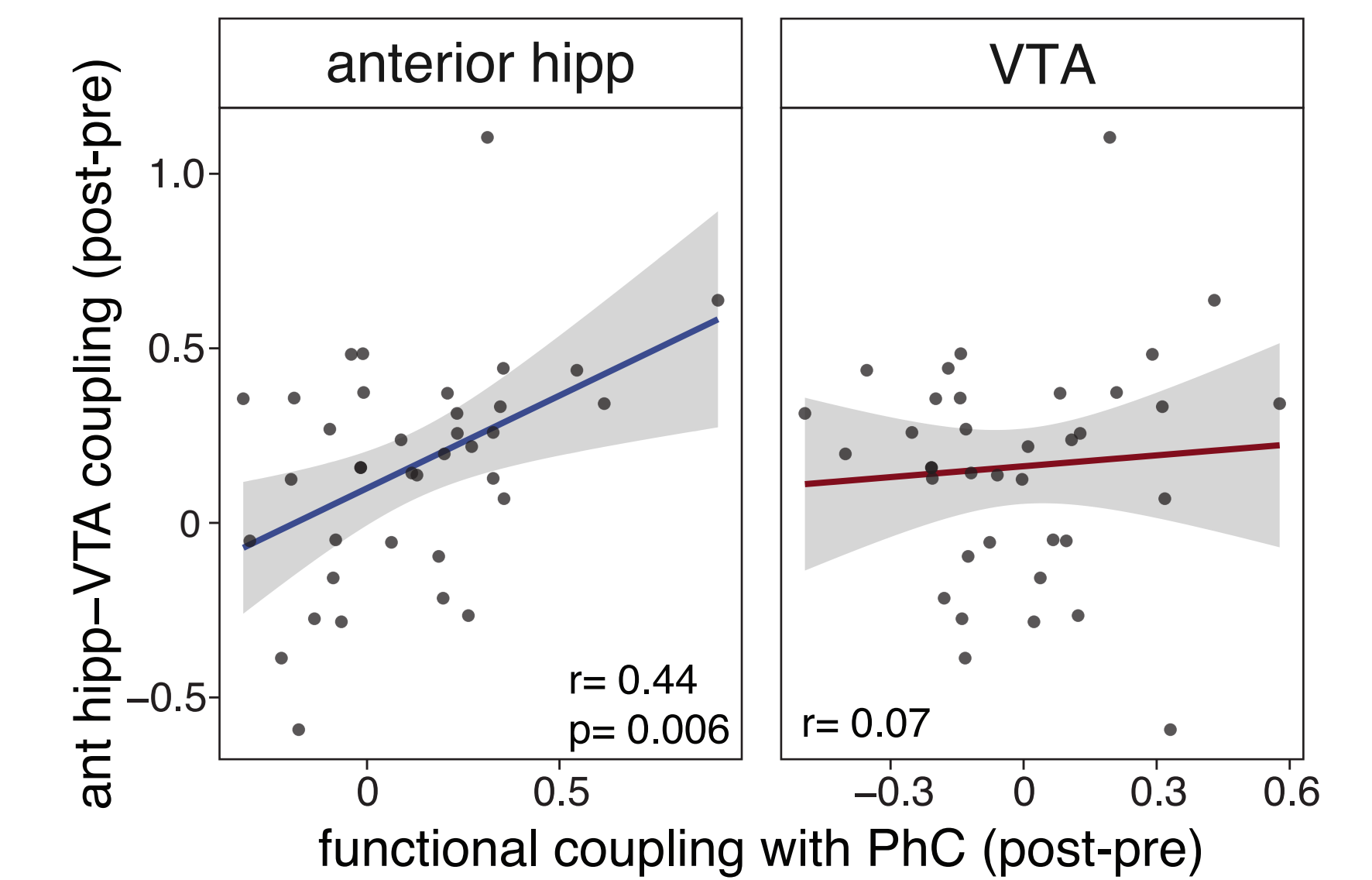


Functional coupling between PMAT network regions and VTA, but not anterior hipp, is enhanced following novelty exposure

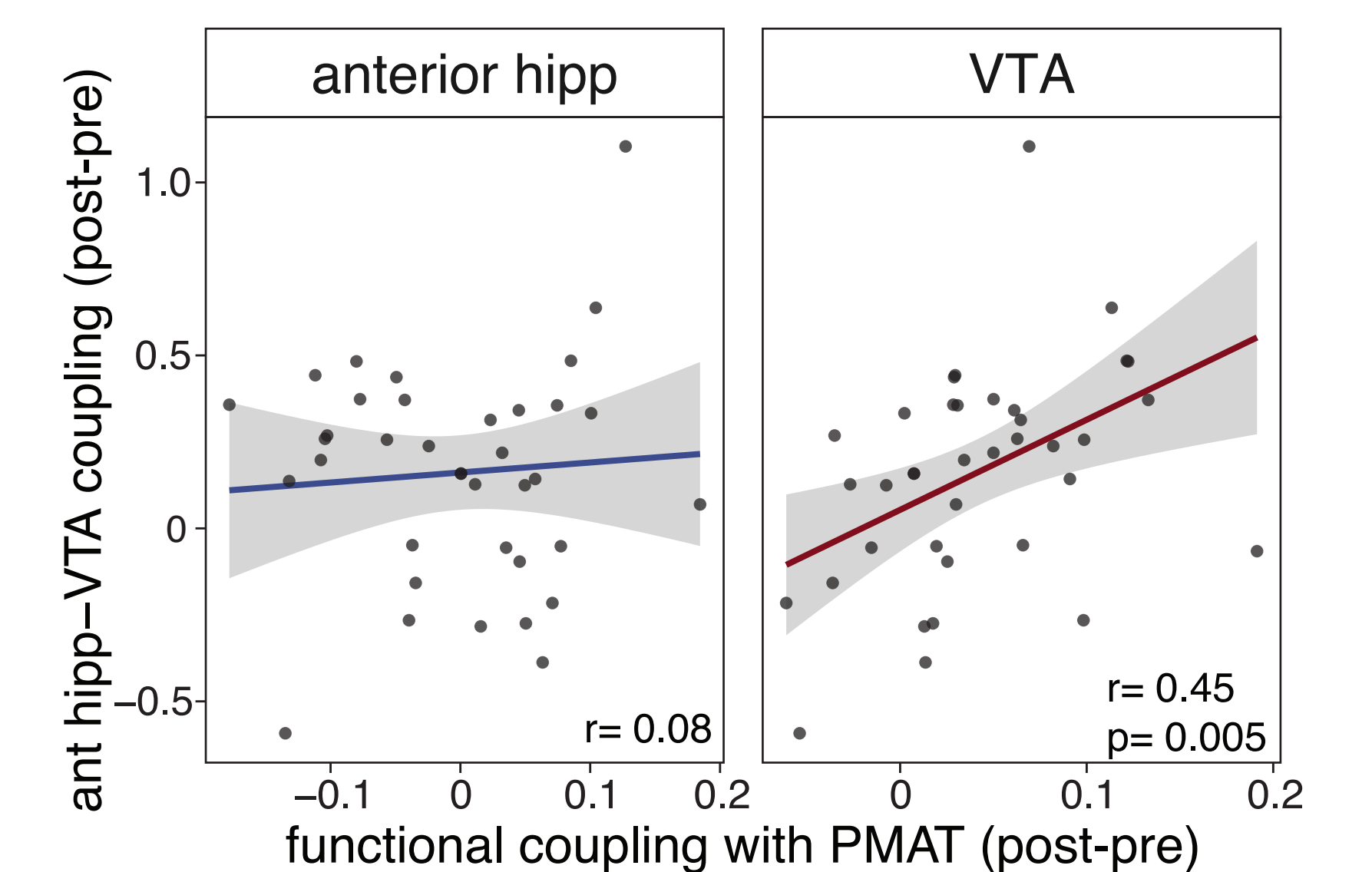
Network x Seed x Session interaction $F(1,36)=9.55, p=0.004$

Anterior hipp-VTA coupling modulates network enhancements

Anterior hipp-PhC post-encoding coupling enhancements are related to increased anterior hipp-VTA coupling



VTA-PMAT post-encoding coupling enhancements are related to increased anterior hipp-VTA coupling



Summary

A task involving exposure to novelty leads to enhancements in anterior hippocampal-VTA functional coupling.

However, there is a dissociation in the regions showing enhanced coupling for anterior hippocampus and VTA following novelty exposure.

Systems consolidation mechanisms for the hippocampus and VTA may act on different spatial scales, with the hippocampus targeting reactivation of specific memory traces whereas the VTA facilitates information processing across large-scale networks.

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