

The organization of memory for language following memory impairment

Background: Memory for linguistic material can be quantified not only in terms of the quantity of recall, but also in terms of the *organization* of recall. When recalling a word list, people spontaneously recall those words in the same order they encountered them, an effect known as *temporal contiguity* (Kahana, 1996; Healey et al., 2019). Yet ordinary language exhibits both linear and hierarchical organization (Grosz & Sidner, 1986), thus the ecological validity of temporal contiguity effects for linguistic material is unclear (Hintzman, 2016). Some findings demonstrate temporal contiguity in recall of complex stimuli including news stories, autobiographical memories, and narratives (Uitvlugt & Healey, 2019; Diamond & Levine, 2020). Poorly understood, however, is the role of the declarative (episodic) memory system in the organization of memory for linguistic material. While measures of recall rate and recall organization are mathematically independent, individuals with higher recall rates tend to also exhibit more organization (Sederberg et al., 2010). One explanation at the level of individuals is that strategies for leveraging the temporal structure in memories are beneficial for recall rates. Another explanation is that temporal organization is a core component of declarative memory. The present research takes a hybrid psycholinguistic-neuropsychological approach to understanding the contributions of the declarative memory system to memory for naturalistic linguistic stimuli by testing individuals with cognitive-communication disorder and declarative memory impairment in the recall of brief narratives.

General Method: Participants (Ps) viewed 4 videos of a narrator telling a story in English, then attempted to immediately retell each story. Videos were ~30 sec. and contained 10-12 details. Retellings were coded for which order details were recalled in. Recall of details in sequence (e.g., recalling detail 2,3,4) reflects greater temporal organization than recall of details out of sequence (e.g., detail 4,1,3). Absolute Lag refers to the distance between two sequential recalls, e.g., recalling detail 2 then 3 is lag of $|1|$; recalling detail 5 then 4 is also a lag $|1|$. We quantify organization with two standard measures: lag-conditional response probabilities (CRP) and temporal organization scores (TOS). Lag-CRP quantifies the probability of making a transition (e.g., 2→3) considering all possible transitions that could have been made. TOS are percentiles that represent the average temporal contiguity of all transitions in one recall.

E1: Ps were 4 adults with bilateral hippocampal damage and severe declarative memory impairment (hippocampal amnesia), 4 adults with bilateral ventromedial prefrontal cortex (vmPFC) damage and no declarative memory impairment, and 20 non-brain-injured comparison adults (NC). Adults with amnesia had weaker TOS than NCs ($\beta = 0.16, p < .001$) and were less likely to make lag $|1|$ transitions than NCs ($\beta = 0.21, p = .002$). In contrast, the adults with vmPFC damage did not differ from the NCs.

E2: Ps were 60 adults with moderate-severe traumatic brain injury (TBI) and 60 NCs. Ps with TBI had significantly weaker TOS than NCs when recalling narratives ($\beta = -.07, t = 3.47, p = .002$) and were less likely to make lag +1 transitions ($F(1,1415) = 66.8, p < .001$). However, significant group effects were not observed in word list recall (TOS difference: $t(105) = 0.56, p = .575$; CRP at +1 difference: $F(1,105) = 0.03, p = .864$). These findings point to deficits in recall organization in TBI for narrative.

Discussion: Successful language use requires not only processing in the moment, but also remembering what was said in order to guide future language use. For people with cognitive-communication disorder, little is known about the organization of memory for past linguistic experiences. By examining temporal organization in narrative memory in two populations with cognitive-communication disorder (Amnesia and TBI), we identify a role for declarative memory in the organization of memory for language. Narrative discourse is central to functional communication and social interaction. Thus, individuals with memory impairment may be at greater risk for poorer communication and social outcomes.

References

- Diamond, N. B., & Levine, B. (2020). Linking Detail to Temporal Structure in Naturalistic-Event Recall. *Psychological Science*, 31(12), 1557–1572. <https://doi.org/10.1177/0956797620958651>
- Grosz, B.J. & Sidner, C.L. (1986). Attention, intentions, and the structure of discourse. *Computational Linguistics*, 12(3),175–204.
- Healey, M. K., Long, N. M., & Kahana, M. J. (2019). Contiguity in episodic memory. *Psychonomic Bulletin & Review*, 26(3), 699–720. <https://doi.org/10.3758/s13423-018-1537-3>
- Hintzman, D. L. (2016). Is memory organized by temporal contiguity? *Memory & Cognition*, 44(3), 365–375. <https://doi.org/10.3758/s13421-015-0573-8>
- Kahana, M. J. (1996). Associative retrieval processes in free recall. *Memory & Cognition*, 24(1), 103–109.
- Sederberg, P., Miller, J., Howard, M. W., & Kahana, M. J. (2010). The temporal contiguity effect predicts episodic memory performance. *Memory & Cognition*, 38(6), 689–699.
- Uitvlugt, M. G., & Healey, M. K. (2019). Temporal Proximity Links Unrelated News Events in Memory. *Psychological Science*, 30(1), 92–104. <https://doi.org/10.1177/09567976188084744>

Figures

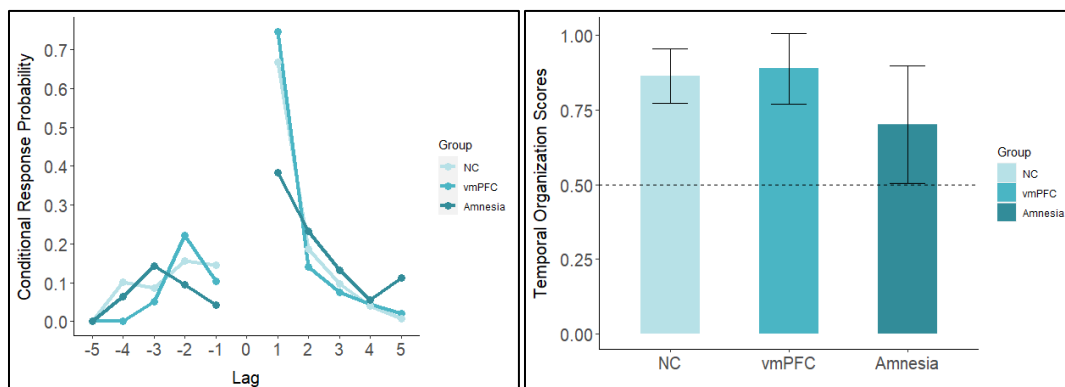


Fig. 1. Experiment 1. The lag-CRP values plotted by group (Left) and the temporal organization scores plotted by group with a dashed line representing chance (Right).

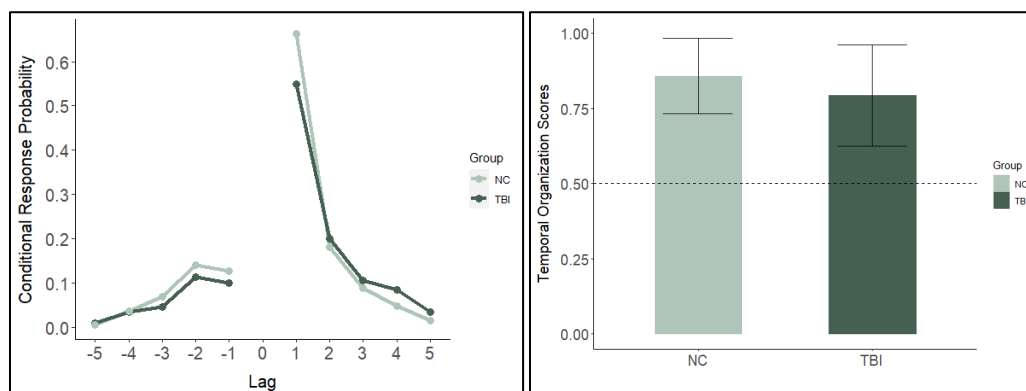


Fig 2. Experiment 2. The lag-CRP values plotted by group (Left) and the temporal organization scores plotted by group with a dashed line representing chance (Right).