Effects of age on goal-dependent modulation of episodic memory retrieval

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Psychology Lecture Series

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fNIM laboratory
functional Neuroimaging of Memory

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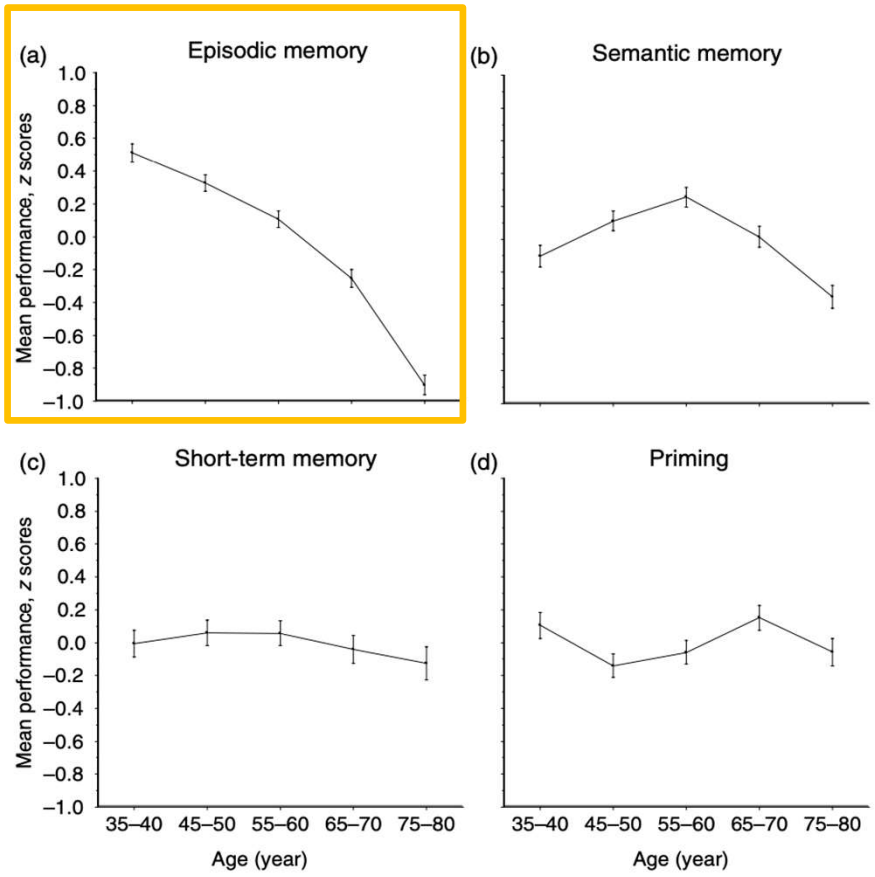
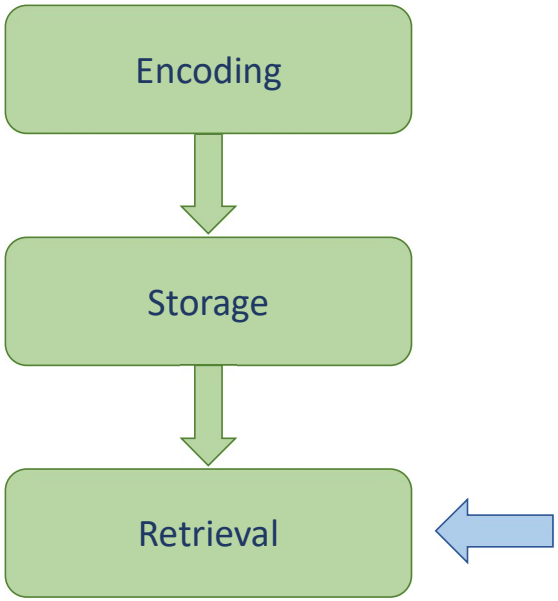
Episodic memory declines with increasing age

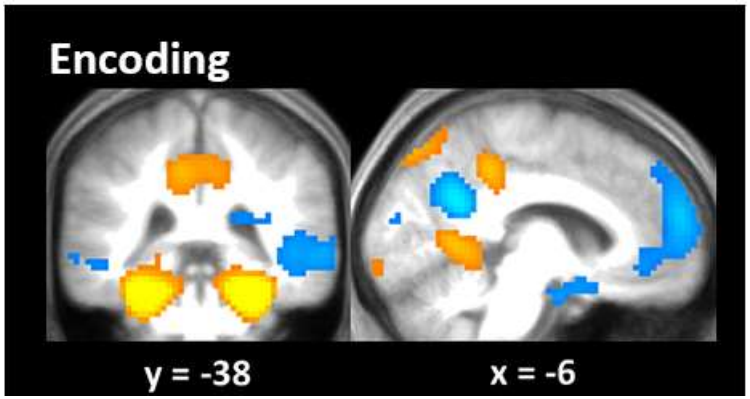




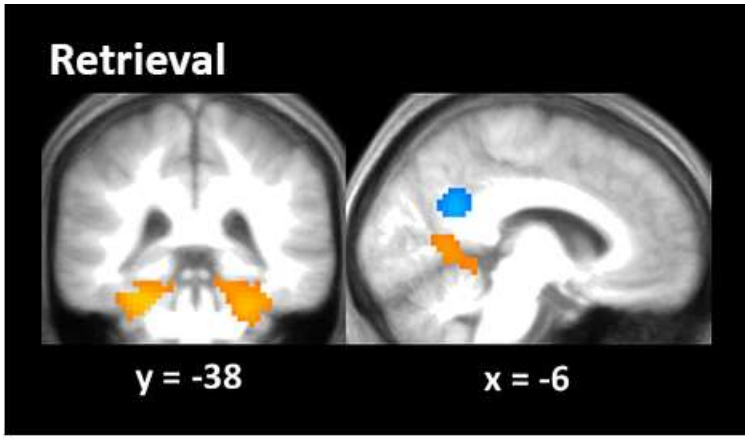
Nilsson, 2003

Cortical Reinstatement

Retrieval-related reactivation of neural patterns which were elicited during encoding



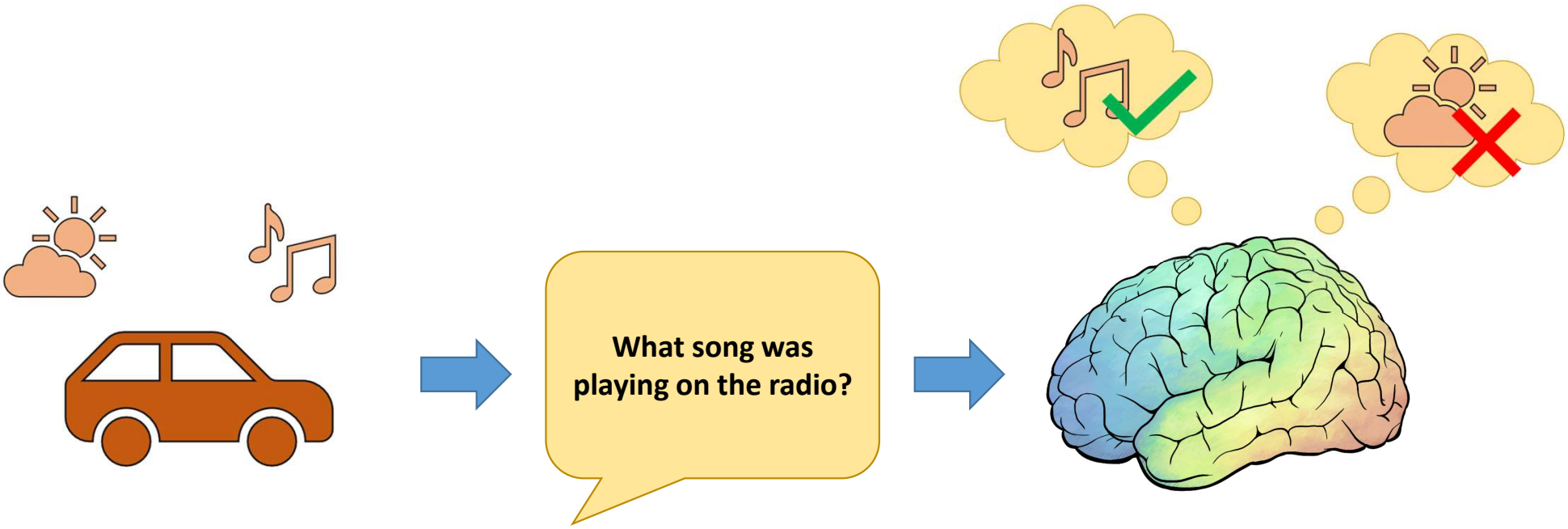
Viewing:
Faces and Scenes



Remembering:
Faces and Scenes

Hill et al., 2020

Episodic memory retrieval relies on the selection of information that corresponds with retrieval goals

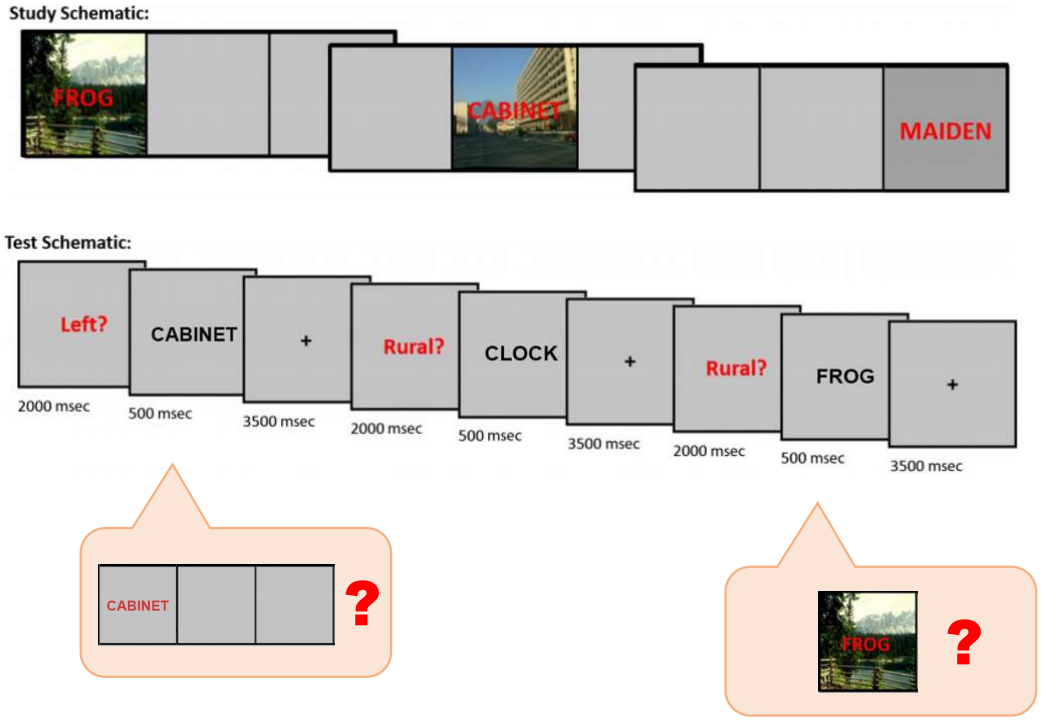


Memory Episode

Memory Retrieval

Retrieval Gating

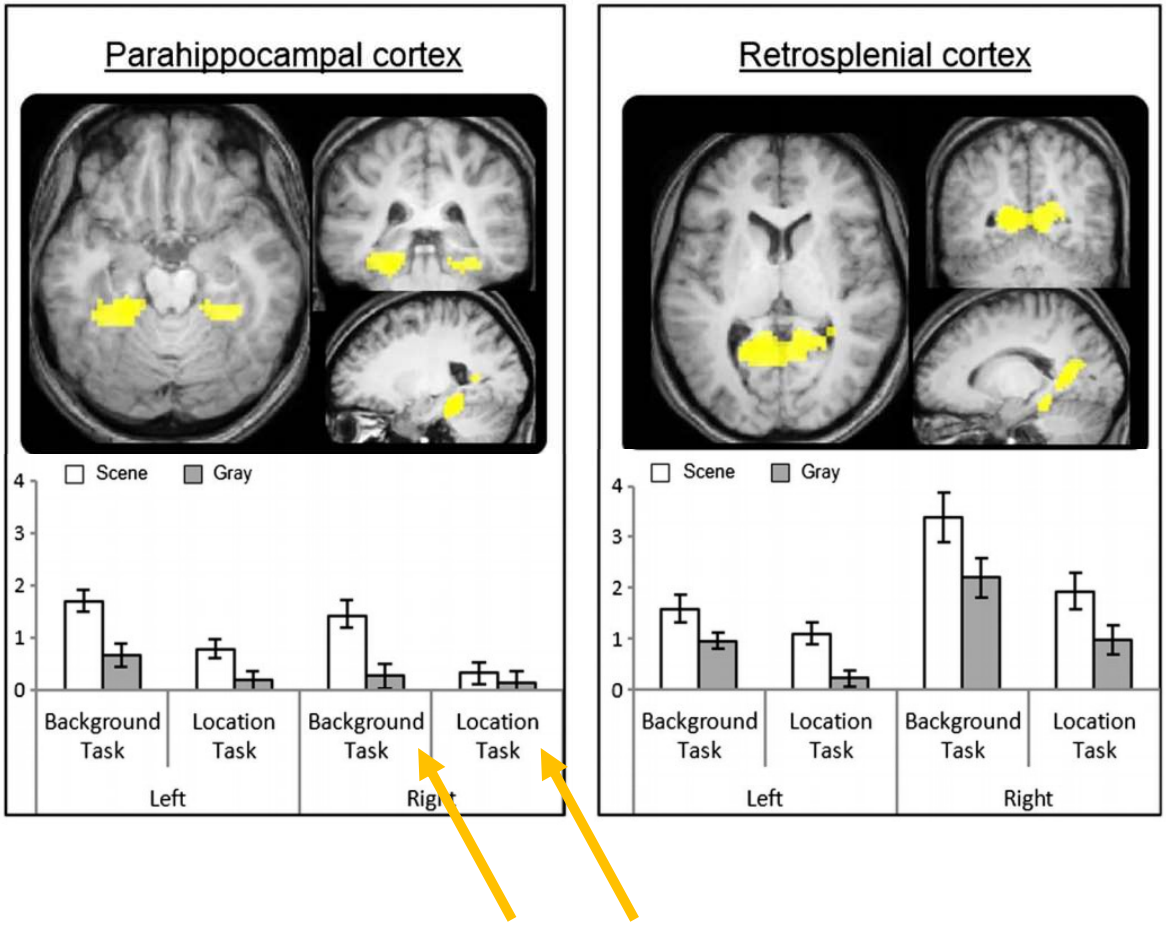
*Ability to modulate the retrieval of features belonging to a **single memory episode**.*



Elward & Rugg, 2015

Scene Reinstatement : Main effects

Scene > Gray

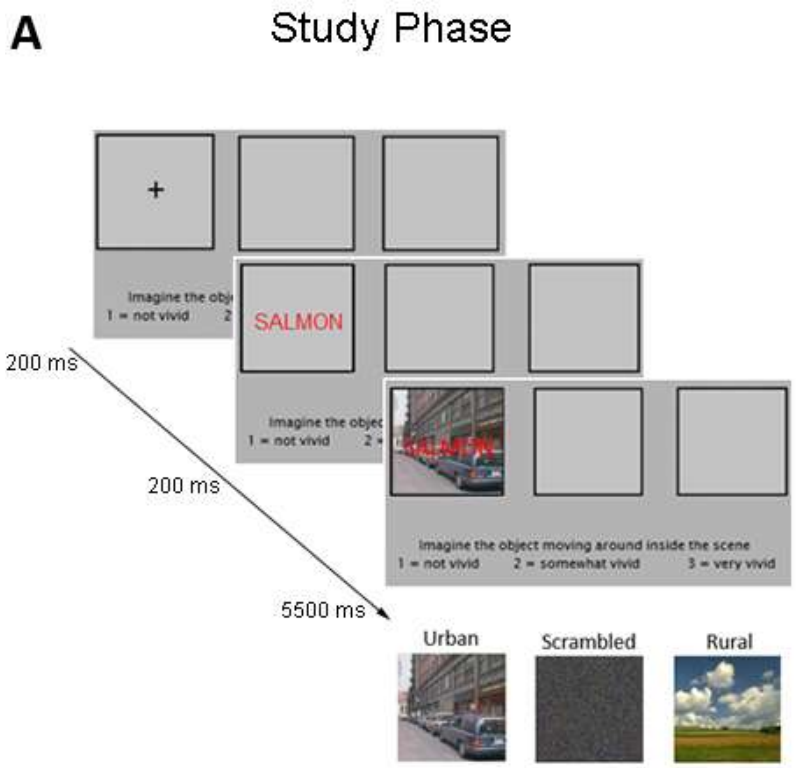


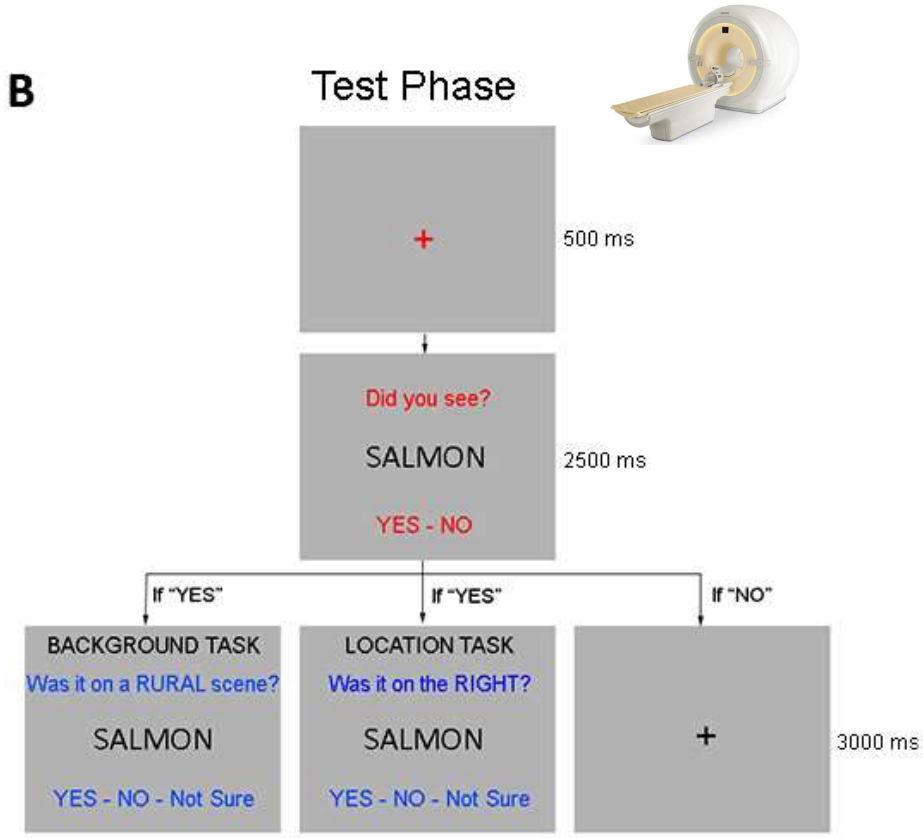
Elward & Rugg, 2015

Do older adults engage in retrieval gating?

- Inhibitory deficit hypothesis of aging *(Hasher & Zacks, 1988)*
- In the domain of working memory – reduced ability to strategically downregulate cortical activity in regions selective to task-irrelevant information *(Chadick & Gazzaley, 2011; Chadick et al., 2014; Weeks et al., 2020).*
  - *Unclear how these findings translate to episodic memory and retrieval gating.*
- **Prediction**: Older adults would be less able to modulate scene-related cortical reinstatement in accordance with the retrieval goal.

Experiment paradigm





Memory Performance

Item Memory

$$\frac{Item\ Hit}{Old\ Trials} - \frac{False\ Alarms}{New\ Trials}$$

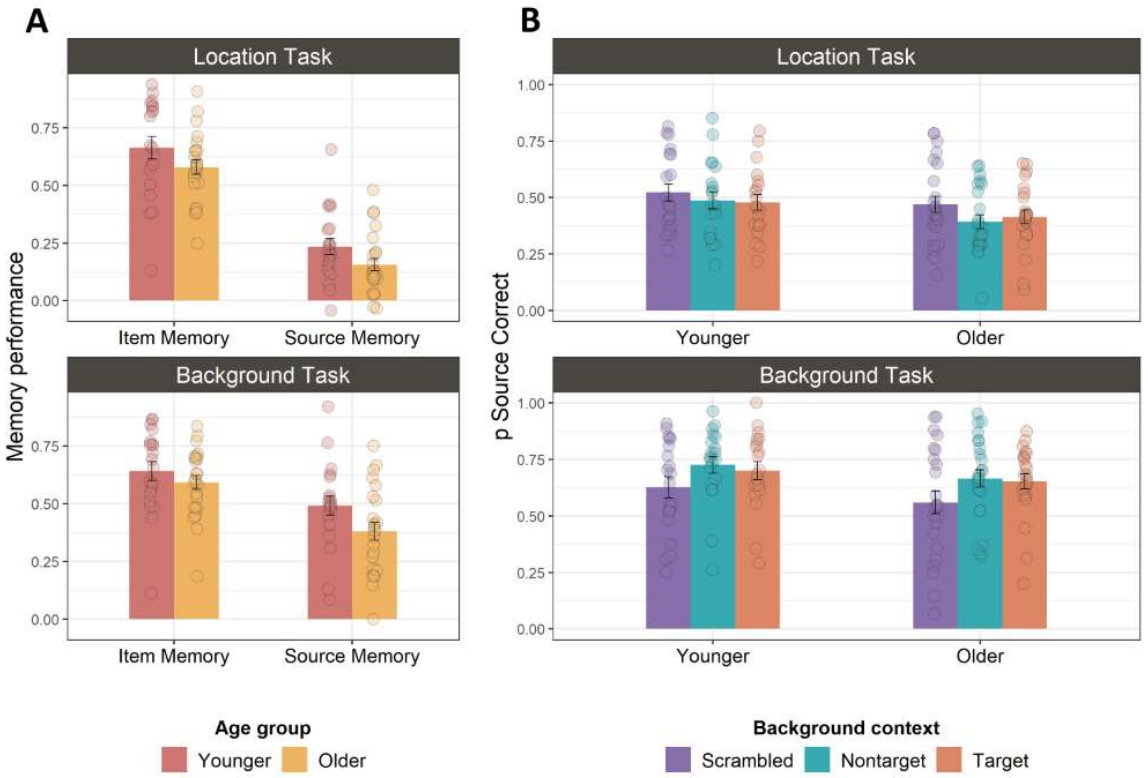
Source Memory

$$\frac{pSource\ Correct - 0.5 * (1 - pDon't\ Know)}{1 - 0.5 * (1 - pDon't\ Know)}$$

Item memory: No age or task effects.

Source memory: Worse location memory across both age groups, older adults had worse performance across both tasks.

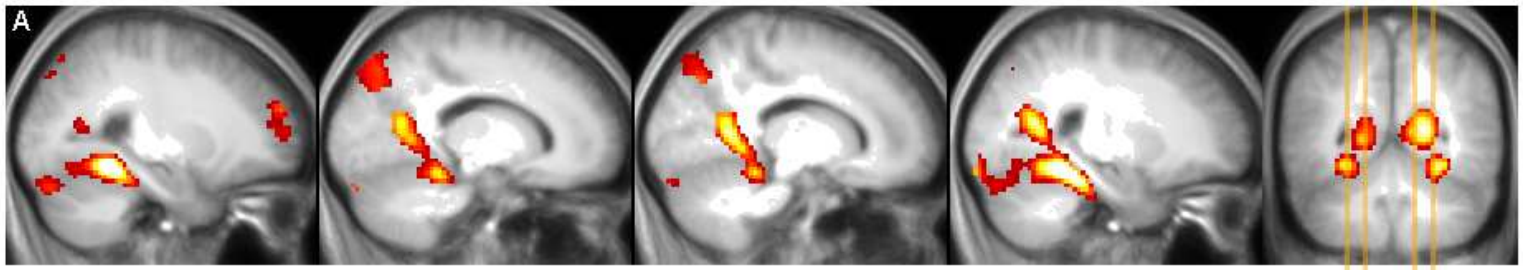
Effect of context: Words studied over scrambled (relative to scene) backgrounds were associated with better location memory but worse background memory across the two age groups.



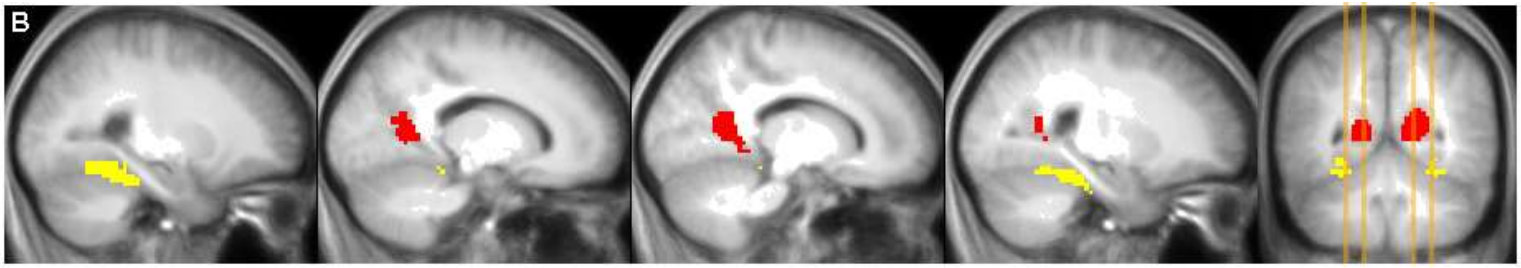
Region of Interest (ROI) definition

Functional localizer – blocks of scenes, objects, and scrambled backgrounds

2nd level GLM – Conjunction of Scene > Object and Scene > scrambled contrasts



Clusters delimited with anatomical masks



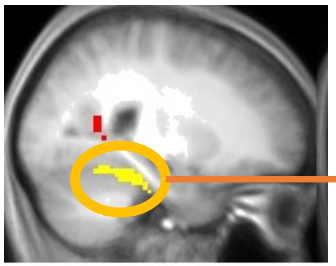
Parahippocampal place area (PPA)

Retrosplenial cortex (RSC)

Methods – Reinstatement Index

Test phase data subjected to a 'least-squares-all' GLM

Each trial modeled with delta function at stimulus onset → single-trial β-weights

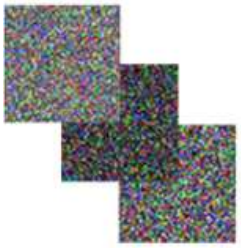


per ROI

per Retrieval Task

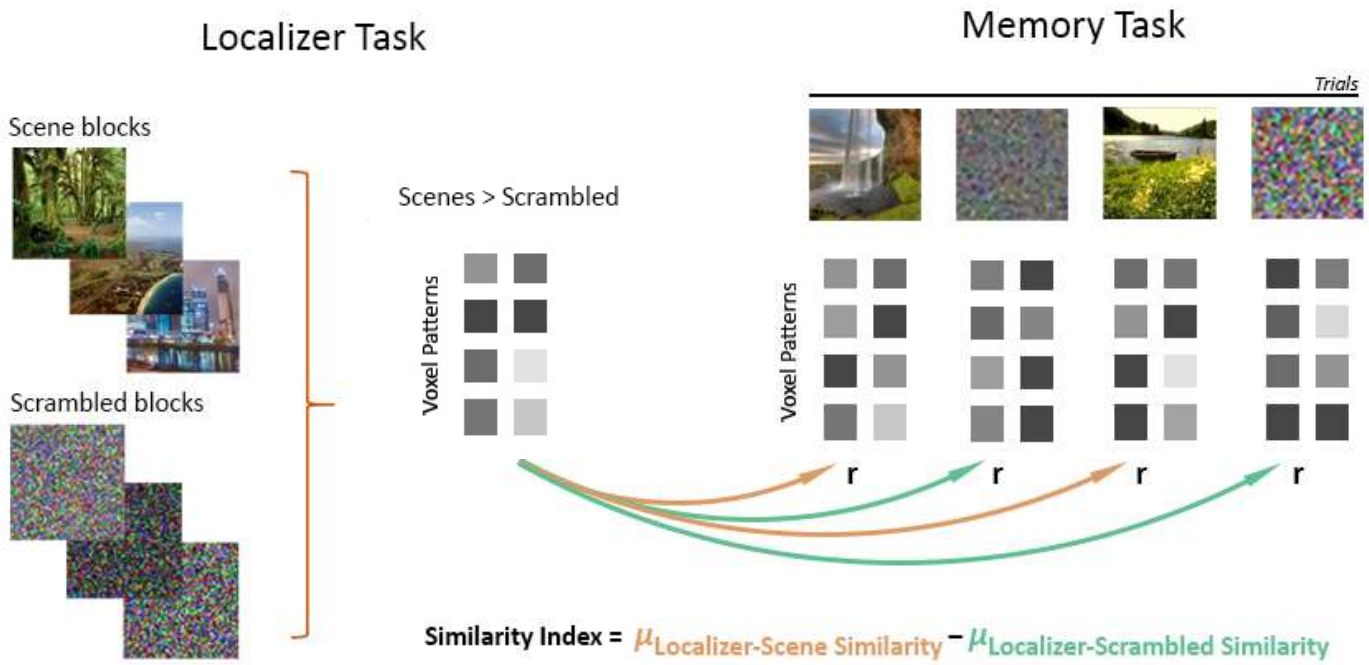
Test trials (words) studied over **scene** backgrounds

Test trials (words) studied over **scrambled** backgrounds



$$\textbf{\textit{Reinstatement Index}} = \frac{\mu_{scene} - \mu_{scrambled}}{\sqrt{\frac{\sigma^2_{scene} + \sigma^2_{scrambled}}{2}}}$$

Methods – Pattern Similarity Analysis



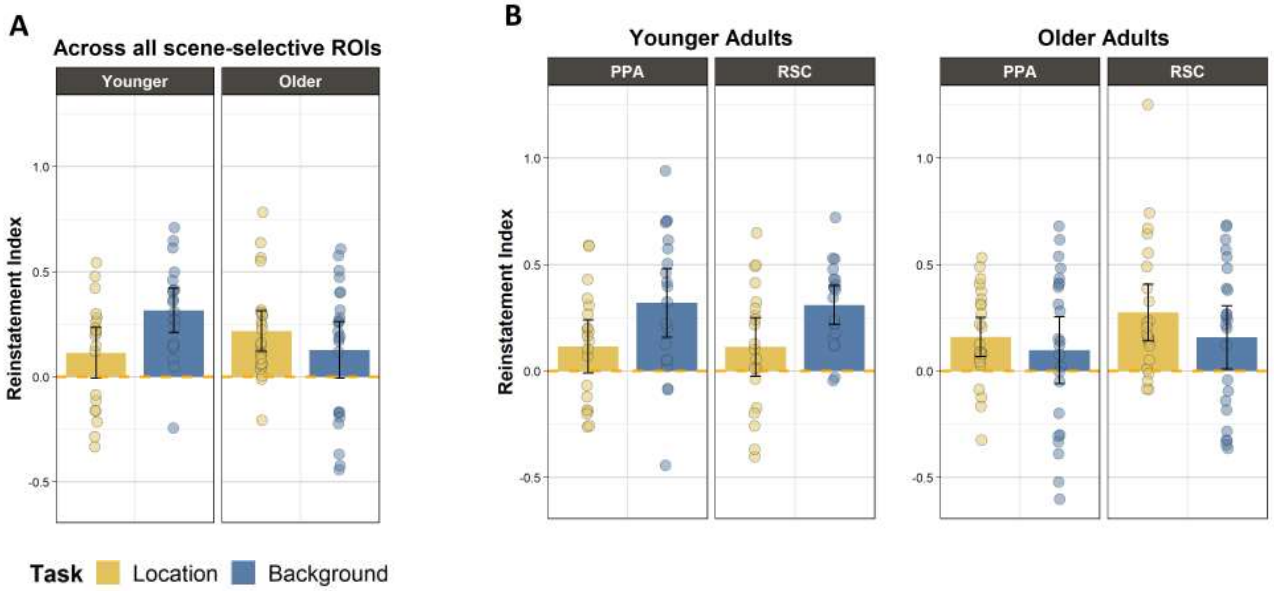
Results – Reinstatement Index

Age group x Retrieval task x Hemisphere x ROI ANOVA

Age group x Task: *p = 0.002*

Scene reinstatement across ROIs as a function of task separately in younger and older adults:

Younger adults: *p = 0.008*
Older adults: *p = 0.145*



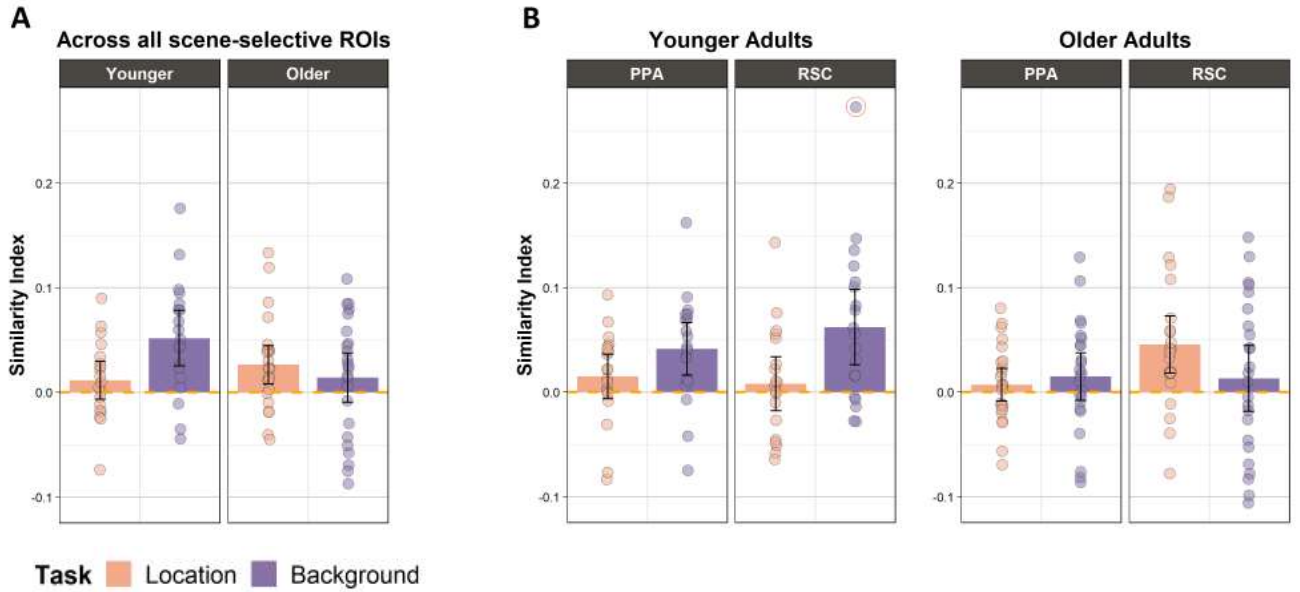
Results – Pattern Similarity Analysis

Age group x Retrieval task x Hemisphere x ROI ANOVA

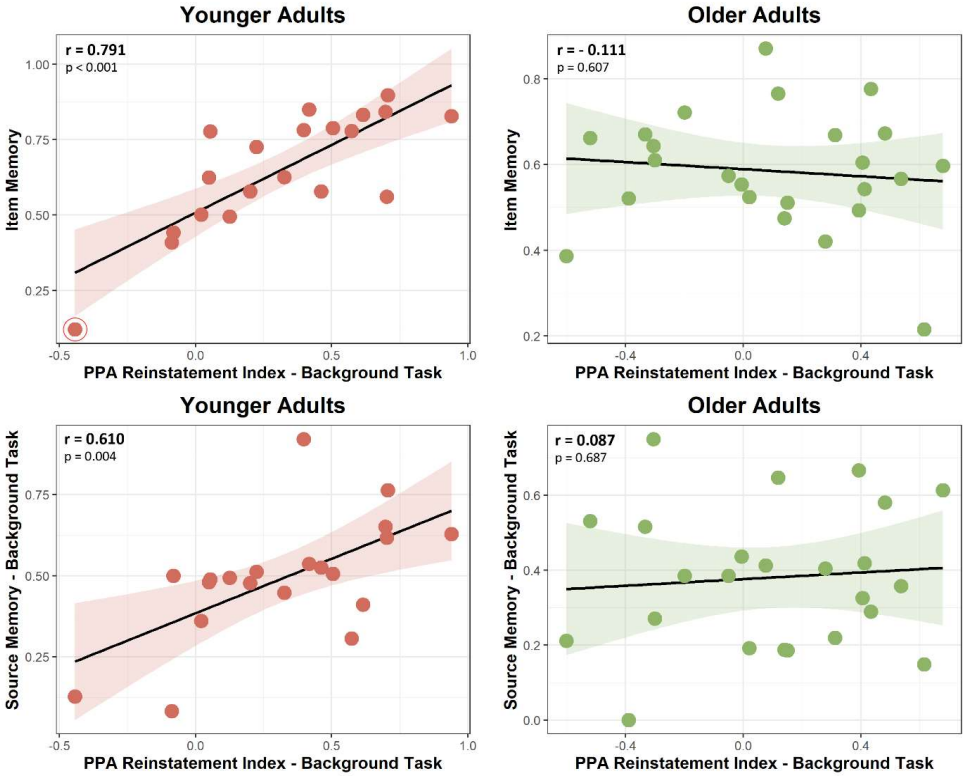
Age group x Task: *p = 0.018*
Age group x Task x ROI: *p = 0.007*

Retrieval task x ROI ANOVA (per age group)

Younger Adults - Task effect: *p = 0.028*
Older Adults - Task effect: *p = 0.374*



Relationship with memory performance



Difference between correlations:

→ $p < 0.001$

→ $p = 0.056$

Summary

- Study examined potential age differences in retrieval gating
- Younger, but not older adults, engage retrieval gating.
  - Deficits in inhibitory control?
- PPA reinstatement during background task was associated with memory performance, but only in younger adults.
- Location task reinstatement did not correlate with memory performance

Future directions

- Does the absence of retrieval gating in older adults reflect an inability to gate?
- How does retrieval gating vary with memory strength for the irrelevant content?
- When does retrieval gating occur? Post-retrieval? At the time of retrieval?
- Is retrieval gating an active top-down mechanism or a “passive” biased memory search?

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… Comments, Questions?

Not now? Email me later! ☺
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