Age Differences in Hippocampal Neural Timescales During Naturalistic Memory Encoding

Nichole R. Bouffard[1], Angelique I. Delarazan[1], Ata B. Karagoz[2], Jeffrey M. Zacks[1] & Zachariah M. Reagh[1]

[1]Department of Psychological and Brain Sciences, Washington University in St. Louis, St. Louis, MO
[2]Department of Psychology, University of Chicago, Chicago, IL

@nicholebouffard.bsky.social

National Institute on Aging

Introduction

- As we age, there is a shift in memory towards coarse, gist-like memory and a decrease in fine details[1,2,3]
- Aging affects the structure and function of the hippocampus
- Functional dissociations along the hippocampal long axis,[4,5,6] and gradients of neural timescales,[7] may relate to memory specificity
- **How might the gradient of neural timescales relate to the age-related shift towards coarser memory?**

Paradigm

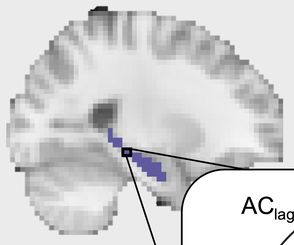
Younger (N = 32) and Older adults (N = 22)
Scanned while watching episode (~26 min)

Free recall of episode

TL;DR Take Home

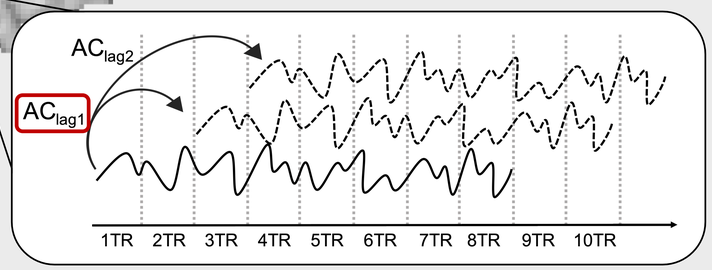
- YAs have a gradient of neural timescales (high in anterior-medial to low in posterior-lateral)
- OAs show a *reversal* of the gradient
- Hippocampal neural timescales during movie watching are related to specificity of memory
  - Faster timescales relate to more detail recall
- Intact functional gradient might be important for hippocampal functioning, i.e., the ability to recall specific details from past events

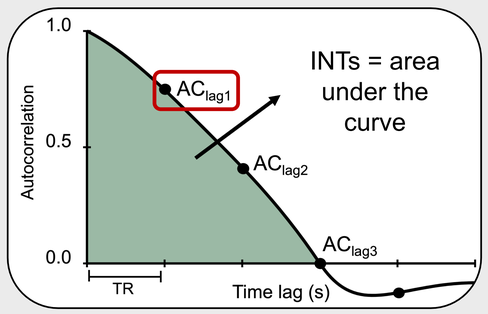
Calculating Intrinsic Neural Timescales (INTs)



1. Compute autocorrelation function (ACF)

- For a single voxel, take the entire BOLD series and correlate it with a lagged version of itself
- Iteratively shift down by 1 lag (1 TR) and correlate



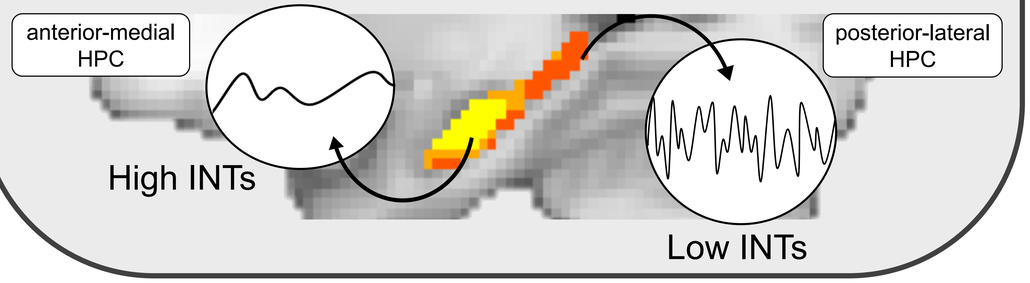


2. Take the area under ACF curve

- Find the point (the TR) when the ACF function reaches zero
- Compute the area under the curve Repeat for every voxel

3. Mask voxels using data-driven clusters

- Clusters based on autocorrelation from a resting state fMRI dataset in a prior study[7]



Results

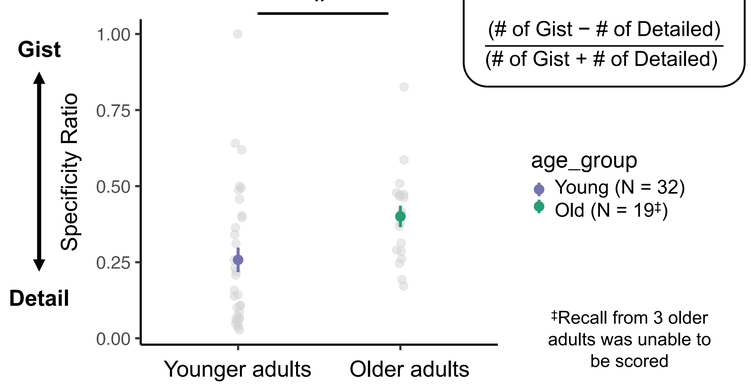
Older adults have gist-like memory

Example Detailed Response: *"When they get to the table Larry's wife invites them all the guests to sit wherever they would like to sit so the wife sits at the head of the table on the one end and on the other end the mechanic takes Larry's chair and Larry ends up sitting in the chair next to the mechanic rather than at his usual spot at the head of the table so Larry looks a little bit upset but ultimately doesn't say anything…"*

Example Gist Response: *"And then they had a dinner party. There were a bunch of people there. And there was the host was displaced by his friend taking his chair. Overall, the food was very good, people were happy with that."*

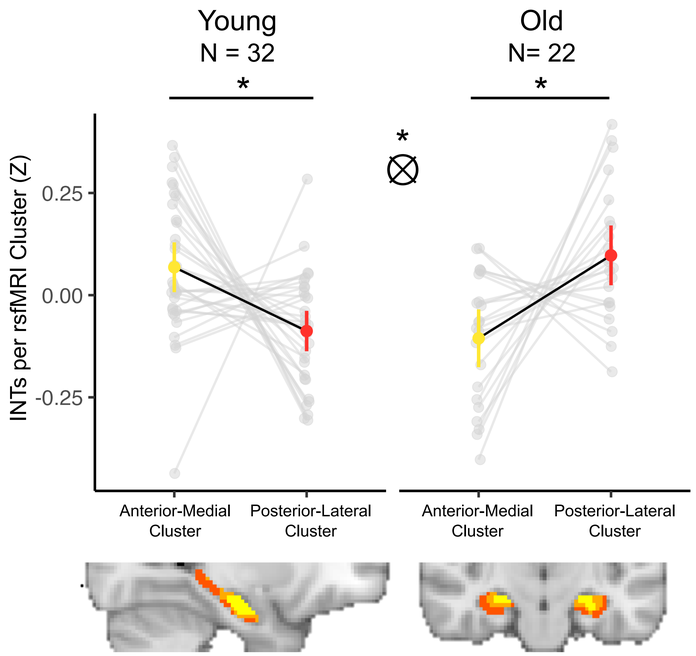
Recall scoring: Specificity Ratio

$$\frac{(\#\text{ of Gist} - \#\text{ of Detailed})}{(\#\text{ of Gist} + \#\text{ of Detailed})}$$



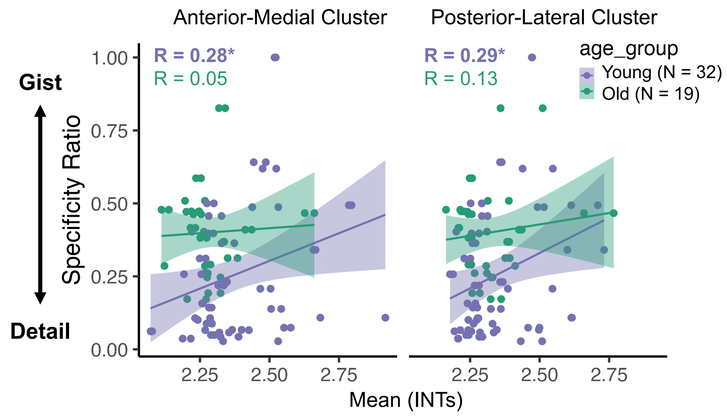
‡Recall from 3 older adults was unable to be scored

Hippocampal INTs gradient ***reversed*** in older adults



Hippocampal INTs are correlated with recall specificity† in **younger adults**

†This was an *a priori* analysis of interest, but upon doing some digging, the story gets more complicated, ask me how if you're interested!



RESEARCH SUPPORT: Funded by the NIA T32: 5T32AG000030-48 and R01AG06243801

REFERENCES: 1-Delarazan et al., 2023 **2-**Kurby & Zacks, 2011 **3-**Zacks et al., 2006, **4-**Poppenk et al., 2013 **5-**Robin & Moscovitch, 2017 **6-**Strange et al., 2014 **7-**Bouffard, Golestani et al., 2023