The Effects of Aging on Spatial Memory Reconsolidation in Rats

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1. Introduction

- Memory reconsolidation is the process by which memories which have been de-stabilized due to reactivation are re-stabilized and updated.
- Re-exposure to the experimental environment has been shown to trigger reactivation and updating in humans (Hupbach et al., 2008) and rodents (Artinian et al., 2007).
- Most studies of memory reconsolidation have used aversive learning tasks.
- Aging is associated with episodic memory impairments. However, no research has been done to study the effects of aging on memory reconsolidation.
- The objective of this study is to compare the updating of positively-motivated spatial memories in young and aged rats.

2. Methods

Animals

• Male Fischer 344 and Fischer 344/Brown Norway hybrid rats which were mildly food deprived.

Watermaze

. •Rats use distal visual cues to learn the location of a hidden platform. Four consecutive days, 6 trials per rat per day.

Behavioral Apparatus

. • Open field arena with 8 equally spaced feeders (sugar water) with LED lights.

Context

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

Training

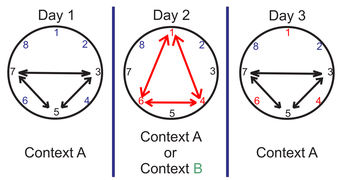
• Pretraining
• List Training: rats learn a list of 3 feeders (e.g., 3-5-7) in a pseudo-random order.

Test

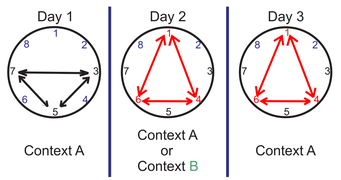
• Rats are cued to recall a particular list of feeders.

Experimental Design

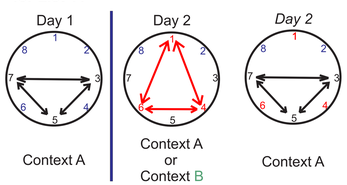
Experiment 1:
Does reactivating the List 1 memory prior to new learning result in incorporation of new information into List 1?



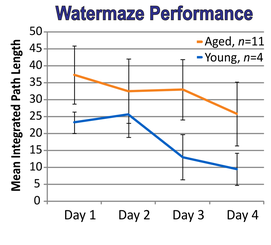
Experiment 2:
Does reactivating the List 1 memory prior to new learning affect List 2?

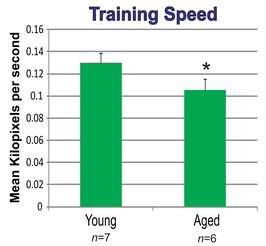


Experiment 3:
Does reactivating the List 1 memory prior to new learning *immediately* affect the memory for List 1?

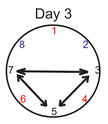


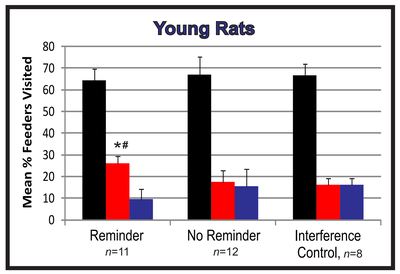
3. Baseline differences between young and aged rats

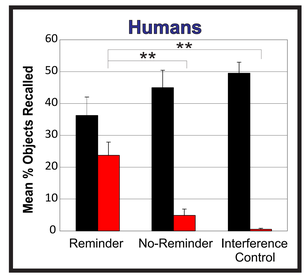




4. Exp 1: A reminder triggers memory intrusions in young rats but not in aged rats

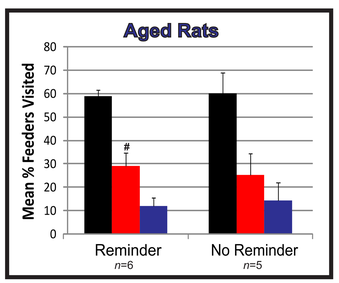


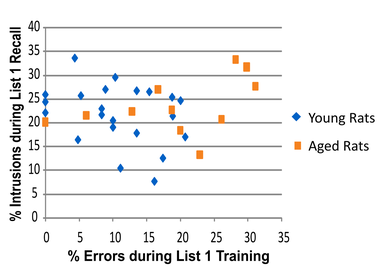




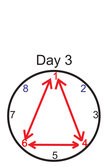
Adapted from Hupbach et al. (2007)

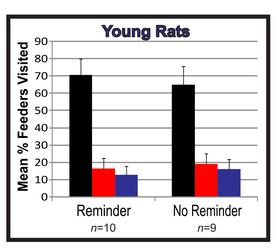
- Recall (List 1)
- Intrusions (List 2)
- No List

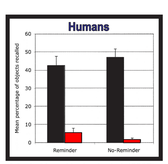




5. Exp 2: Memory intrusions are asymmetric

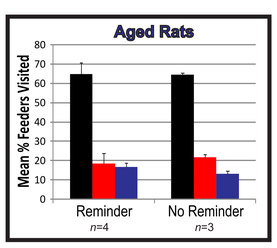




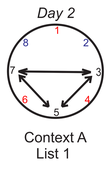


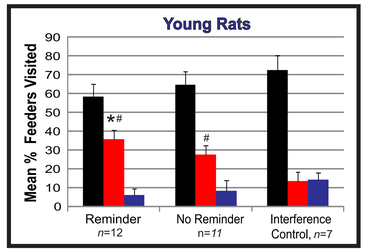
Adapted from Hupbach et al. (2007)

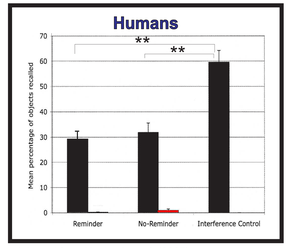
- Recall (List 2)
- Intrusions (List 1)
- No List



6. Exp 3: Memory intrusions occur early in young rats but not in aged rats







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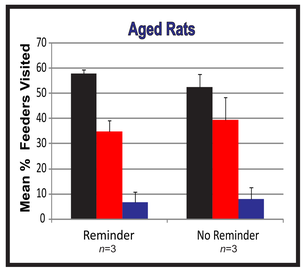

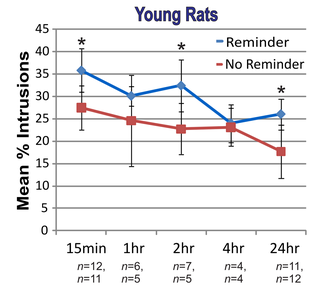

7. Conclusions

- Reactivating a positively-motivated spatial memory with contextual cues allows for updating to occur in young rats.
- Updating occurs in the reactivated memory but not in the new memory.
- In young rats, memory intrusions occur early and may reflect a competition between the reactivated memory trace and the new memory trace.
- The absence of updating in aged rats suggests that the types of contextual cues used here are not as salient of a reminder for aged animals as they are for young rats.
- Using high-density chronic recordings from the hippocampus, this paradigm will allow us to compare the neural correlates of memory updating between young and aged rats.

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. Hippocampus.17(3):181-91 (2007).

Hupbach A, Gomez R, Hardt O, Nadel L. Reconsolidation of episodic memories: a subtle reminder triggers integration of new information. Learning and memory 3;14(1-2):47-53 (2007).

Hupbach A, Hardt O, Gomez R, Nadel L. The dynamics of memory: Context-dependent updating. Learning and memory 15:574-579 (2008).

9. Acknowledgements

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