Detail and spatiotemporal structure in naturalistic recall

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Background

In **laboratory (e.g. word list) recall**, episodic memory is defined by **temporal contextual organization**[1]

Encoding: …apple cat boat dog cup…

Retrieval: "cup" "cat" "dog" "cup"…

In **autobiographical recall**, episodic memory is defined by **recovering specific details (sights, feelings..)**[2]

Temporal organization is a **universal organizing principle** in word list recall at short delays[3]

What about **recall of complex real-world experiences** at naturalistic delays?

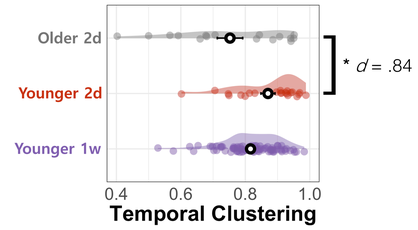
Are more **temporally structured** memories richer in **episodic detail**[4]?

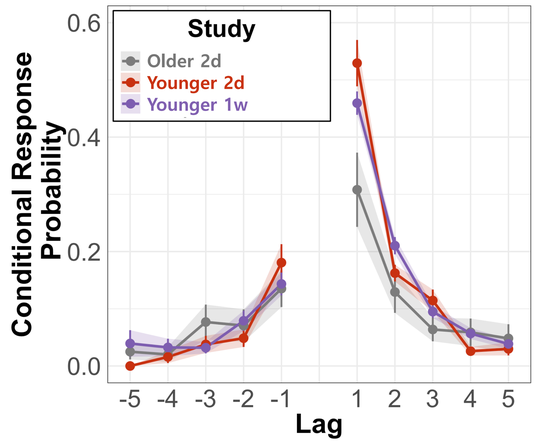
Results

spatiotemporal context guides real-world recall dynamics

clustering

impaired with age but not remoteness

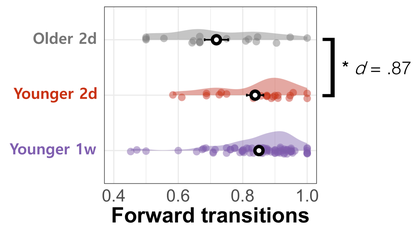




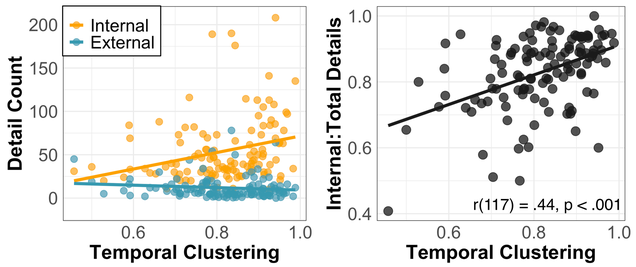
Errors bars are bootstrap-derived standard error (1000 iterations)
Significant age-related reduction at Lag 1 (p = .009, d = .77)
No difference in serial position or recall initiation curves

forward asymmetry

impaired with age but not remoteness

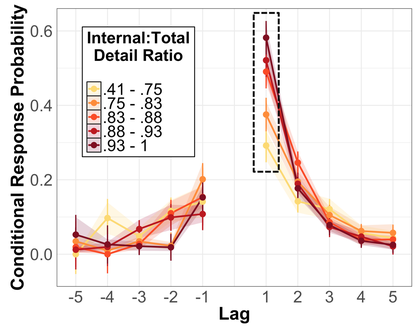


+ correlates with internal (episodic) details

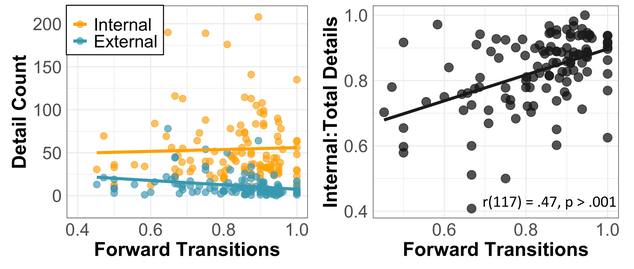


interaction between clustering & detail type (F(1,113) = 12.60, p < .001)
no interaction with group

more context reinstatement, more detail-rich recall



- correlates with external (non-episodic) details



interaction between clustering & detail type (F(1,113) = 12.28, p < .001)
no interaction with group

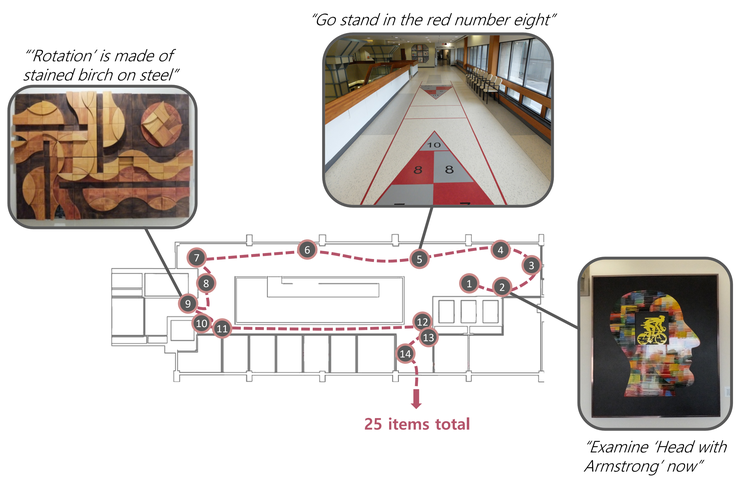
temporal clustering and forward transitions are correlated but explain unique variance in internal:total detail proportion when modelled together

Methods

Participants underwent an audio-guided real-world walking tours of the artwork in Baycrest Hospital

Tour 1
- Younger, 2 day delay (*N* = 22)
- Older, 2 day delay (*N* = 19)

Tour 2
- Younger, 7 day delay (*N* = 79)



Free Recall Analysis

Contextual organization (recall *dynamics*):

We tagged target items with their ordinal positions then analyzed vectors of tags extracted from narrative recall transcripts:

Lag-conditional response probability curves[1,3,5]
- Probability of recall transitions as a function of ordinal lag

(spatio)temporal clustering score[5]
- rank of each transition distance relative to possible distances

Forward asymmetry score
- What proportion of transitions moved forward?

Details (recall *content*):

Internal details[2]
- Event-specific; perceptual, event, spatial, temporal, thoughts

External details[2]
- Not event specific; semantic, metacognitive, etc.

Conclusions

1. **Principles of contextual organization in word list recall at short delays extend to autobiographical recall of remote real-world experiences**
   - This suggests that temporal organization is not merely based on recency or rehearsal
2. **Aging is associated with impaired temporal context reinstatement**
   - Despite no age difference in recall initiation nor serial position curves; it's about *dynamics*
3. **Spatiotemporal context reinstatement and episodic detail richness are associated, as predicted[4]. The way we move through memory space shapes the kinds and quantity of details that come to mind.**
   - Spatial/temporal clustering may bring ambient episodic details into higher resolution
   - Chronologically-ordered search may suppress external detail interjections

References

1. Howard MW, Kahana MJ (2002) A Distributed Representation of Temporal Context. J Math Psychol 46(3):269–299.
2. Levine B, Svoboda E, Hay JF, Winocur G, Moscovitch M (2002) Aging and autobiographical memory: Dissociating episodic from semantic retrieval. Psychol Aging
3. Healey MK, Kahana MJ (2014) Is memory search governed by universal principles or idiosyncratic strategies? J Exp Psychol Gen 143(2):575–596.
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5. Polyn SM, Norman KA, Kahana MJ (2009) A Context Maintenance and Retrieval Model of Organizational Processes in Free Recall. Psychol Rev 116(1):129–156.

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