Narrative Memory: a story told by the hippocampus

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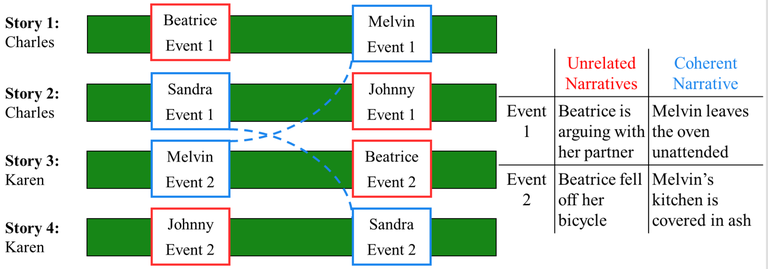
Introduction

- We often remember past experiences in the form of a story. We can even form narratives from events which occur at disparate times.
- Yet, the neuroscience of memory has historically tried to understand how we remember specific periods of time, or "events."
- The hippocampus is necessary for remembering specific events. One possibility is that the hippocampus organizes our memories in time. [1]
- However, we previously found that narratives can bridge the gap between events in our memory, making events easier to remember.[2]
- **Hypothesis:** the hippocampus might link two events together in memory when they can form a single, coherent narrative.

Functional MRI (fMRI) approach

Day 1: Memorize fictional stories during fMRI

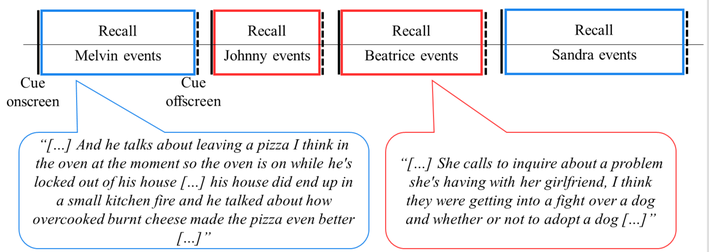
- Participants memorized stories, in which characters appeared in separated events
- These "sideplot" events could form a Coherent Narrative, or not (Unrelated Narratives)



	Unrelated Narratives	Coherent Narrative
Event 1	Beatrice is arguing with her partner	Melvin leaves the oven unattended
Event 2	Beatrice fell off her bicycle	Melvin's kitchen is covered in ash

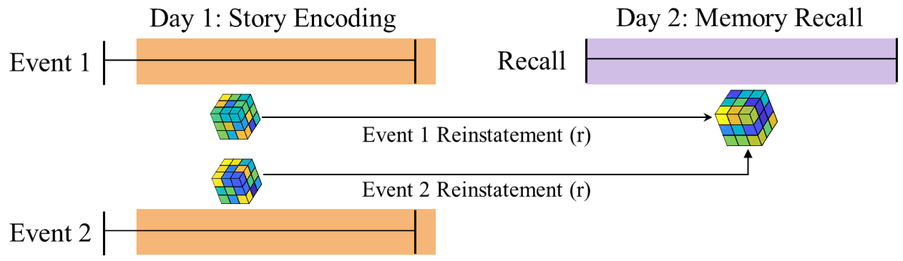
Day 2: Recall events during fMRI

- Participants were asked to recall all events involving each character, using a microphone in the MRI scanner
- Recall was transcribed and then scored in a blinded fashion



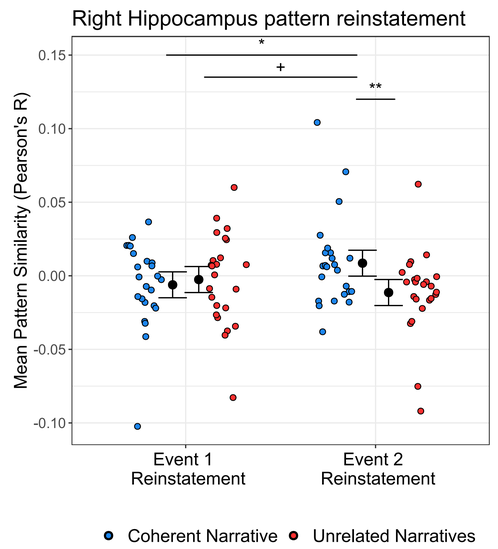
fMRI pattern similarity analysis approach

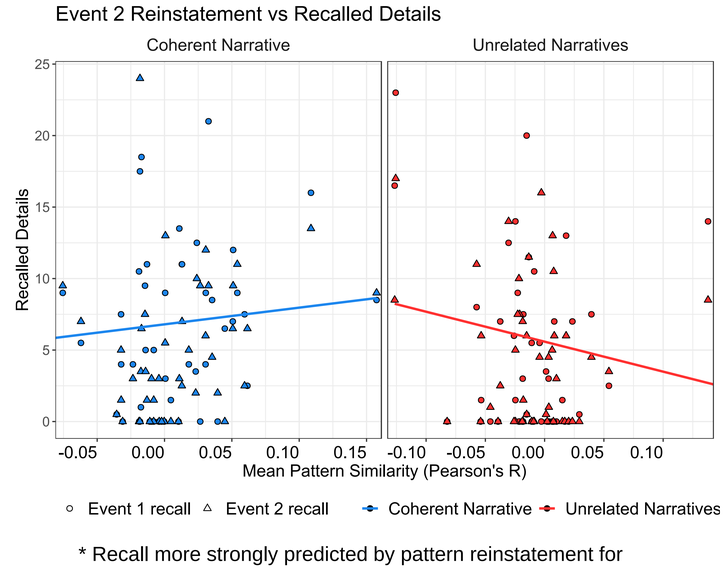
- We isolated patterns of activity in the hippocampus
- We correlated patterns of activity between Day 1 and Day 2 (i.e. "pattern similarity")
- Pattern similarity tells us how much the hippocampus "reinstates" a memory for each event during recall



Result: Hippocampus preferentially reinstates memories for Coherent Narrative events

- When a new event reminds you of an old event (i.e. Event 2), you have the chance to create a narrative that bridges those two events
- Meaning, your memory for Event 2 might contain information about Event 1 – i.e., a linked "narrative memory"
- LEFT: the pattern of activity from Event 2 was preferentially reinstated during recall of Coherent Narrative events
- RIGHT: Event 2 pattern reinstatement predicted the number of details recalled for *both* Coherent Narrative events *
- This suggests that, during Event 2, the hippocampus interwove Events 1 and 2 to form a single narrative memory





* Recall more strongly predicted by pattern reinstatement for Coherent Narratives than Unrelated Narratives (t(156)=2.28, p=0.024)

Summary

- The hippocampus organizes our experiences into larger narratives in memory[3]: (1) by incorporating memories for old events into memories for new events; (2) by preferentially supporting our recall of events that form coherent narratives.
- These findings may pave the way for applications in early-stage cognitive decline, education, and literary theory[4,5].

References

1. Cohn-Sheehy, B.I., and Ranganath, C. (2017). Time regained: how the human brain constructs memory for time. Current Opinion in Behavioral Sciences *17*, 169–177. 10.1016/j.cobeha.2017.08.005.
2. Cohn-Sheehy, B.I., Delarazan, A.I., Crivelli-Decker, J.E., Reagh, Z.M., Mundada, N.S., Yonelinas, A.P., Zacks, J.M., and Ranganath, C. (2022). Narratives bridge the divide between distant events in episodic memory. Memory & Cognition *50*, 478–494. 10.3758/s13421-021-01178-x.
3. Cohn-Sheehy, B.I., Delarazan, A.I., Reagh, Z.M., Crivelli-Decker, J.E., Kim, K., Barnett, A.J., Zacks, J.M., and Ranganath, C. (2021). The hippocampus constructs narrative memories across distant events. Current Biology *31*, 4935-4945.e7. 10.1016/j.cub.2021.09.013.
4. Cohn-Sheehy, B.I. (2021). The Narrative Architecture of Events in Episodic Memory and the Human Hippocampus. University of California, Davis ProQuest Dissertations Publishing, 28317709 (28317709, Serial No. 28317709).
5. Cohn-Sheehy, B.I. (2023). Narrative memories woven by an intertextual hippocampus. In press, Journal of Comparative Literature and Aesthetics.

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