

Understanding the Temporal Compression of Continuous Events in Memory

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Based on

Leroy, Majerus & D'Argembeau (2024). *Cognition*, 247, 105789.

Leroy & D'Argembeau (2025). *Memory*, 33(9), 1058-1074.

Leroy & D'Argembeau (2025). *Open Mind*, 9, 2066-2091.

Temporally compressed memories

Experience (real time)



Memory replay

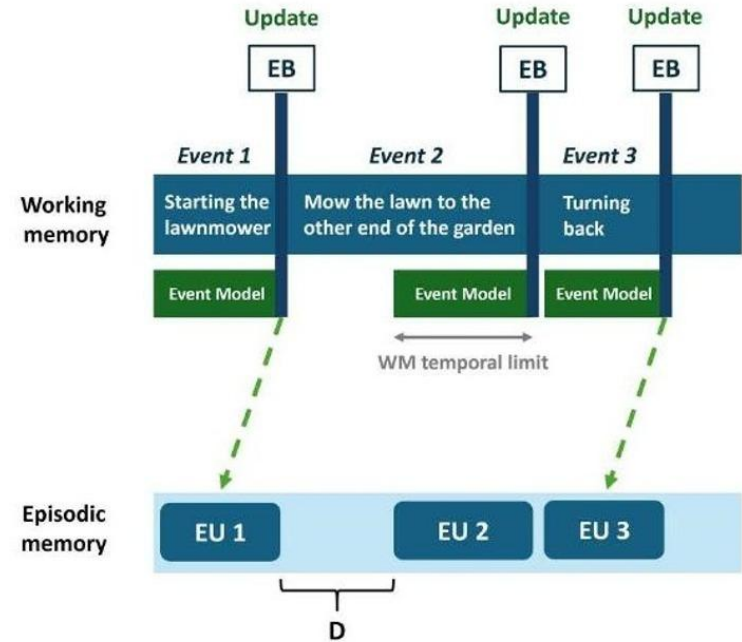


gaps = moments that are not remembered

Replay duration < event duration

Where do the gaps come from?

- Event segmentation theory: we build an event model of the current situation, maintained in working memory (WM)
- At an event boundary, the model is updated and transferred to long-term memory as an experience unit
- WM is capacity-limited
- **Hypothesis: when an event is too long to be entirely held in WM, its representation is truncated → discontinuities in episodic memory**



Three studies

1

A temporal limit?

When does the mental replay of a single continuous event start to be compressed?

2

A better estimate

What happens once we control for recall initiation time and central tendency?

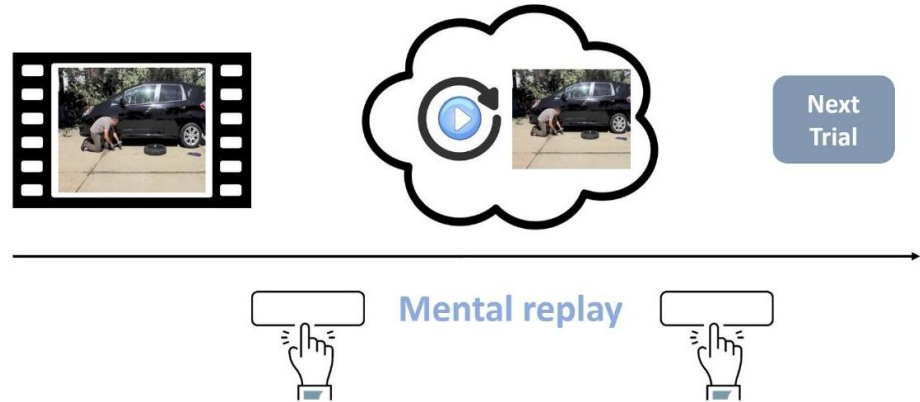
3

Events in sequence

How do the number and duration of events jointly shape memories' temporal resolution?

Measuring working memory for continuous events

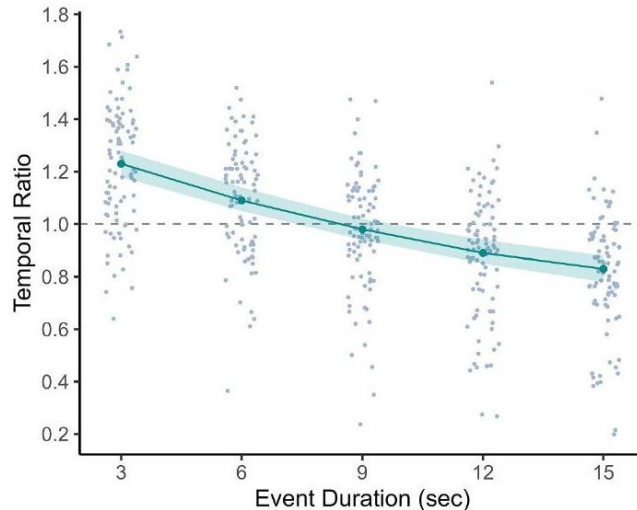
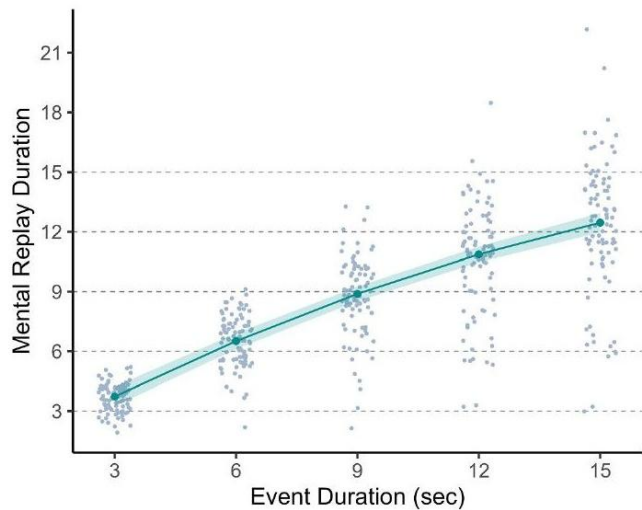
- 90 young adults
- Video clips: one continuous action, no event boundary
- 3, 6, 9, 12 or 15 s



Temporal ratio :

remembering duration/ event duration

Compression is not systematic



Temporal ratio

3 s $\rightarrow$ 1.23

6 s $\rightarrow$ 1.09

9 s $\rightarrow$ 0.98

12 s $\rightarrow$ 0.89

15 s $\rightarrow$ 0.83

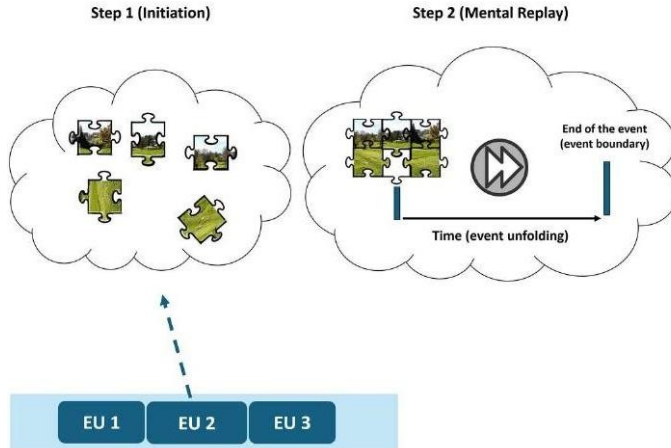
Ratio < 1 only beyond 9 s

Non-linear increase of replay duration (left)

A temporal limit — but two open issues

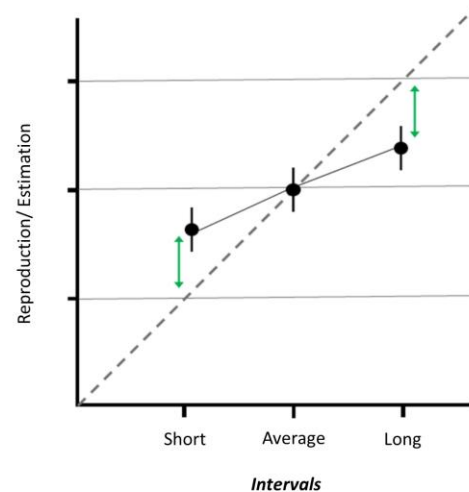
Recall initiation time

The key presses also include the time needed to mentally access the initial scene → replay duration is overestimated



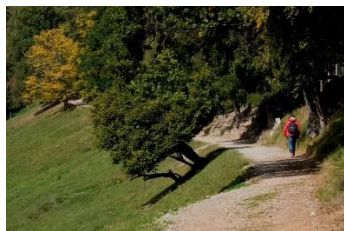
Central tendency bias

Overestimating short and underestimating long durations could mimic the same pattern



Correcting for recall initiation time

- 50 participants
- Mental replay task + New initiation task
- **Corrected replay duration = remembering duration – initiation time**



1 s



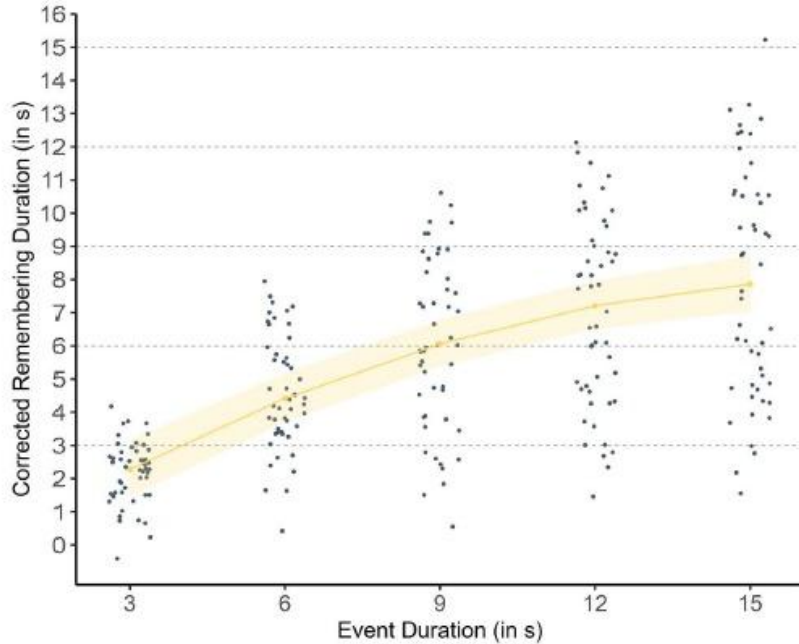
2, 5, 8, 11, 14 s



Making the image reappear in mind



Corrected mental replay duration



Corrected replay

3 s: CI includes the actual duration

≥ 6 s: reliably shorter than the event

Still a non-linear increase with event duration

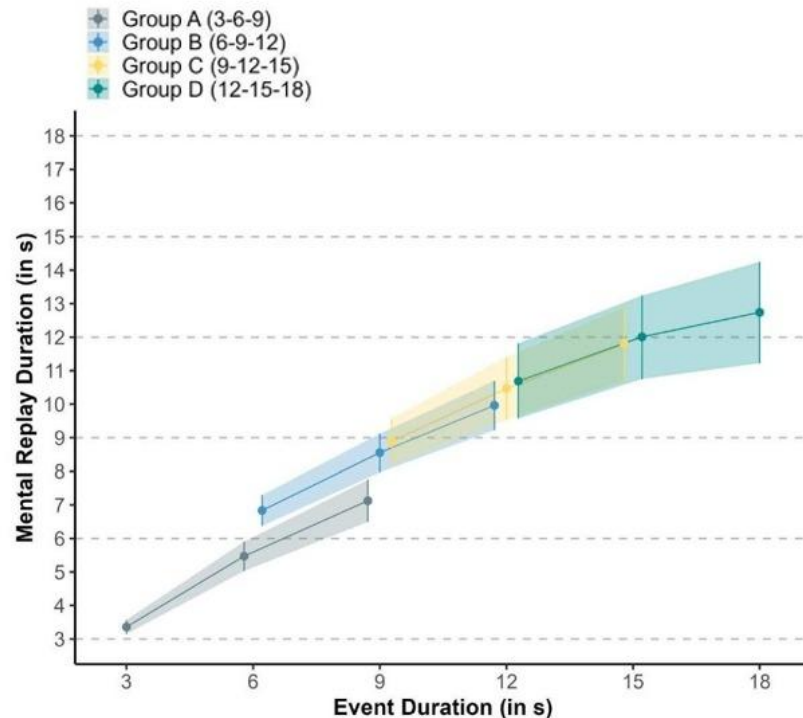
Is it just a central tendency bias?

218 participants: **four groups, four ranges of event duration**

Central tendency bias observed for short-duration groups

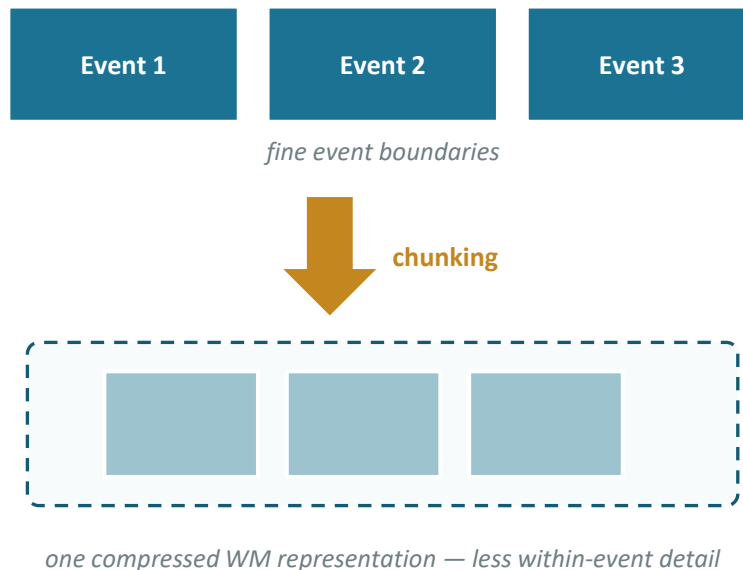
Groups C & D: 9- and 12-s events are compressed even as the shortest events of the set

Beyond ~9 s, compression occurs whatever the range



Beyond single events: sequences and chunking

- Segmentation is hierarchical: fine sub-events nested within coarse events
- Only coarse boundaries trigger the transfer to long-term memory → a whole sequence must be held in WM
- Proposal: each fine boundary triggers chunking — a synthetic recoding of the fine event just experienced
- **Chunking = data compression: more items retained, but with less precision**



Manipulating event number and duration

- Exp. 1: 72 participants

-Clips contained 1, 2 or 3 continuous events, each lasting 3, 6, 9 or 12 s (orthogonal design)

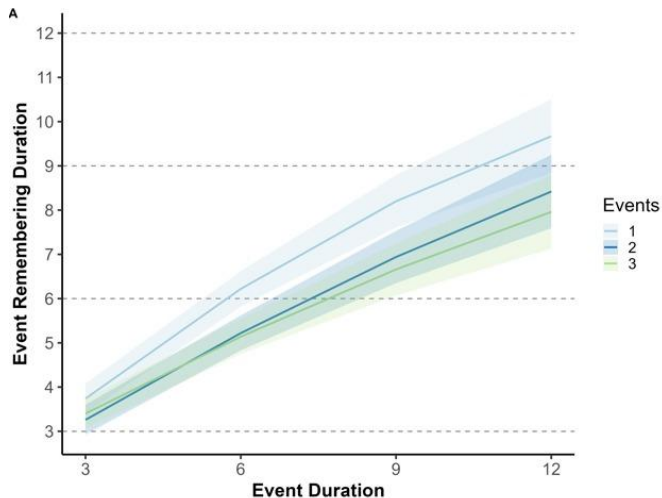
-Indices per event: event remembering duration (total replay / number of events)

- Exp. 2 (72 new participants, online): a key press at each event transition → direct measure per event**

Event duration	Event number	
Three seconds	One	3
	Two	3 3
	Three	3 3 3
Six seconds	One	6
	Two	6 6
	Three	6 6 6
Nine seconds	One	9
	Two	9 9
	Three	9 9 9
Twelve seconds	One	12
	Two	12 12
	Three	12 12 12

Both duration and number shape memory resolution

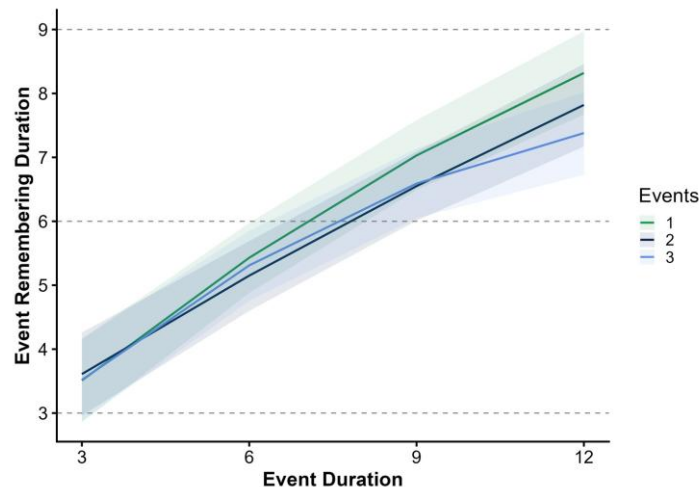
Experiment 1



Duration effect replicated

Compression emerges for single events of 9 s or longer.

Experiment 2



Number effect

An event is replayed faster in a sequence of 2 or 3 events than alone,

Interaction

The cost of event number grows with event duration.

Conclusions and perspectives

- Continuous events become temporally compressed in memory when they exceed a few seconds

-Initiation time and central tendency bias seem to play a role but cannot entirely explain the effect

- Compression magnitude depends on the microstructure of experience — the duration and the number of events to be maintained
- A plausible source: the limited capacity of working memory in accumulating the perceptual stream

Open questions

- Which slices of an event are kept, and which are dropped?
- Encoding vs. retrieval contributions?
- Mechanisms behind the central tendency effect (// remembered duration?)

Acknowledgements

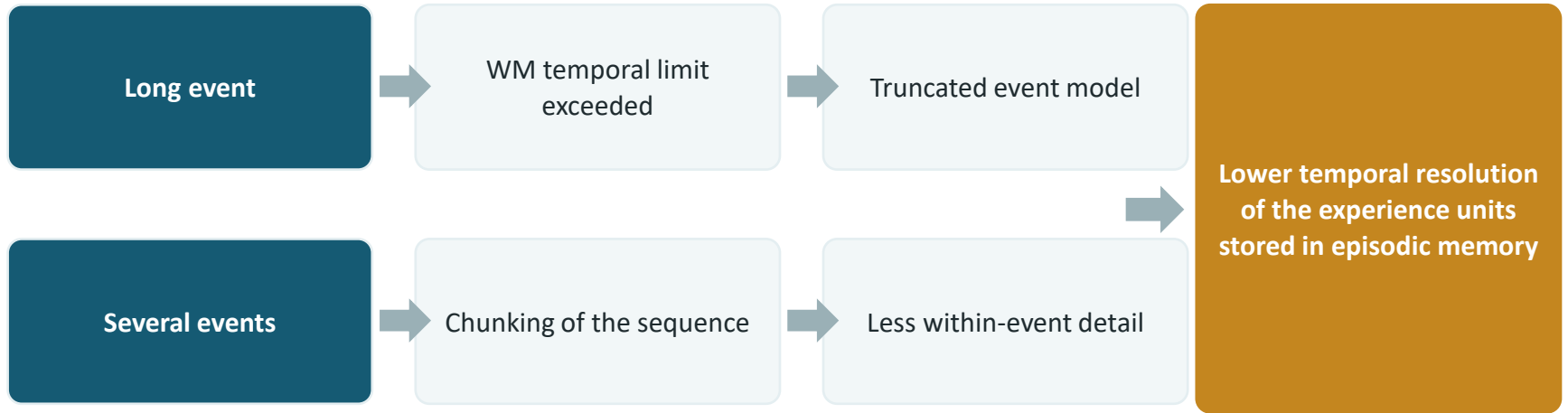


Thank you for your attention

nathan.leroy@uliege.be · Data and materials: osf.io/zkwf2 · osf.io/2xt93 · osf.io/6aecj

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Supplementary Materials



Video
(careful watching)



Mental Replay



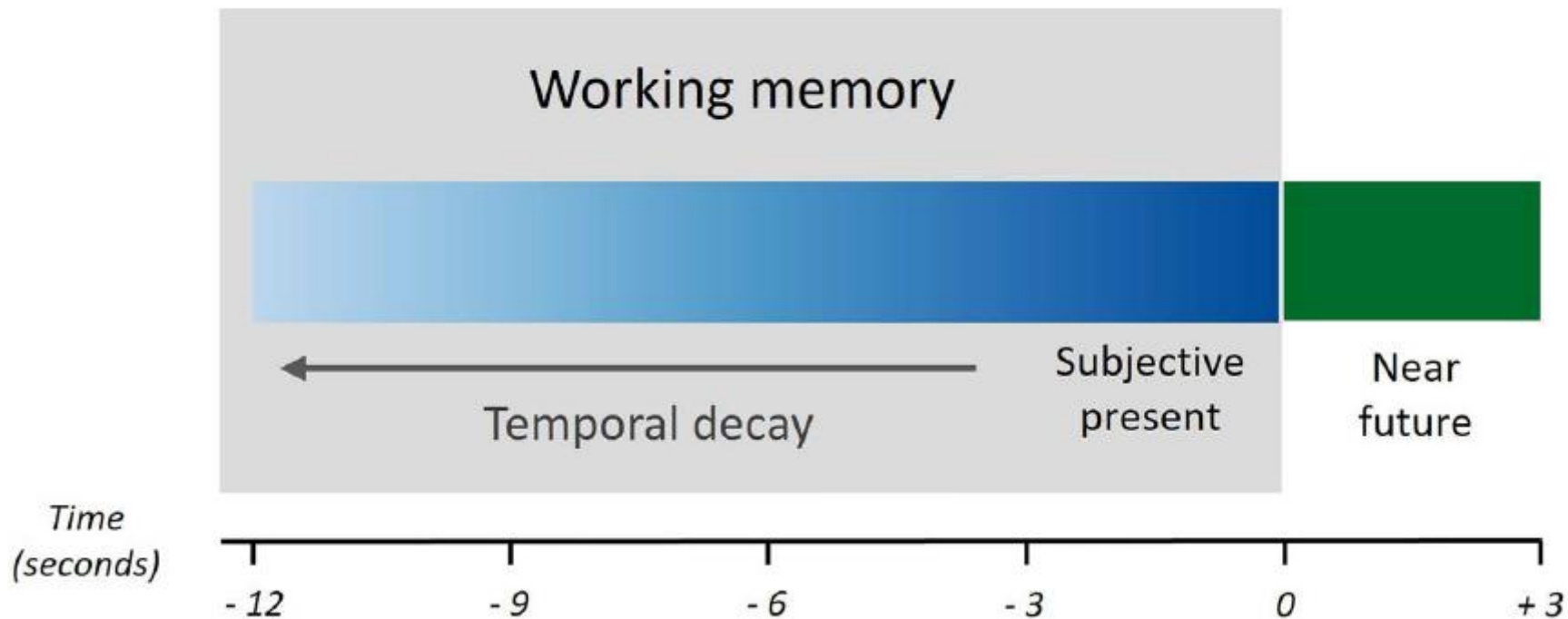
Event 1



Event 2



Event 3

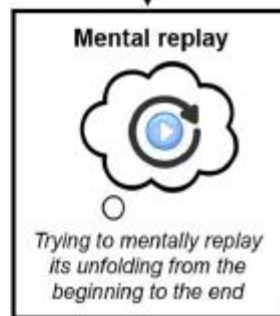


Event:
Continuous action
performed without
interruption during
3, 6, 9, or 12 seconds


**Remembering
START**




**Remembering
END**



Next Trial

X 12



**One
event**



**Two
events**



**Three
events**

Event Remembering Duration:

$\text{Mental replay duration} / \text{Number of events}$

Event Temporal Ratio:

$\text{Event Remembering Duration} / \text{Event Duration}$



**72 healthy
young adults**