

Investigating Remapping and Replay in a Spatial Memory Reconsolidation Task

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1. Introduction

- Re-exposure to the experimental environment/context can trigger memory reconsolidation in humans (Hupbach et al., 2008) and rodents (Artinian et al., 2007; Jones et al., 2012).
- Hippocampal place cells represent spatial location, and their activity changes ("remaps") across different spatial contexts.
- Place cell activity during a task is repeated during post-task rest/sleep. Evidence suggests this "replay" underlies systems memory consolidation.
- The objective of this study is to investigate remapping and replay of hippocampal place cells during a spatial reconsolidation task.

2. Methods

Animals

Male Brown Norway rats, 8-12m old.

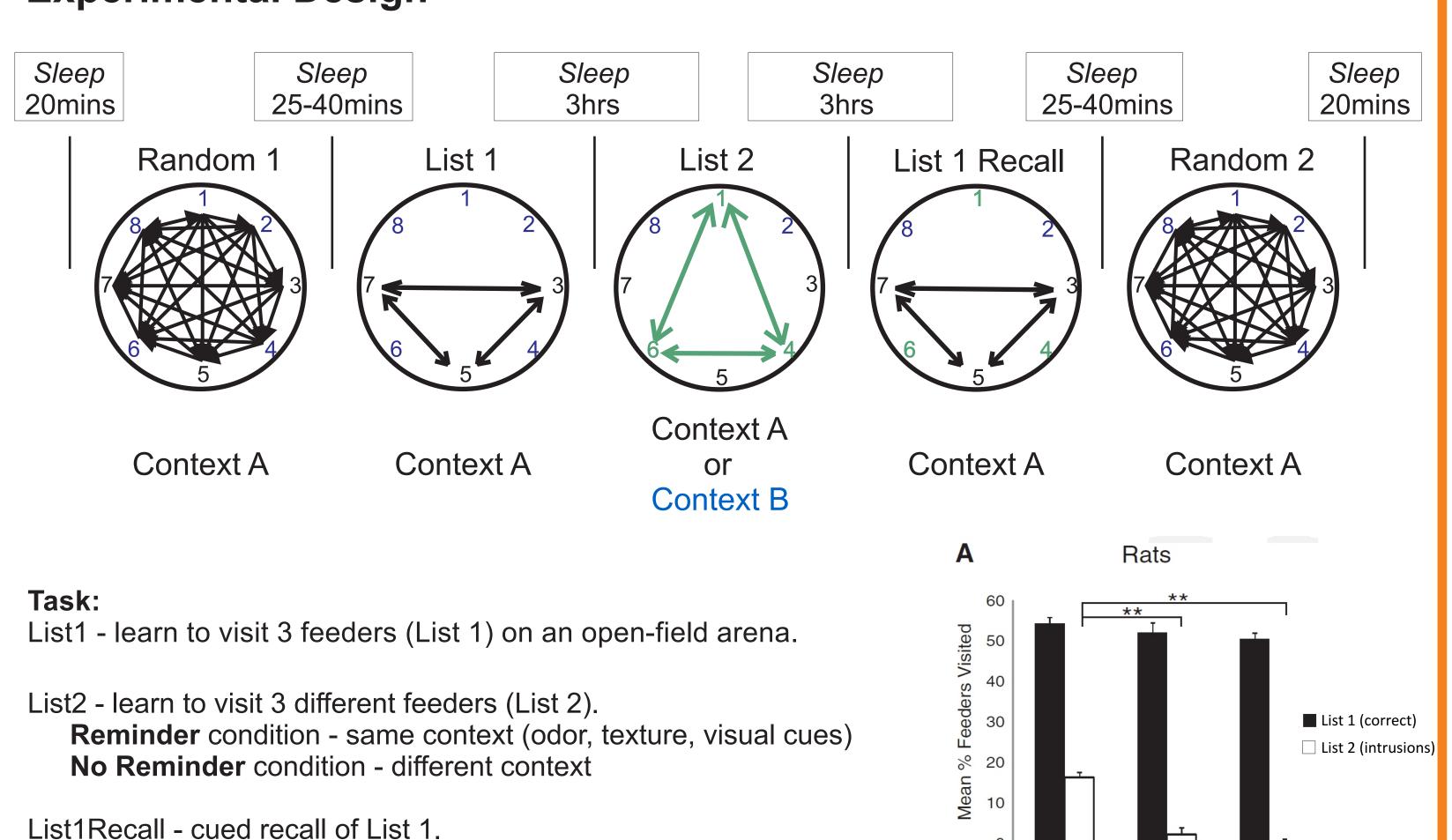
Behavioral Apparatus

- Open field arena with 8 equally spaced feeders containing sugar water.
- Multi-unit chronic recordings using the hyperdrive technique. 12 Tetrodes, 2
- Recordings from hippocampus CA1.

Context

 Combination of odor, texture, and visual cues in the room.

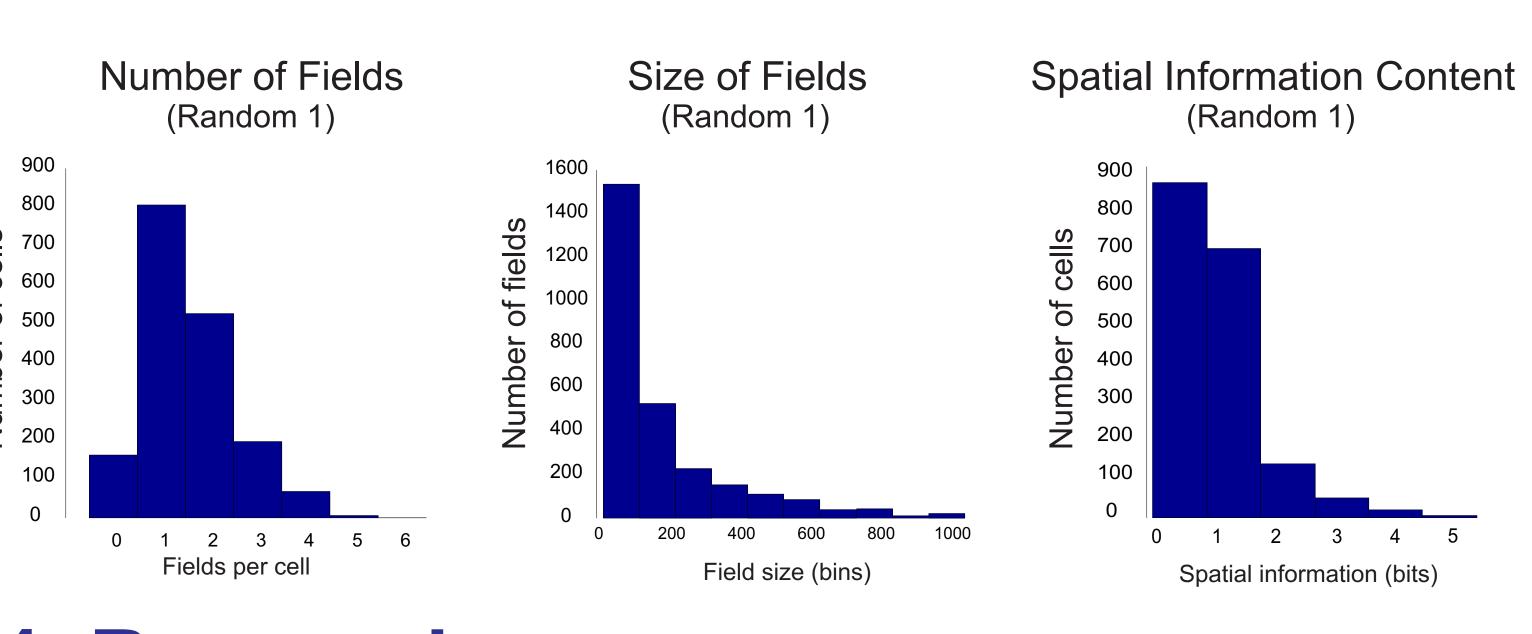
Experimental Design



n = 12 Control

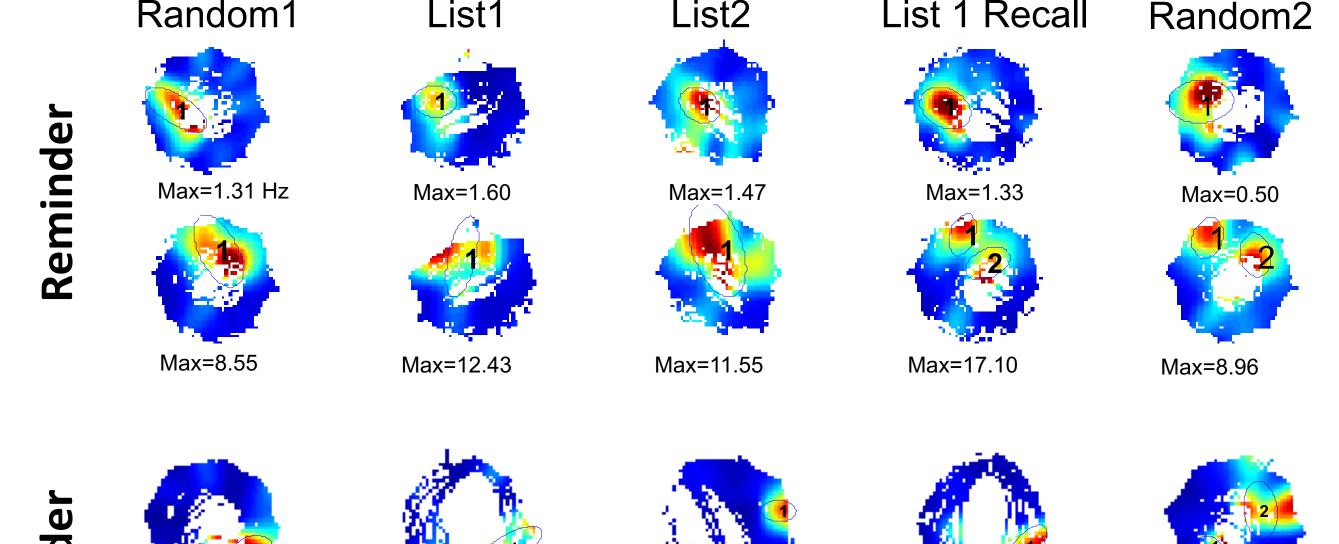
(Jones et al. 2012)

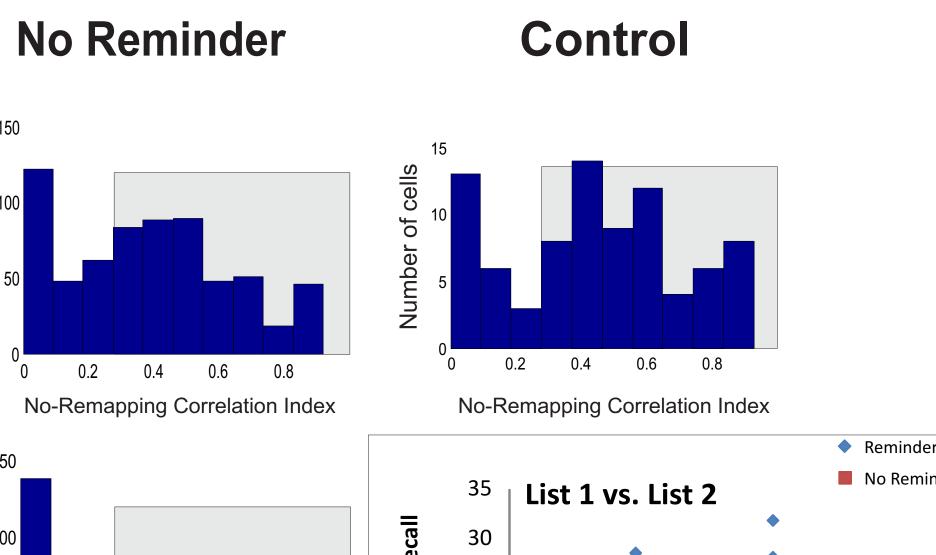
3. Basic Cell Properties

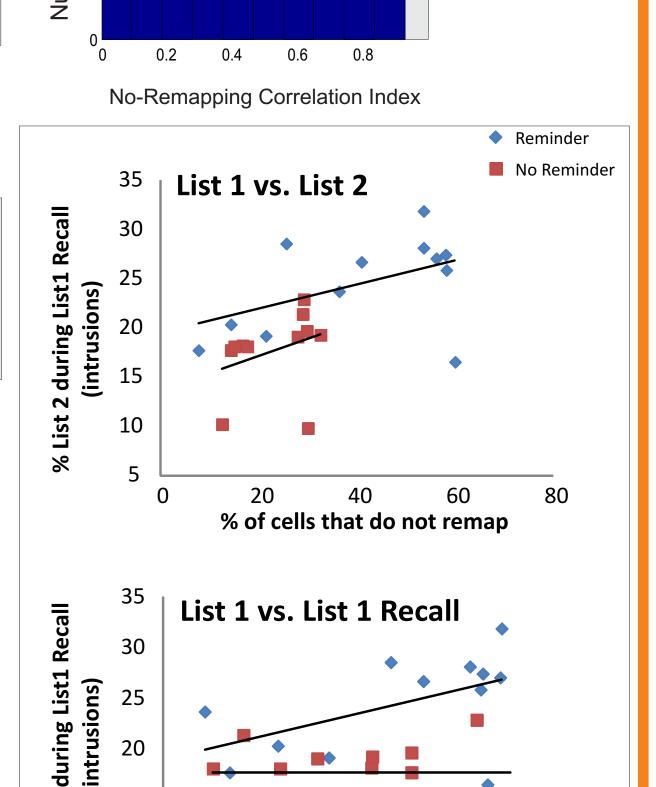


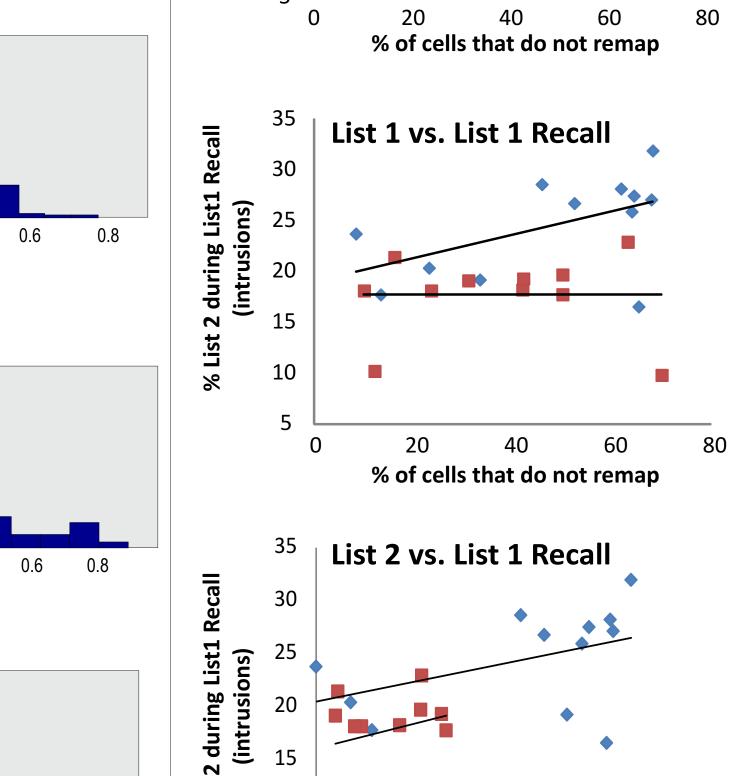
4. Remapping

Reminder





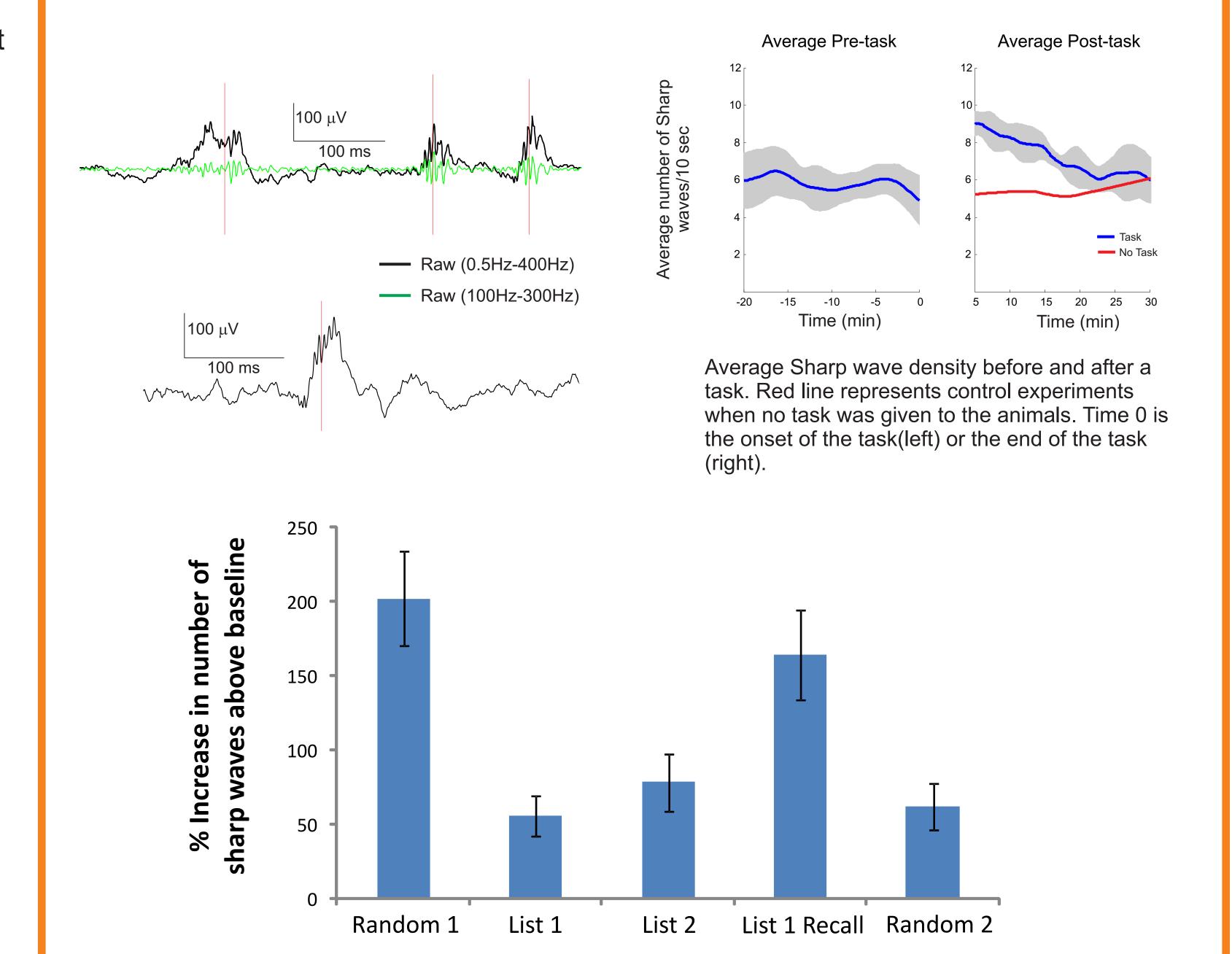




10

% of cells that do not remap

5. Sharp waves



Sharp Waves and Behavior

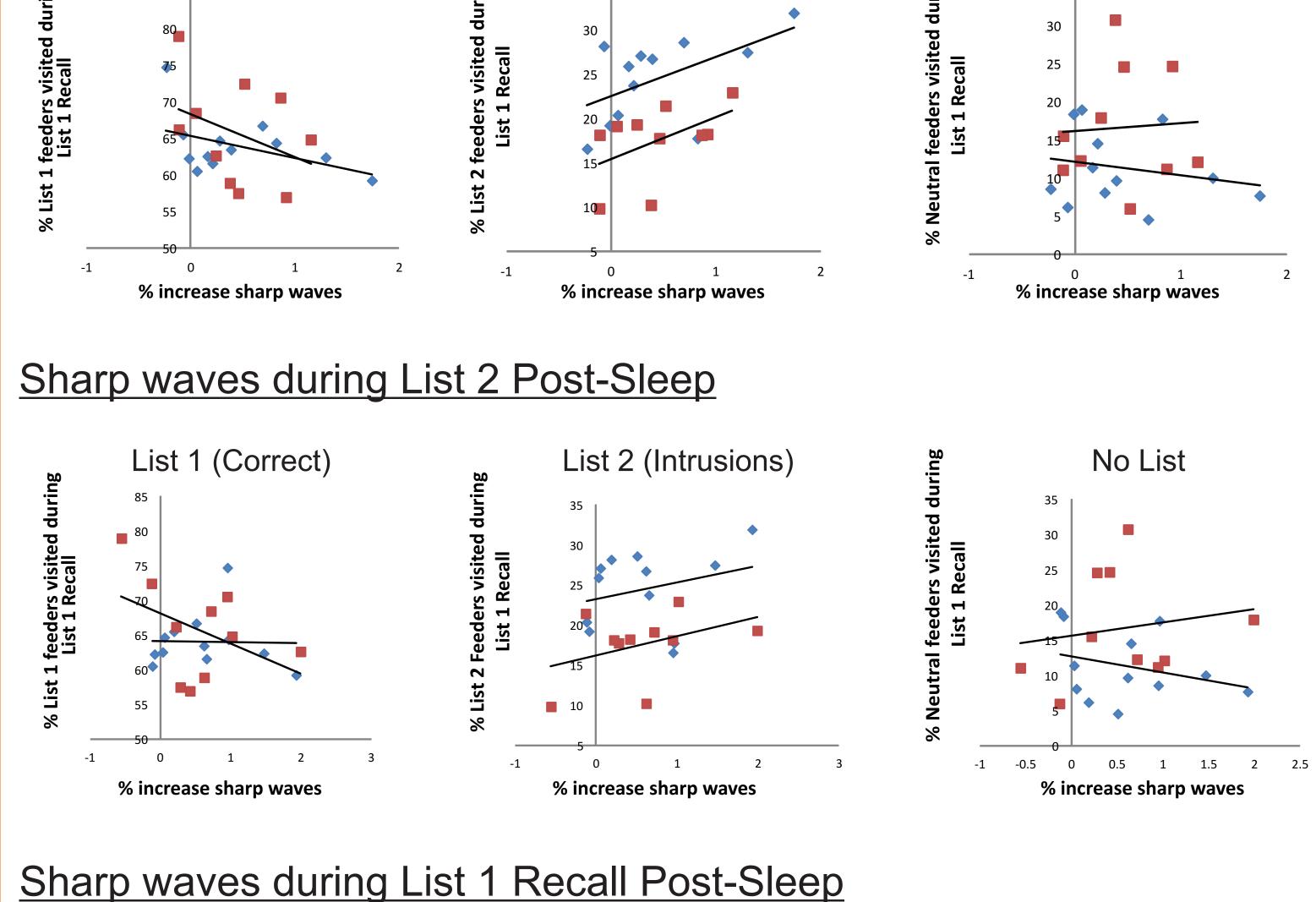
List 2 (Intrusions)

Sharp waves during List 1 Post-Sleep

List 1 (Correct)

List 1 (Correct)

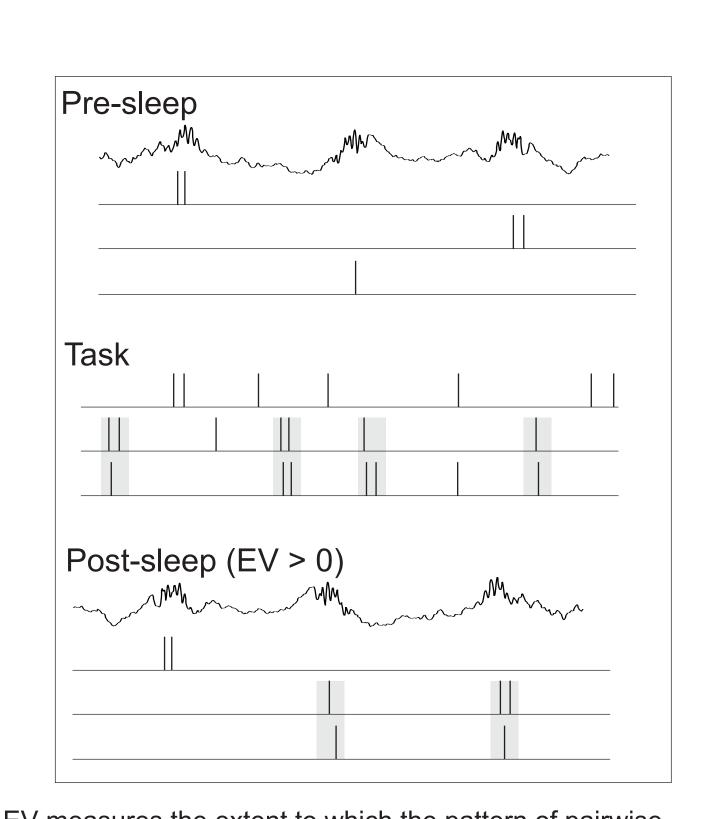
% increase sharp waves



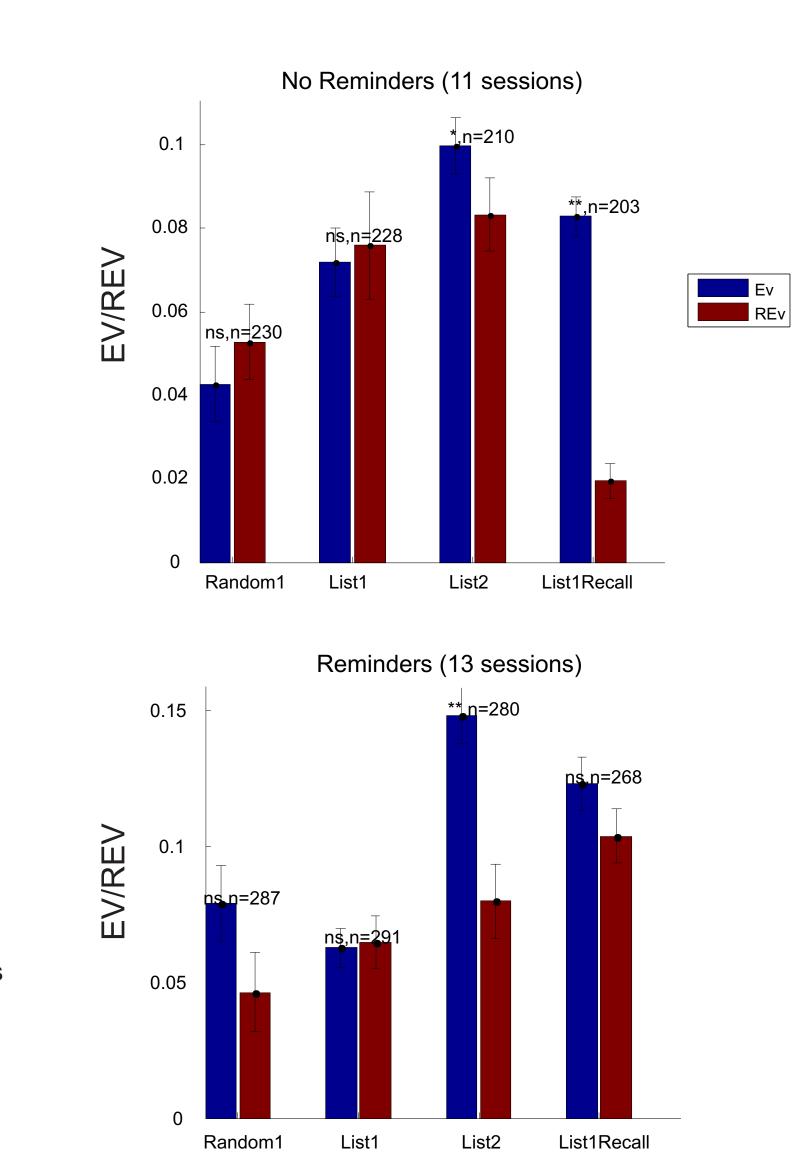
List 2 (Intrusions)

% increase sharp waves

6. EV vs REV



induced by the task, factoring out any pre-existing correlations (Kudrimoti et al. 1999, Kruscal et al. 2007).



7. Conclusions

Reminder

No List

No List

-

% increase sharp waves

No Reminder

- A contextual change in the task results in more remapping.
- Place field stability is affected by intervening tasks (R1 Vs R2, L1 Vs L1r).
- Place field stability during leaning is predictive of memory intrusions during recall, regardless of environmental contextual cues.
- Spatial learning tasks lead to increases in the number ad density of sharp waves during the first 10-15 mins of post-task sleep.
- Increase in sharp waves after learning List 1 or List 2 is weakly positively correlated with intrusions of list 2 into list 1 recall.

Hupbach A, Hardt O, Gomez R, Nadel L. The dynamics of memory: Context-dependent updating. Learning and Memory, 15:574-579 (2008). Hippocampus, 17(3):181-91 (2007).

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Kruskal PB, Stanis JJ, McNaughton BL and Thomas PJ. A 2007 binless correlation measure reduces the variability of memory reactivation estimates. Stat Med, 26(21):3997-4008

Kudrimoti HS, Barnes CA, McNaughton BL.1999. Reactivation of hippocampal cell assemblies: Effects of behavioral state, experience, and EEG dynamics. Jneurosci 19:4090-4101.

9. Acknowledgements

We would like to thank Eric, Kael, Justin for help with spike sorting and data analyses. This project was funded by NIH grant R36AG034230 through the National Institute on Aging and in part by the Graduate Interdisciplinary Program in Neuroscience and NSF grant CRCNS 1010172.

8. References

Artinian J, De Jaeger X, Fellini L, de Saint Blanquat P, Roullet P. Reactivation with a simple exposure to the experimental environment is sufficient to induce reconsolidation requiring protein synthesis in the hippocampal CA3 region in mice.