

Working memory capacity for continuous events: the root of temporal compression in episodic memory

Remembering the unfolding of past episodes usually takes less time than their actual duration. In this study, we show that such temporal compression is not systematic but emerges when events composing daily life activities are too long to be fully held in working memory.

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Our past experiences are represented in episodic memory as sequences of experience units (EUs)—each unit representing a moment of the past experience—that are separated by temporal discontinuities (i.e., moments that are not remembered). Because of these discontinuities, the time taken to mentally re-experience everyday activities is typically shorter than their actual duration (i.e., episodic memories are temporally compressed). However, the cognitive mechanisms leading to this structure of episodic memories are not fully understood, especially factors that might explain temporal discontinuities.

A consistent body of work suggests that EUs are formed through cognitive processing taking place during perception (Zacks, 2020). In daily life, we segment the continuous flow of experience into meaningful units (i.e., events) that are temporally delimited by the perception of event boundaries (i.e., the end of an event and the beginning of another). Between event boundaries, working memory enables us to construct and maintain a mental model of the current situation (i.e., an event model) while continuously processing incoming information. When the situation changes (i.e., when an event boundary is perceived), the current event model is updated and its previous version is integrated in the long-term memory representation of the ongoing sequence of events.

We hypothesized that temporal discontinuities within episodic memories are a byproduct of the role of working memory in constructing event models. When new information needs to be continuously processed, working memory capacity is temporally limited: without rehearsal, the information just perceived is only maintained for a limited amount of time. In the context of event model formation, the length of time that information can be held in working memory without rehearsal should correspond to the maximal duration of an event model that can be fully maintained in mind. When this temporal capacity is exceeded before the perception of an event boundary, the EU formed at the end of the current event would only partially represent its unfolding, leading to temporal discontinuities in the long-term memory representation into which this EU is integrated.

To test this hypothesis, we recruited 90 healthy young adults. They saw video clips showing people performing a continuous action (i.e., actions without event boundaries; e.g., turning a car jack in an uninterrupted way). Videos lasted 3, 6, 9, 12, or 15s. For each of them, participants had to carefully watch the action and then to mentally replay its unfolding as accurately and precisely as possible. We measured the duration of their remembering by asking them to press a key at the beginning and at the end of their mental replay. Results showed that remembering duration was close to the actual stimuli duration for short videos, but smaller for longer ones. These results support the view that temporal compression is not systematic but emerges when events composing daily life activities are too long to be fully held in working memory.

References:

Zacks J. M. (2020). Event Perception and Memory. *Annual review of psychology*, 71, 165–191. <https://doi.org/10.1146/annurev-psych-010419-051101>