

Familiarization helps contextual features stick to item features: A multi-voxel pattern analysis study

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1. Introduction

- Mnemonic benefits of repetition (rather than novelty) are found in source memory studies involving mixed lists of novel and familiar stimuli (Poppenk et al., 2010; cf. Tulving & Kroll, 1995).
- **How** does repetition of materials lead to better memory for episodes?

2. Two possible mechanisms

- 1) **Attention hypothesis**. Participants spend more time attending to novel materials and less time processing contextual details, reducing their ability to remember item-context associations.
- 2) **Scaffolding hypothesis**. Pre-existing stimulus representations in memory provide a foundation upon which new episodic memories can “stick”.

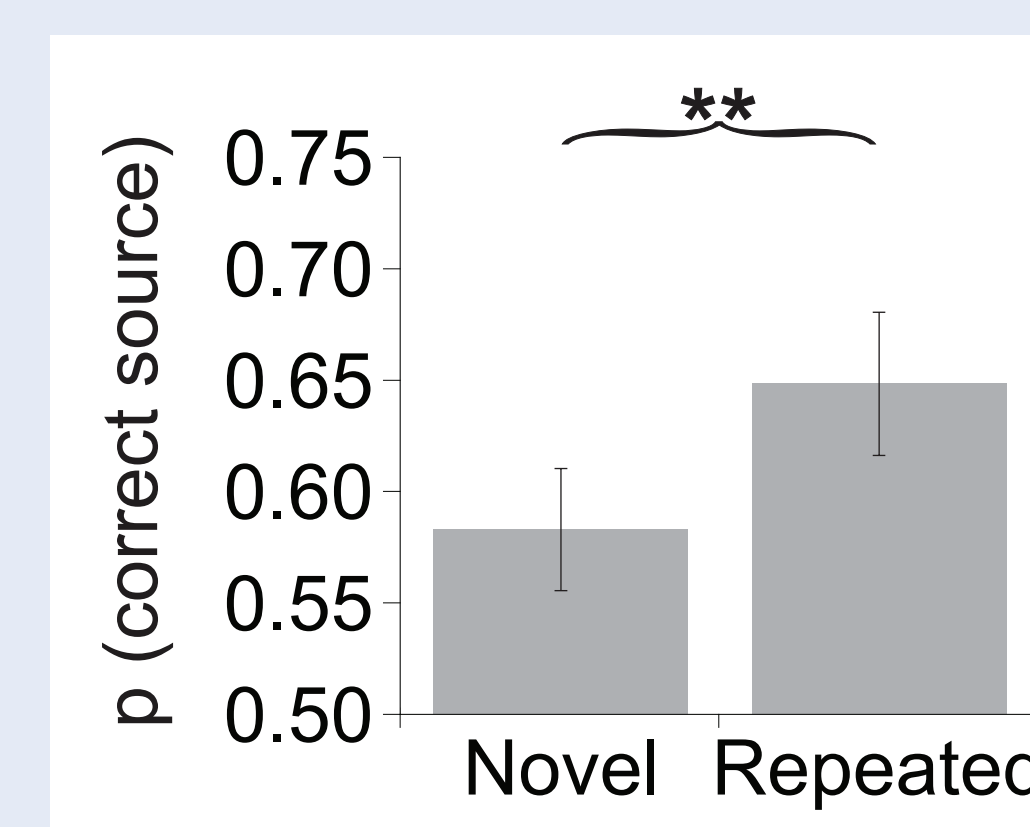
3. Dataset

- To test these questions, we reanalyzed a recent fMRI dataset investigating novelty and memory (Poppenk, 2011, dissertation).
- $N=16$ healthy young adults
- 80 novel and 80 repeated Asian proverbs
e.g., “A single hair can hide a mountain.”
- Two study tasks were the basis of a source memory test:
Task 1) Rate proverb quality (poor or good)
Task 2) Rate target age (youth or adult)

Experimental design

P1) Pre-study repetition (fMRI): A B
P2) Study (fMRI): A¹ X¹ B² Y² baseline
P3) Source memory test: A[?] B[?] X[?] Y[?]

A source memory advantage for repeated materials over novel ones, as measured in the source memory test in this dataset (P3), replicates earlier findings (Poppenk et al., 2010).



4. Classifier training

- Using multivariate pattern analysis (MVPA; Norman et al., 2006), we derived measures of stimulus and task processing in the study phase (P2).

Task correctness (P2): A¹ X¹ B² Y² baseline Xval. perf.: 0.55 ($P < 0.01$)

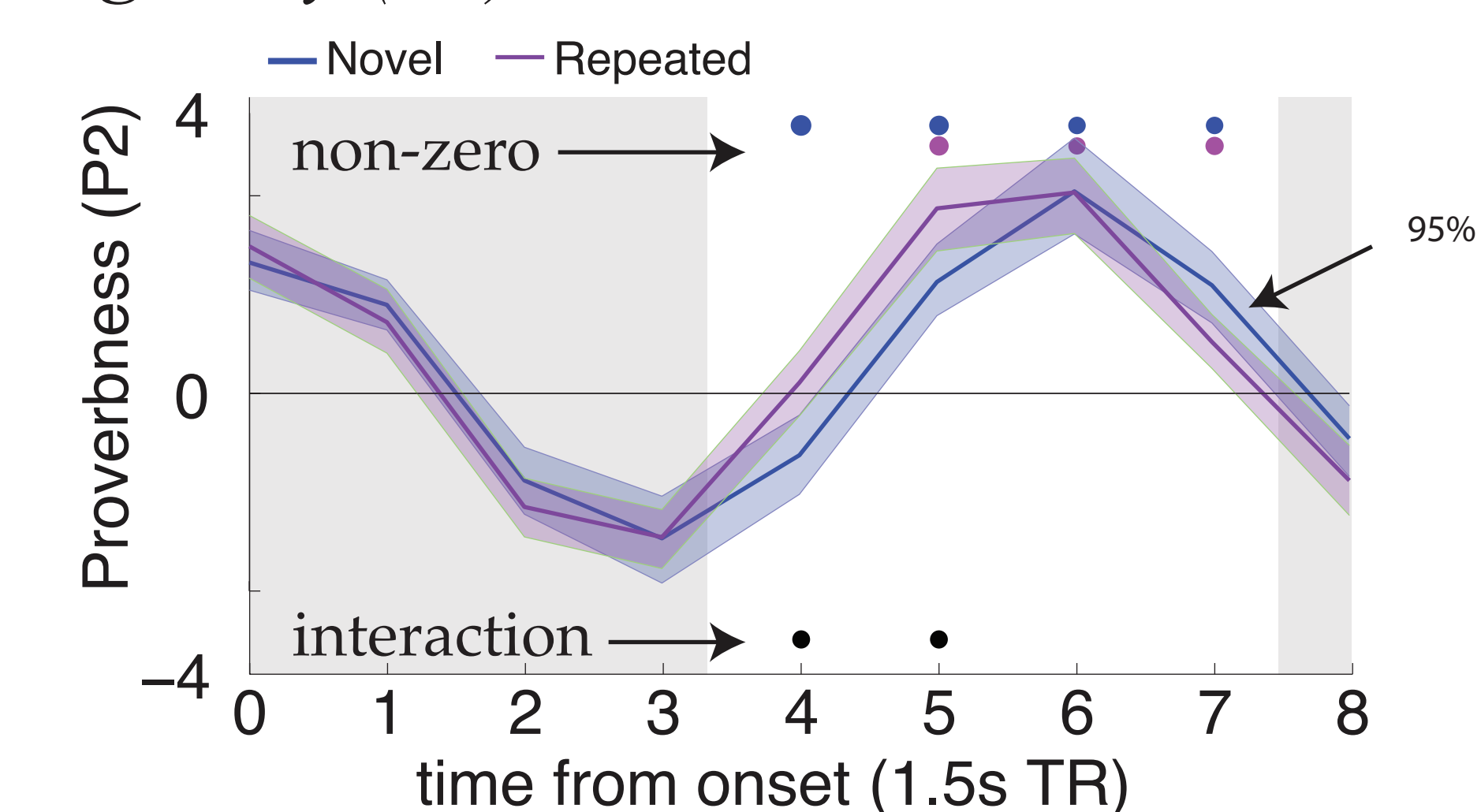
Proverbness (P2): A¹ X¹ B² Y² baseline Xval. perf.: 0.69 ($P < 0.001$)

- Classifiers trained and tested using ridge regression on blocked data; penalty 0.1; feature selection of the 6500 most discriminative voxels; four cross-validation folds (with one run left out); P2 classifier readout reconstructed using the unit activation values from each left-out test run (i.e., in a non-circular fashion).

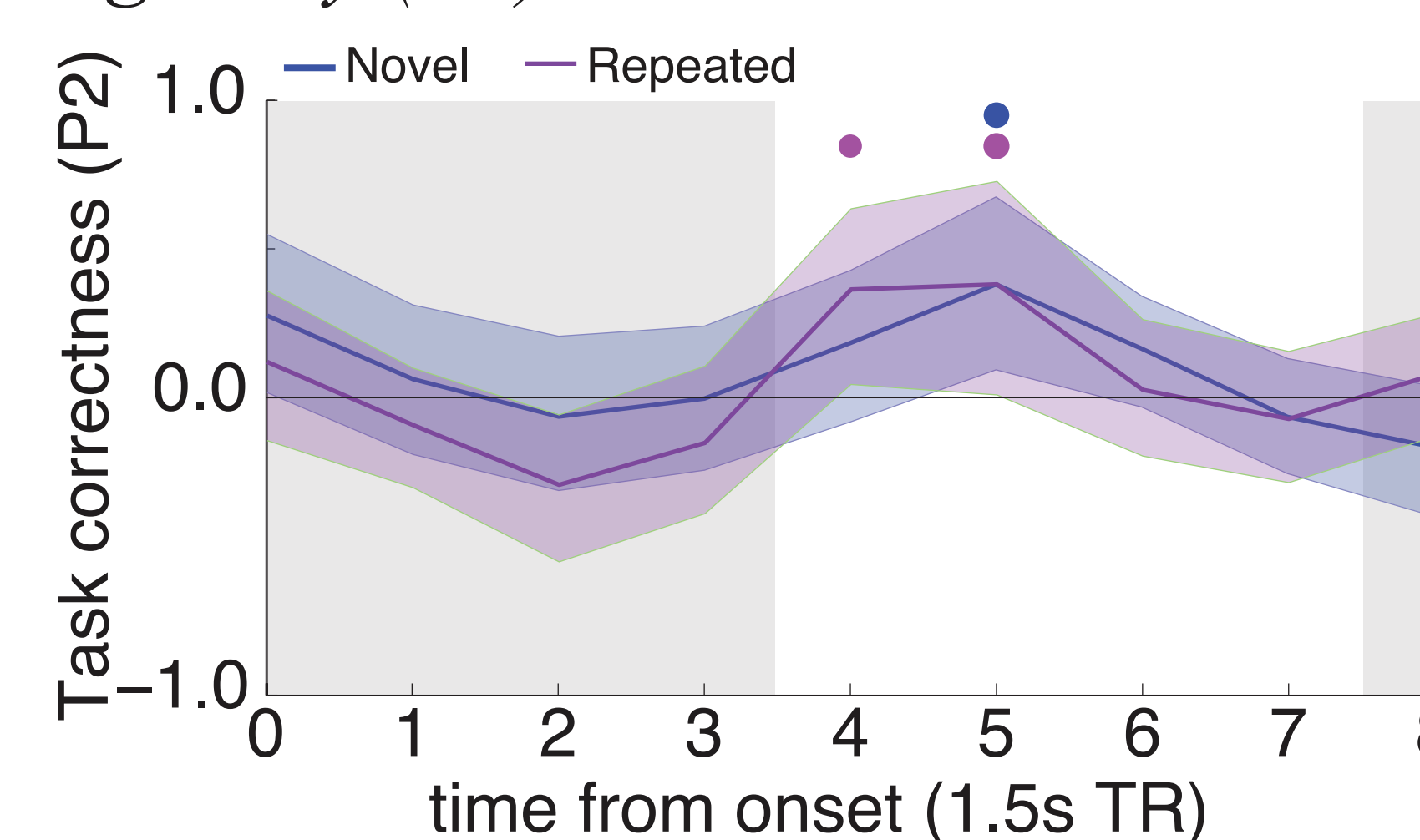
5. Item and task processing during the study phase

a. Attention hypothesis: novel items will have more item focus and less task-appropriate processing at study (P2).

- *Proverbness: not greater for novel items during study (P2).*

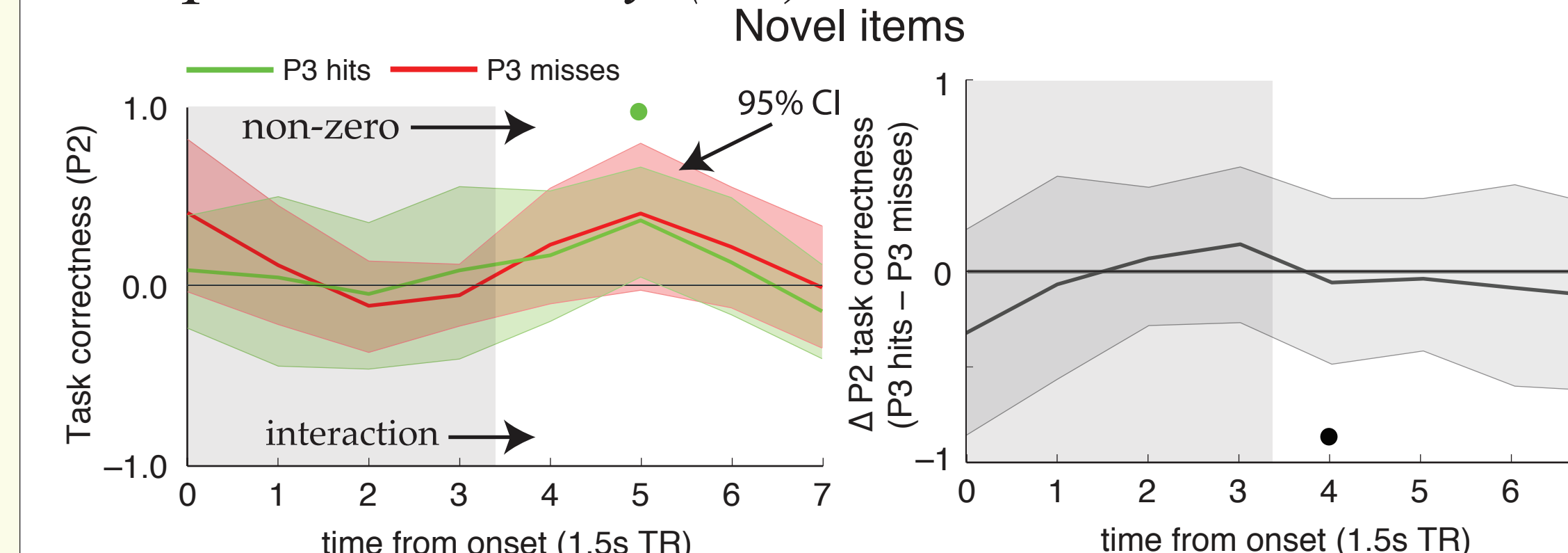


- *Task correctness: not less for novel items during study (P2).*

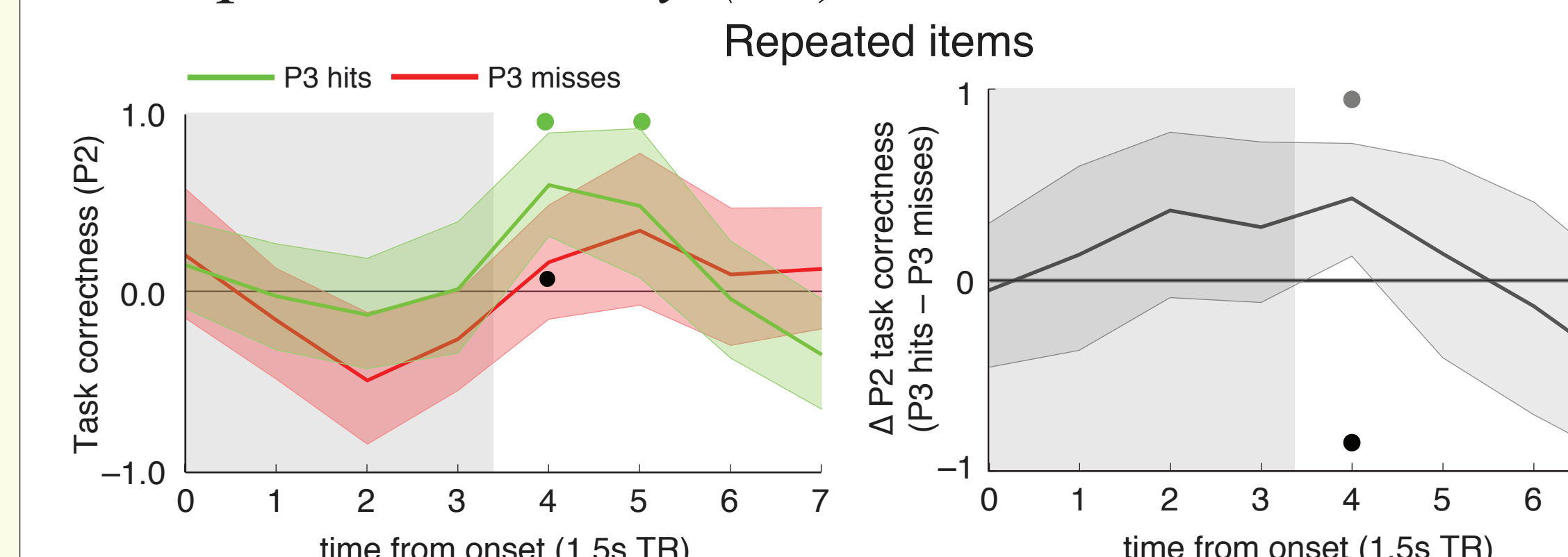


b. Scaffolding hypothesis: participants perform the task for both novel and repeated items during study (P2). An episode is retained only for items with prior representation (i.e., those repeated in P1), upon which new episodic memories may adhere.

- *Novel items: task correctness at study (P2) does not predict memory (P3).*



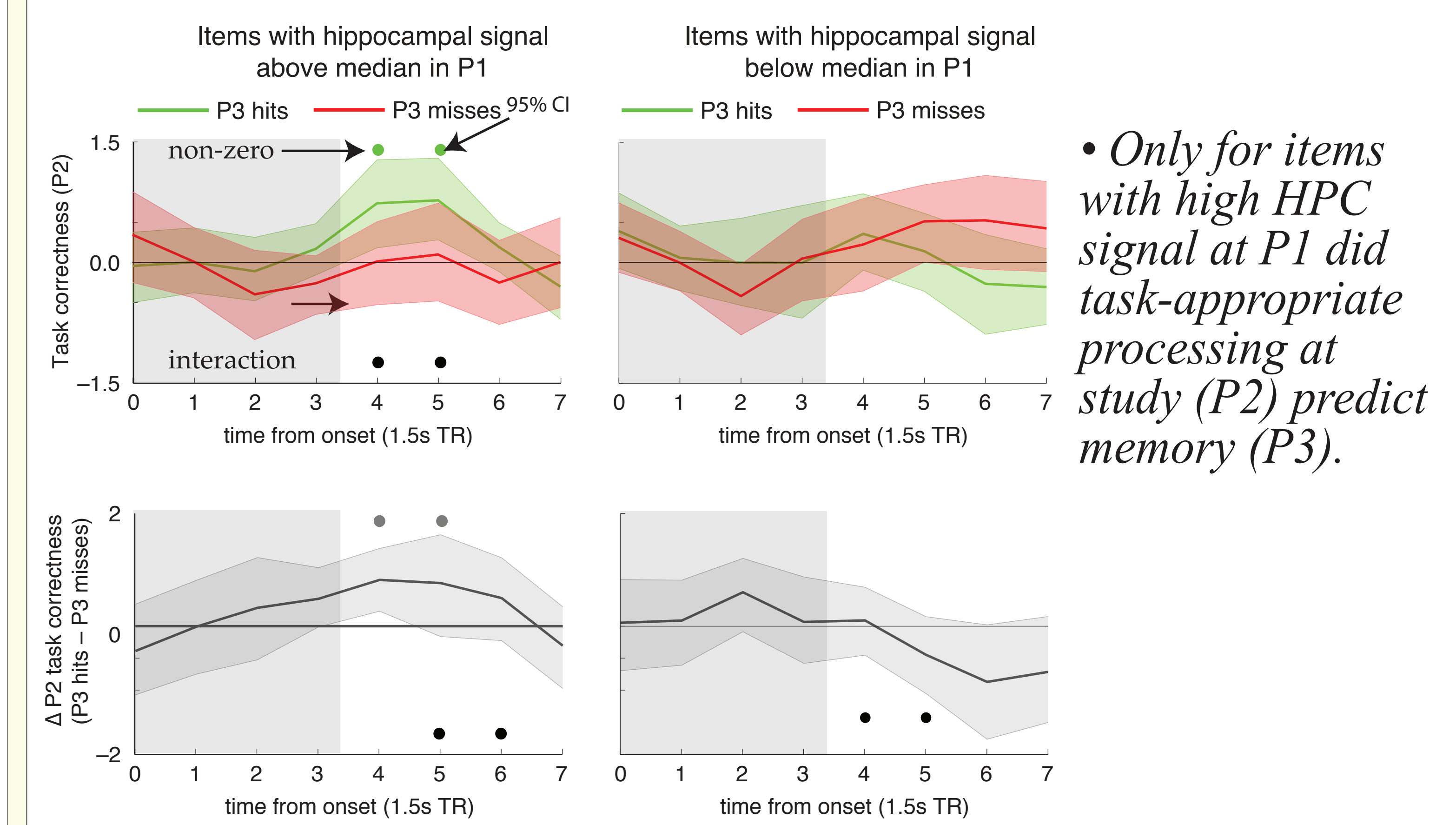
- *Repeated items: task correctness at study (P2) does predict memory (P3).*



6. Repetition phase modulation

Scaffolding hypothesis: memory formation during repetition (P1) determines whether task correctness at study (P2) will lead to episodic memory at test (P3).

- Hippocampal signal linked to memory for recent memory in many studies.
- Extracted repetition phase (P1) peak hippocampal signal for each item using customized masks.
- Sorted repeated items on the basis of their P1 hippocampal signal and repeated analysis from 5b.



- *Only for items with high HPC signal at P1 did task-appropriate processing at study (P2) predict memory (P3).*

7. Conclusions

Our results best support a scaffolding account of the mnemonic benefits of repetition.

- Contrary to attention account, task-correct processing is not lower for novel items, and item processing no higher for novel items.
- Repeated but not novel items are “sticky”, consistent with scaffolding account.
- Hippocampal signal from repetition phase predicts later stickiness, consistent with scaffolding account.

References

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- Poppenk, J, Köhler, S, & Moscovitch, M (2010). Revisiting the novelty effect: when familiarity, not novelty, enhances memory. *JEP:LMC*. 1321-1330.
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