Effects of Presentation Order and Delay on Recall of Narrative Details

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Introduction

- Comprehending stories (and recalling them) requires **encoding** and **maintaining** a lot of info in **episodic memory** for later **retrieval** and **recall**.
- **Episodic memory** remains poorly understood.
- According to the Process Model of Memory [1], episodic information is **encoded** in long-term memory [LTM] so automatically **maintained/consolidated.** Thus, during narrative comprehension, online **encoding** in LTM is all you need to later **recall** the story.

Even scrambled stories?

- We noticed people tend to unscramble scrambled stories.
- Some have suggested working memory (WM) is needed to access LTM for recall [2]. Thus, it might be possible that cues needed for memory **retrieval of scrambled stories** are stored in WM.
- We attempted to disrupt WM after hearing a story and test whether recall was affected.
- Participants recalled both scrambled and ordered stories either before or after a *strenuous delay* period

Hypotheses

1. Contradictory to the Process theory, **reconstructive processes** reliant on WM might be used to recall stories after it is heard. If true, these would likely occur while attempting to recall details of a scrambled story
2. If WM is used for consolidation and reconstruction, the delay would cause more difficulty recalling scrambled stories than recalling normal stories
3. If both Scrambled and Ordered stories were encoded using long-term memory, without relying on WM reconstruction, neither would be affected by the delay

Methods & Procedure

- Subjects: 21, UMD students age 18-22
- Procedure:
  - Two groups
    - Delay (n=10)
    - Immediate (n=11)
- 6 Narrative Blocks, 2 Conditions
  - Ordered Story
  - Scrambled Story
  - Each 45-55 Sentence
  - ~5 minutes each
- Working memory task
  - Complex span task
- Recall (As many details as possible)
  - Idea Units
- True or False Comprehension
  - 20 Inference-based questions
  - Binary forced choice (T/F)

Sentences	Idea Units
The prince made his way silently into the holy cave.	1
The first chamber had a balcony high above the floor.	1
Walking through the long narrow chamber, the prince looked around.	2
Glancing at the cave walls, the prince approached a clear pool.	2
When the traveler returned home, two black dogs awaited him.	2

Table 1. (Above) Example of sentences and idea units

Complex span task (Strenuous Delay)

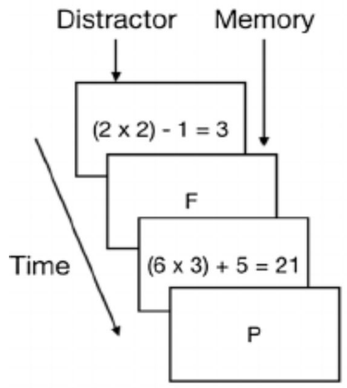

Figure 1. (Left) Diagram of complex span task with a strenuous delay. A distractor is distributed in between story recall tasks as a means to gauge the accuracy of the participant's memory.

Recall Results

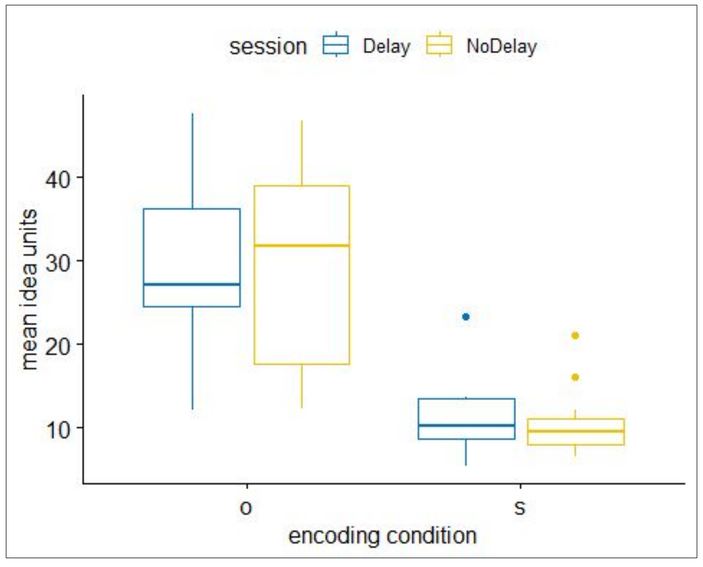

Figure 2. (Above) Boxplots showing differences between mean idea units recalled in the groups who experienced delay before recall (blue) and the groups who did not experience delay before recall (yellow) in both encoding conditions (o = Ordered, s = Scrambled).

Effect	DFn	DFd	F	p	ges
Delay vs None	1	19	0.05	0.84	0.002
Condition	1	19	84.12	0.000 *	0.53
Delay x Condition	1	19	0.00	0.99	0.00

Figure 3 (Above). Table 2. The effect from the delay paired with the condition was significant. It indicates that there was virtually no difference between the delay group and the no delay group. However, there was an effect that depicted a significant difference between a participant recalling an ordered story or a scrambled story.

True or False Results

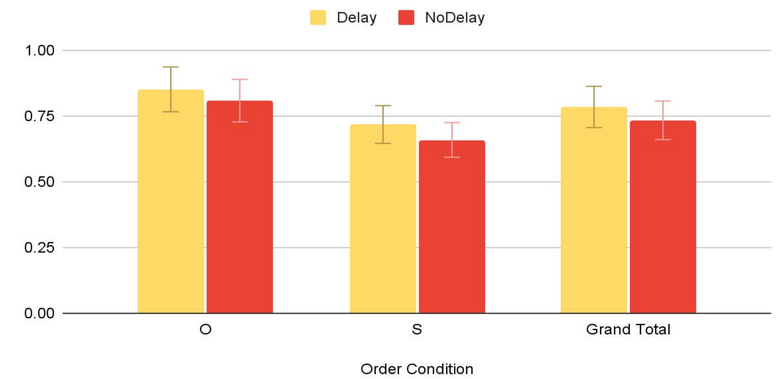

Figure 4. (Above) Bar graph that shows True and False accuracy of participants when presented after a delay (yellow) or with no delay (red).

Summary

- Our study found that while encoding was made much more difficult by scrambling the order of the story, distracting subjects between the story and the recall did very little to affect recall performance. Suggesting:
  - (Hyp 1) Encoding of story information in LTM in is happening online, and not using cues or reconstructive processes in working memory after the story is over.
  - Episodic Information not properly encoded online is irretrievable.
  - Retrieval processes after the story is over are not using WM (Hyp 2/3).
- People did slightly better in the True False with a delay! (Figure 4) Suggesting:
  - consolidation might have occurred during the strenuous delay!
  - LTM effects on recognition change with brief consolidation
- These finding has implications for: Education, art, clinical importance for understanding how narratives are formed and remembered.
- Working memory still likely important for maintaining local coherence.

Limitations and Future Directions

Limitations

- Sample size
- Fatigue effects
- Limited number of stories
- Only one time delay
- non random scrambling

Future Directions

- Individual differences i.e. What allowed some people to recall scrambled stories better than others?
  - WM levels
  - Experience Levels?
  - Schema based processing
- EEG effects
- Age effects?

References

[1]. Hasson, U., Chen, J., & Honey, C. J. (2015). Hierarchical process memory: memory as an integral component of information processing. *Trends in cognitive sciences*, *19*(6), 304-313.

[2]. Ericsson, K. A., & Kintsch, W. (1995). Long-term working memory. *Psychological review*, *102*(2), 211.