



DARTMOUTH

Probing temporal associations of naturalistic events with cued recall



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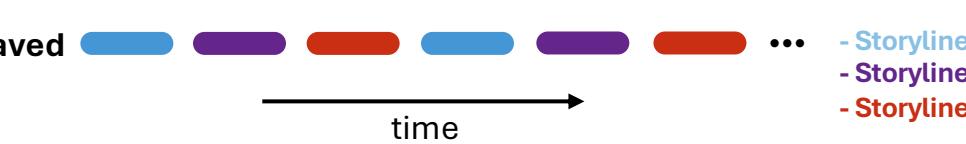
Background

- Memories are temporally organized. Recalling one event could facilitate the retrieval of temporally nearby events (see temporal contiguity effect^{1,2}).
- It is suggested that items are linked through a drifting context in memory. During retrieval of an item, retrieved context could serve as a cue for retrieving memory of nearby items (both past and future)³.
- Real life events have pre-built links (e.g., event schema), which could also aid the retrieval of nearby events.
- Here, we study how these pre-built links and the memory association mechanisms conjointly shape how naturalistic events are temporally linked in memory.

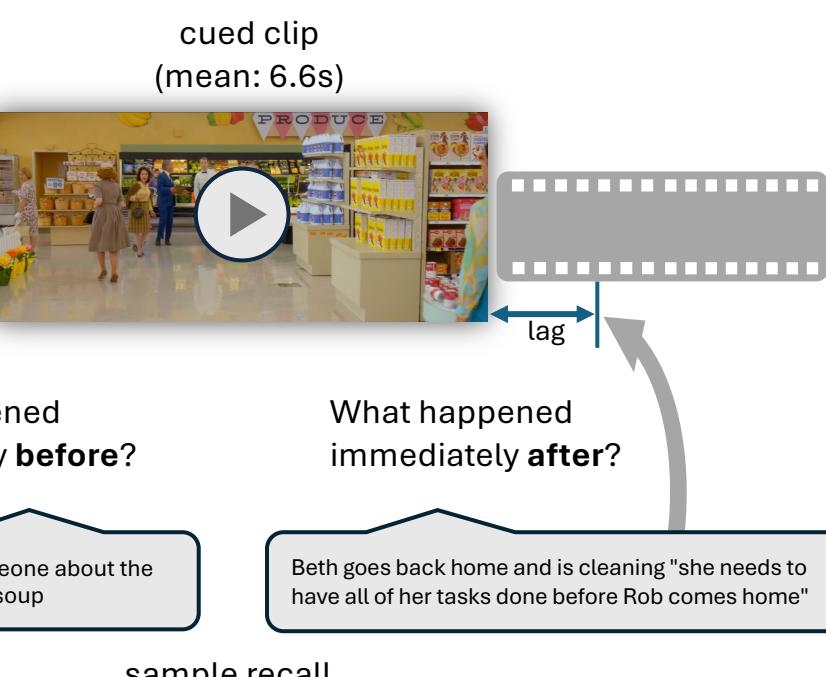
Q1: Are memory links between adjacent events **symmetric** in time?Q2: Do events become temporally **unlinked** in memory when crossing an **event boundary**?Q3: Do temporally non-adjacent events become **relinked** if they are narratively adjacent?

Methods

Encoding

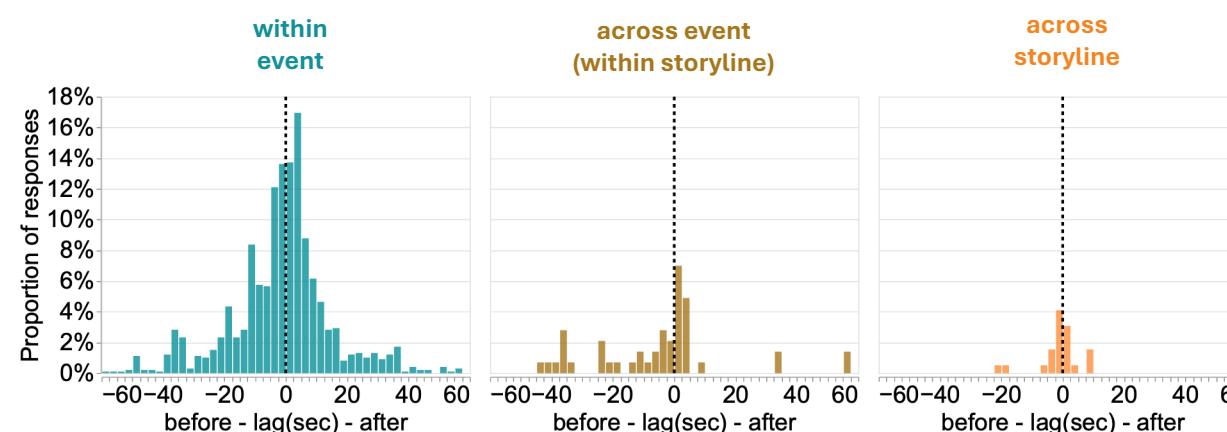
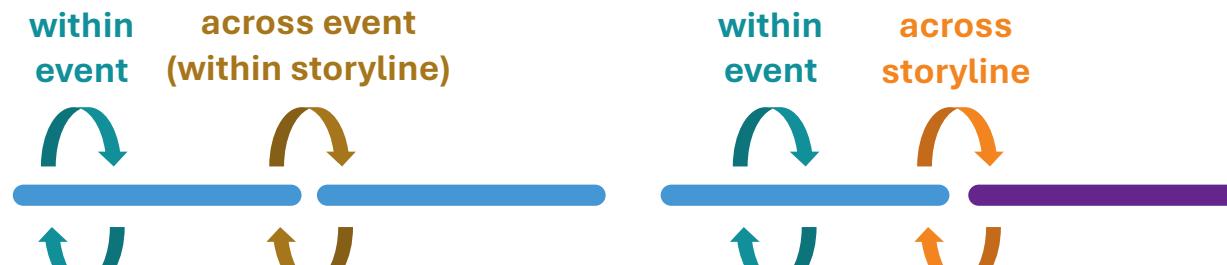
**Exp 1** storylines grouped**Exp 2** storylines interleaved

Retrieval



Results (preliminary)

Memory links between adjacent events are symmetric in time



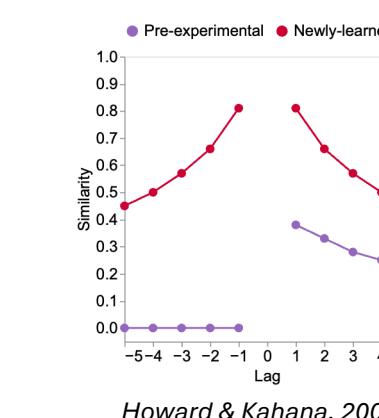
- The temporal symmetry here is at odds with the forward bias in free recall¹ and cued recall⁴ of word lists, suggesting that the pre-built associations might play a role⁵ in linking naturalistic events in memory.



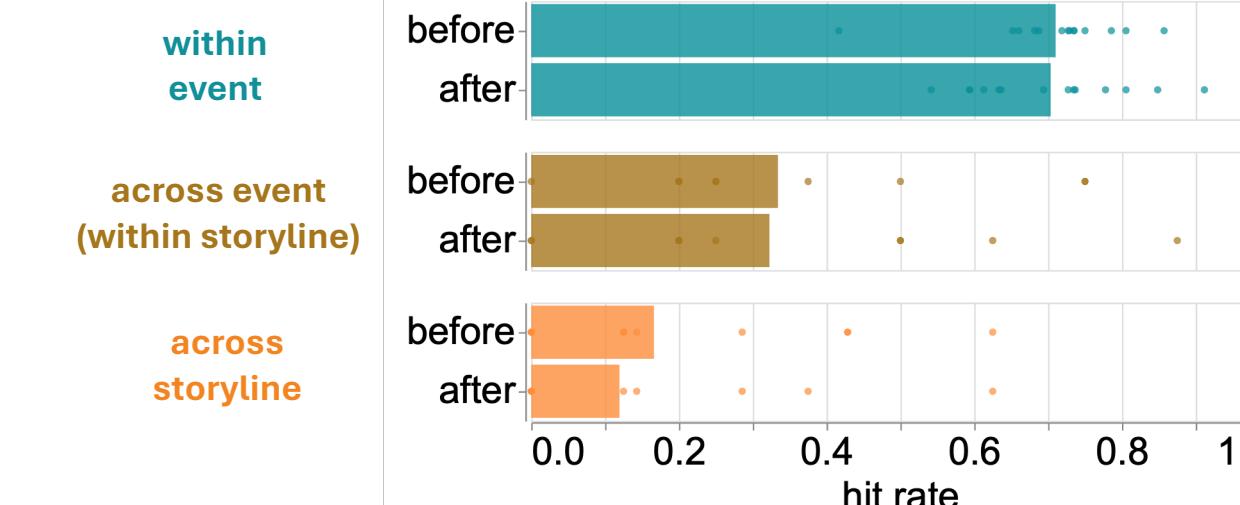
$$C_t = \rho C_{t-1} + \beta C_{enc}$$

$$C_{rec}^{IN} = (1 - \gamma_{FC}) C_{enc}^{IN} + \gamma_{FC} C_{t-1}$$

Pre-experimental context Newly-learned context



Events become temporally unlinked in memory when crossing an event boundary e.g., 6, 7



Non-adjacent events become re-linked if they are narratively adjacent

across event (within storyline)



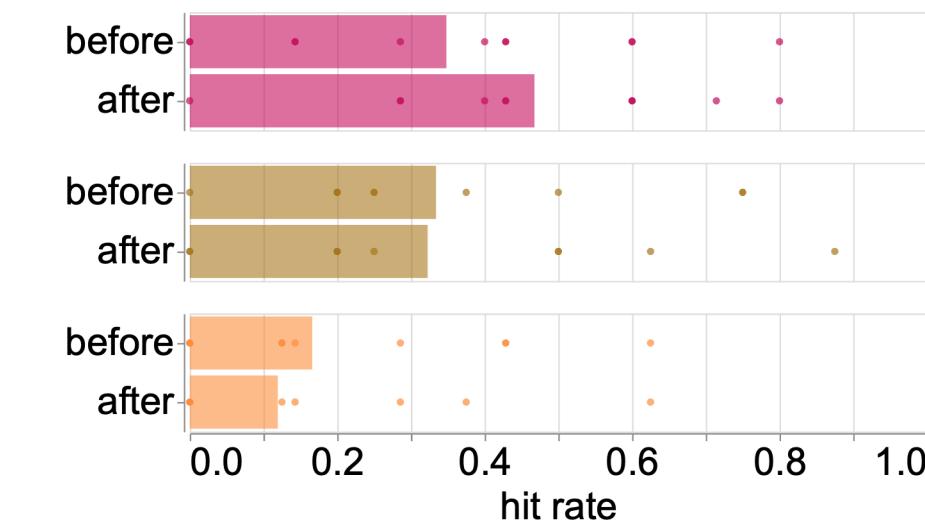
Exp 3

What happened immediately before/after, **within the same storyline**?

across event relink

across event (within storyline)

across storyline



- Insertion of unrelated events does not affect the strength of memory links between narratively adjacent events.
- Extra event boundaries induced by storyline shifts might trigger reinstatement of previous narratively coherent events⁸, strengthening the memory association between events and compensating for the weaker association caused by longer distance between them.

References

1. Kahana, M. J. (1996). Associative retrieval processes in free recall. *Memory & cognition*, 24(1), 103-109.
2. Healey, M. K., Long, N. M., & Kahana, M. J. (2019). Contiguity in episodic memory. *Psychonomic Bulletin & Review*, 26(3), 699-720.
3. Howard, M. W., & Kahana, M. J. (2002). A distributed representation of temporal context. *Journal of Mathematical Psychology*, 46(3), 269-299.
4. Kahana, M. J., & Caplan, J. B. (2002). Associative asymmetry in probed recall of serial lists. *Memory & Cognition*, 30(6), 841-849.
5. Xu, X., Zhu, Z., Zheng, X., & Manning, J. R. (2024). Temporal asymmetries in inferring unobserved past and future events. *Nature Communications*, 15(1), 8502.
6. Ezzyat, Y., & Davachi, L. (2011). What constitutes an episode in episodic memory? *Psychological Science*, 22(2), 243-252.
7. Henderson, S. E., & Campbell, K. L. (2023). Reduced distinctiveness of event boundaries in older adults with poor memory performance. *Psychology and Aging*, 38(5), 401.
8. Hahamy, A., Dubossarsky, H., & Behrens, T. E. (2023). The human brain reactivates context-specific past information at event boundaries of naturalistic experiences. *Nature neuroscience*, 26(6), 1080-1089.