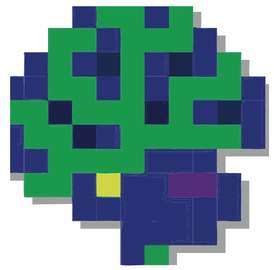
Adaptive Control of Episodic Memory During Story Listening

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Poster PDF



Introduction

Prior work has shown people automatically use episodic memory to predict upcoming words when listening to familiar stories.[1]

Can people learn to adaptively stop making episodic memory-based predictions in environments where memory is misleading?

Experimental Paradigm



Session 0



Multi-session fMRI

Session 0: Participants listen to a set of podcast episodes[2] while in the scanner. Used as training data for an encoding model

Session 1

Trader Joe's West Hollywood. Your total is $20.69," announces the cashier... I entertain another universe -- one where I'm not gay -- and smile wide. Then I say, "Good night."

We met on a train from Paris to Barcelona. Sitting next to one another, we argued over who could use the power outlet... we hadn't exchanged mobile numbers. Sometimes a romantic plan isn't enough.

⋮ *x 78 short stories*

Session 1: Participants listen to a set of 78 short stories.

Session 2 (1 day later)

Between Participants

Trader Joe's West Hollywood. Your total is $20.69," announces the cashier... I entertain another universe -- one where I'm not gay -- and smile wide. Then I say, "Good night."

We met on a train from Paris to Barcelona. Sitting next to one another, we argued over who could use the power outlet... we hadn't exchanged mobile numbers. Sometimes a romantic plan isn't enough.

⋮ *x 78* ***repeat*** *short stories*

Trader Joe's West Hollywood. Your total is $20.69," announces the cashier... I ponder the odds, amused. "Only if we split the winnings," I reply, winking.

We met on a train from Paris to Barcelona. Sitting next to one another, we argued over who could use the power outlet... Six weeks later, amidst shelves of poetry, our story resumed.

⋮ *x 78* ***branched*** *short stories*

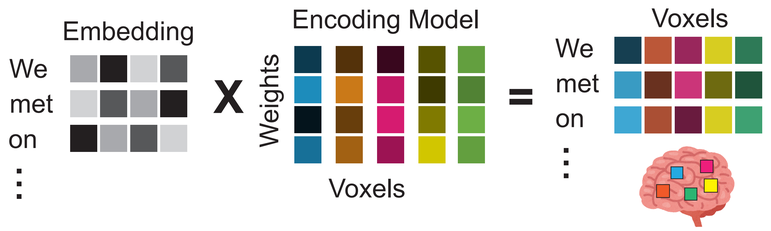
Session 2: After a day, high predictability participants listen to the exact same stories again. Low predictability participants listen to the stories again, but -- while the stories begin in the same way -- they branch off to a different ending instead of the original ending.



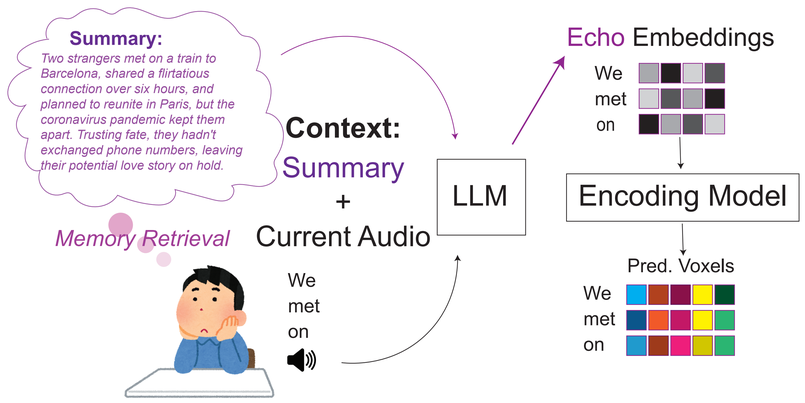
Hypothesis: Participants in the low predictability condition will learn to suppress episodic memory retrieval during the repeated, pre-branch part of the stories.

Methods

We train an ***encoding model***[3] to predict participants' brain responses using embeddings from an LLM that was presented with the words heard (so far) in the story.



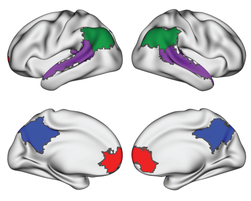
However, participants listen to the stories twice, meaning that they can retrieve the session 1 story from episodic memory in order to predict ahead during session 2. Reflecting this, we can generate memory-informed ***echo embeddings***[4] by prompting LLMs with a summary of the original, complete story from session 1 plus the current story-text heard so far in session 2.



Neural Recall = Ses 2 [Cor(Echo) - Cor(Curr)] – Ses 1 [Cor(Echo) - Cor(Curr)]

Neural recall is operationalized as the difference in brain prediction accuracy using echo embeddings (which reflect information in the full original story) compared to embeddings that only reflect current information. Session 1 serves as a baseline since it is their first time listening to the stories (i.e., no past episodic memory to retrieve).

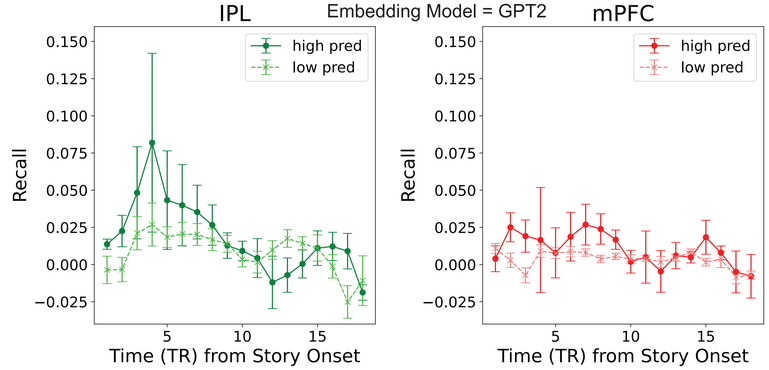
Neural recall is computed over patterns of activity in brain regions previously implicated in memory-based processing of naturalistic stimuli[5,6].

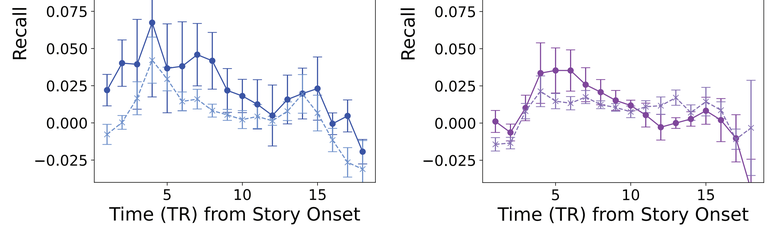


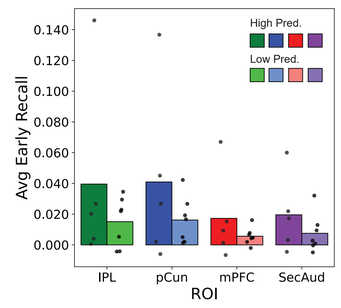
Results

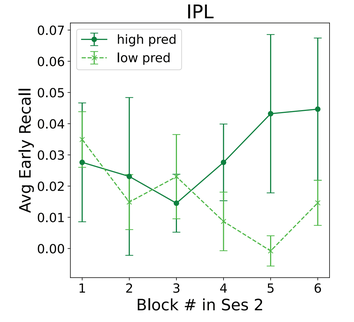
N_{low} = 7, N_{high} = 5; data collection not complete yet (target N = 14 per condition)

Embedding Model = GPT2









Conclusion

Preliminary results indicate that participants in the low predictability condition learn to suppress episodic memory retrieval, as shown by a lower degree of neural recall compared to high predictability participants at story onset. The effect was larger for stories presented later in session 2. These results demonstrate that **people may adaptively modulate memory retrieval based on the predictability of the environment.**

References

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3. Huth, A. G., et al., *Nature* (2016)
4. Springer, J. M., et al., *arXiv* (2024)
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6. Baldassano et al., *Neuron* (2017)

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