Effects of Behavioral Interventions on Episodic-Like Memory in Aged and Young Rats

Anne Mains, Brynn T. Critcher, Sarah L. Stuebing, & Kimberly Kirkpatrick
Department of Psychological Sciences | Kansas State University

Introduction

- Episodic memory is the integration of discrimination (what), spatial navigation (where), and timing (when) substituents of past personal experiences of an individual.[1,2]
- Episodic memory is one of the first types of memory to start declining in both the normal aging processes and in dementia.[3]
- This study aimed to compare the episodic-like memory performance of aged and young rats through the use of interventions targeted toward each individual substituent.
- Cholinergic activity in the hippocampus has been implicated in episodic memory function.[4]
- Further work will be done to compare the episodic-like memory performance and cholinergic functioning of aged and young rats.

Methods

Subjects

- 24 male Sprague Dawley rats
- Young group ~ 7 months old (n=12)
- Aged group ~ 23 months old (n=12)

(The human equivalent of 18 and 55 years old)

Baseline

- Rats were tested in an open field task where individuals searched for target locations of hidden food rewards
- 8 sessions per day, each session consisted of two different trials:

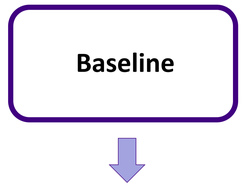
1. *Encoding trial*: rats learned the location of two targets
2. *Test trial:* rats utilized their episodic-like memory to find the target locations

Interventions

- Inter-trial Interval (ITI): 2min → 15min
- Food Discrimination: food pellets → more unique food rewards
- Spatial Uniqueness: 16 possible locations→ 8 possible locations

Analysis

- Recorded correct choices during test trials
- Analysis via generalized mixed effects modeling



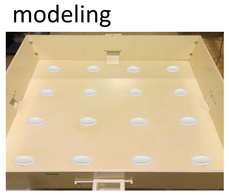


Figure 1. The open field table apparatus which consisted of 16 holes containing plastic cup food receptacles. The subjects could remove a plastic lid to access the food receptacle and obtain the reward.

Results

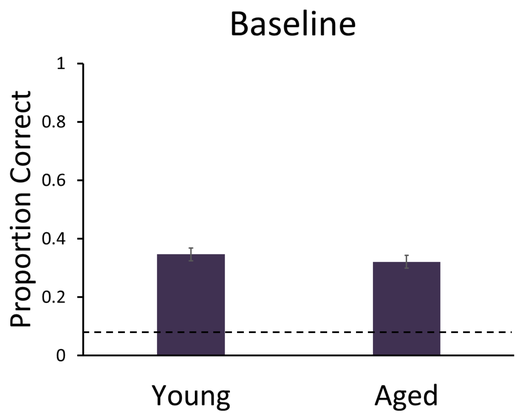


Figure 2. The mean proportion of correct choices made by young and aged groups in the baseline task. There were no significant differences in the proportion of correct choices made between the aged and the young rats. Both groups showed a poor level of performance, but were above chance.

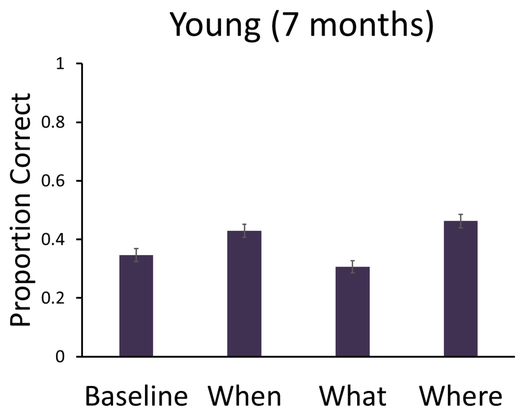


Figure 3. The mean proportion of correct choices made by the young group for each task. The food discrimination (what) intervention did not have a significant effect on performance. However, the young group made more correct choices during the ITI (when) and spatial uniqueness (where) interventions.

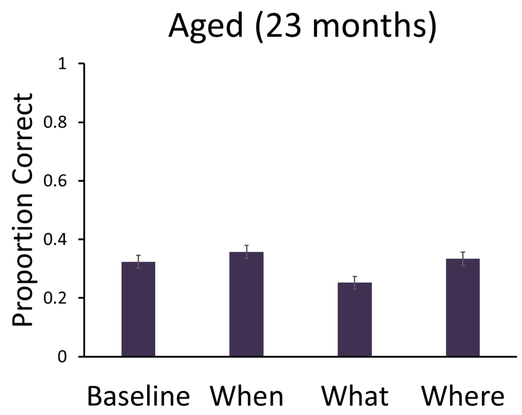


Figure 4. The mean proportion of correct choices made by the aged group for each task. The food discrimination (what) intervention significantly worsened the aged rat's performance, while the other interventions did not have any significant effect on performance.

Discussion

- Due to poor baseline performance by both groups, interventions were applied in an attempt to enhance memory performance.
- The groups did exhibit different responses to the interventions.
- The young rats completed significantly more correct trials during the ITI (when) and spatial uniqueness (where) interventions.
- The when and where interventions did not significantly assist the aged rats in making more correct choices compared to their baseline performance. However, in the what intervention, the aged rats made significantly fewer correct choices than in the baseline.
- These findings indicate that supporting one substituent of episodic-like memory can improve performance.
- Interventions may need to be administered earlier in the aging process in order to be most effective.
- These findings may provide insight for future behavioral mechanisms towards episodic memory improvement.

Future Directions

- Future work aims to analyze ChAT levels in the hippocampus of both groups of rats and compare findings to performance in each task.
- Choline acetyl transferase (ChAT) is used to measure acetylcholine (ACh) levels because it synthesizes ACh.[4]
- A hippocampal ChAT assay was utilized in order to examine potential deficits in cholinergic function.
- The stained cells will be quantified through optical density measures and results will be compared to behavioral findings.

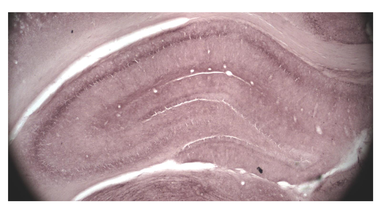


Figure 5. Image of brain tissue stained with the hippocampal ChAT assay that will be used for optical density analysis.

Acknowledgments

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References

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Email: amains14@ksu.edu or brynncritcher@ksu.edu