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

Emily Cowan[1], Matthew R Fain[1], Ian O'Shea[2], Vishnu P Murty[1] [1]Temple University, [2]Northeastern University

## 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 LTP[5]), 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 VTA-hippocampal interactions[5,9], for example by biasing replay[10]

Alternatively, the mesolimbic dopamine system could support this selectivity by restructuring large scale networks[11]

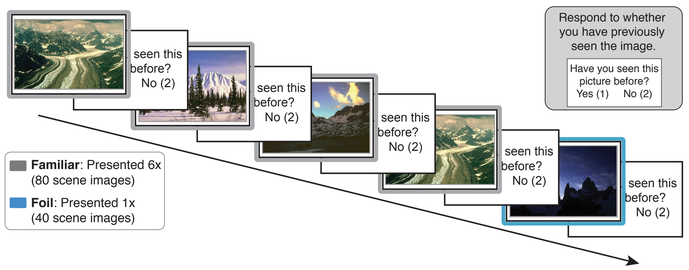
## Research Questions

How are the hippocampus and VTA differentially affected by systems consolidation?

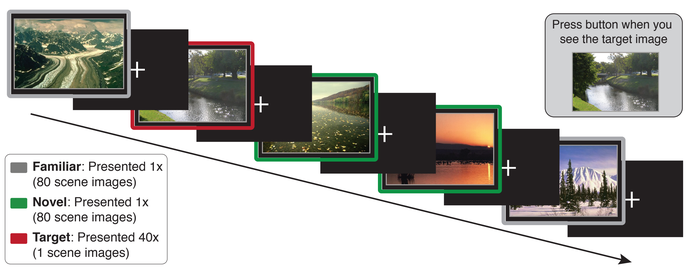
Does systems consolidation lead to changes in network dynamics with specific task-related regions of the cortex, or more broadly across large scale memory-related networks?

## Task design


**Familiarization:** continuous recognition task




**Novelty Exposure:** target detection task

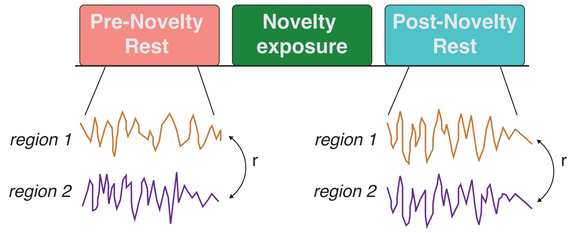



## Methods

37 subjects

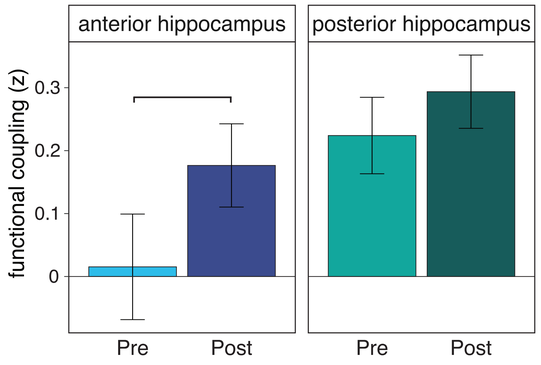
ROIs: Anatomical hippocampus from FSL's FIRST, split into thirds along long-axis; PhC[12] and PMAT[13] regions defined as 6mm kernel sphere at coordinates of peak activation defined by prior studies; VTA defined using probabalistic atlas[14]

## Resting state functional coupling analysis



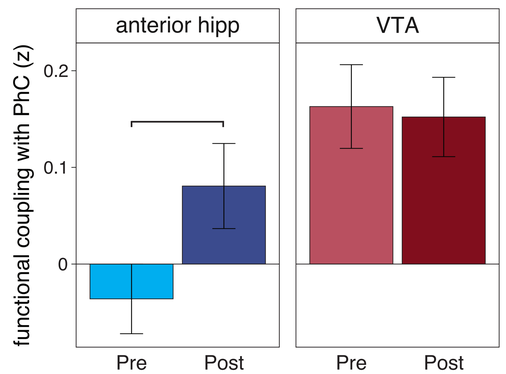

## Hippocampal-VTA functional coupling

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



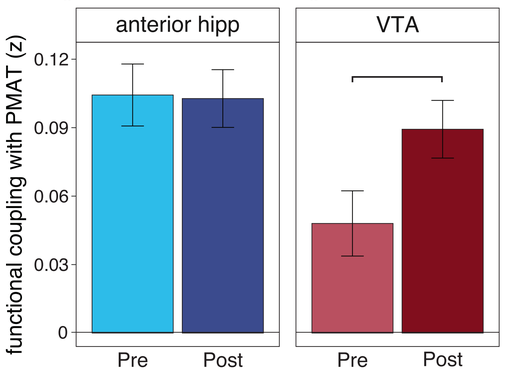

## Dissociation in post-encoding network coupling changes

### 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

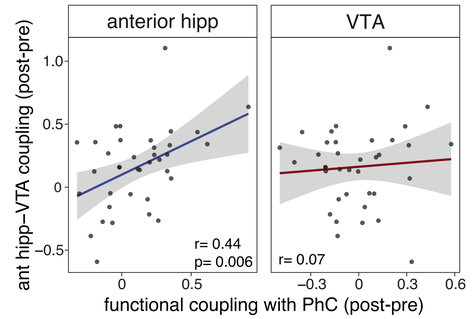



Functional coupling between PMAT network regions and VTA, but not anterior hipp, is enhanced following novelty exposure

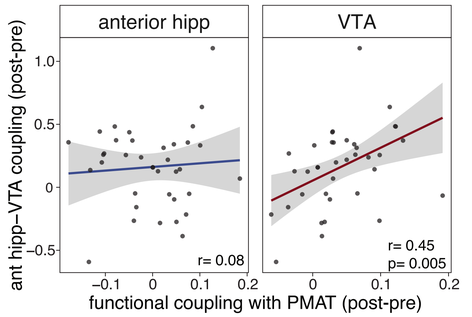
## Anterior hipp-VTA coupling modulates network enhancements

Are the enhancements in coupling in these networks related to plasticity in coupling between hippocampus and VTA?

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:

- Hippocampus targets reactivation of specific memory traces
- VTA facilitates information processing across large-scale networks

## References

**1.** Adcock et al. (2006) Neuron **2.** Wang and Morris (2010) Annual Rev Psychol **3.** Sharot and Phelps (2004) CABN **4.** Murty et al. (2017) JNeurosci **5.** Lisman and Grace (2005) Neuron **6.** Alvarez and Squire (1994) PNAS **7.** Moscovitch et al. (2016) Annual Rev Psychol **8.** Cowan et al (review paper in prep) **9.** Shohamy and Adcock (2010) TICS **10.** McNamara et al. (2014) Nat Neuroscience
11. Shafiei et al. (2019) Cereb Cortex **12.**Murty et al. (2013) Learn Mem
**13.** Ritchey et al. (2014) JOCN **14.** Shermohammad et al. (2014) Neuroimage

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