The multiple encoding benefit: encoding opportunities amplify benefits from encoding duration in visual long-term memory

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Introduction

- Access to visual long-term memory (VLTM) can by improved with multiple encoding opportunities
- The multiple encoding benefit (MEB) might be underlaid by both the **number** of opportunities and the **duration** of encoding

Can we dissociate the contributions of the number and duration of encoding opportunities to the MEB in VLTM?

- VLTM can also be quantified subjectively and objectively
  - While usually correlated, they may not necessarily measure the same constructs
  - How will the MEB affect subjective memory accessibility and objective memory strength?

Discussion

- Increasing the encoding **duration** improved subjective memory accessibility
- Increasing the **number** of encoding opportunities benefited *both* subjective and objective memory quality
- This benefit was enhanced with a large temporal separation between items **(lag)**

- Therefore, although subjective accessibility and objective memory strength are correlated ($r(40) = .83$, $p < .001$), **the contributions of the number and duration of encoding opportunities to the MEB can be dissociated**

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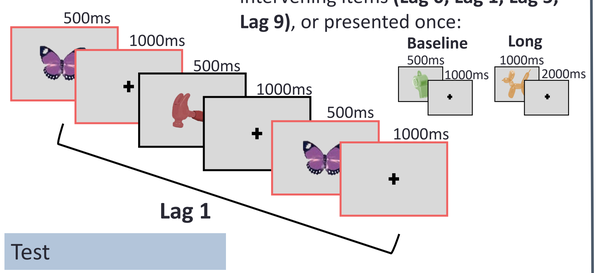
Experiment 1: does increasing the encoding duration improve VLTM performance?

Encoding

Objects repeated (2 presentations) with intervening items **(Lag 0, Lag 1, Lag 5, Lag 9)**, or presented once:



Test

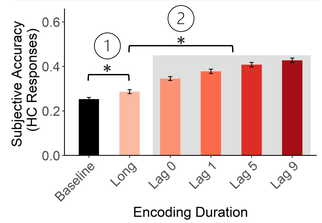
Recognition judgement:
1. Remember object & colour
2. Remember object only
3. Don't remember

Select colour from colour wheel

Adjust colour & confidence judgement:
1. High confidence
2. Low confidence
3. Guessing

Subjective Memory Accessibility

High confidence (HC) responses



Subjective accuracy = proportion HC old – proportion HC new

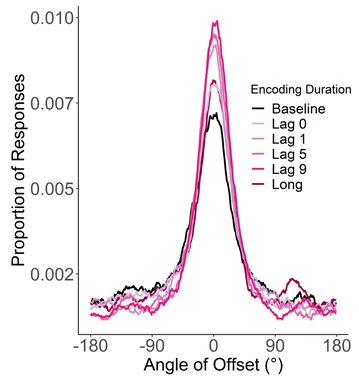
1. **Encoding duration:** Baseline (1500ms) vs. Long (3000ms)
2. **Number encoding opportunities:** Long (1 presentation) vs. Lag conditions (2 presentations)

Subjective accessibility benefited from an increase in encoding **duration**, as well as **number** of encoding opportunities and **lag**.

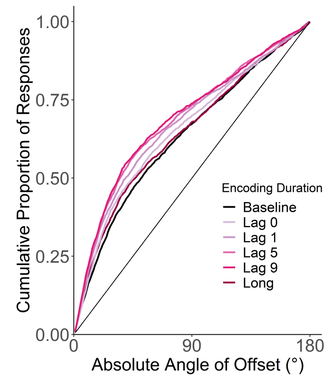
Objective Memory Strength

Does this improvement in VLTM apply to objective memory strength as it does for subjective memory accessibility?

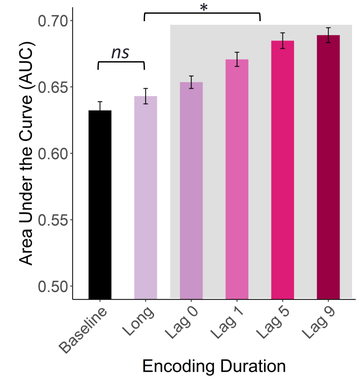
Response Offset Distribution



Cumulative Dist. Function (CDF)



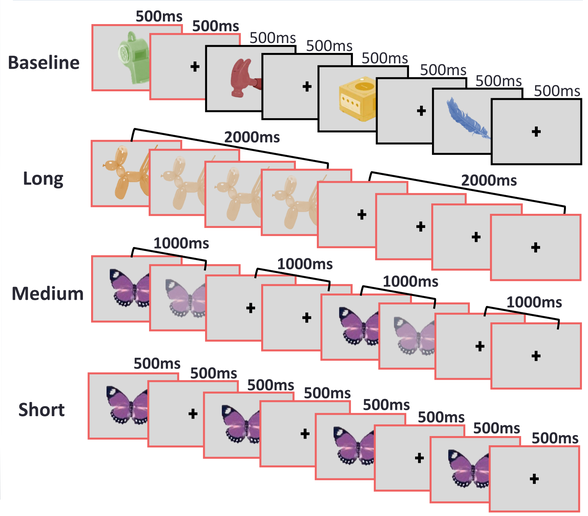
Area Under the Curve of CDF



- **No**, unlike with subjective accessibility, when encoding **duration** was increased from 1500ms (Baseline) to 3000ms (Long), memory performance did not change
- However, increasing the **number** of encoding opportunities (Lag conditions vs. Long) lead to a reliable MEB effect

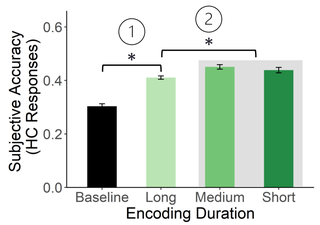
Experiment 2: how far can we push the benefit of multiple encoding opportunities without intervening lag?

Encoding conditions (with same test procedure as Experiment 1)



Subjective Memory Accessibility

High confidence (HC) responses



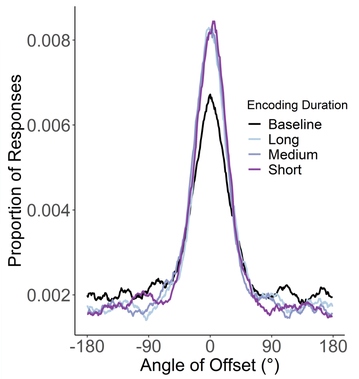
1. **Encoding duration:** Baseline (1000ms) vs. Long (4000ms)
2. **Number encoding opportunities:** Long (1 presentation) vs. Medium & Short (multiple presentations)

The benefit of increased encoding **duration** was replicated from Experiment 1, with further improvement from pushing the **number** of opportunities beyond two presentations to four.

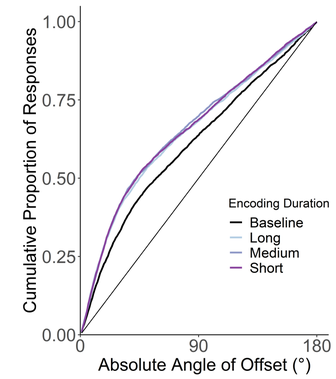
Objective Memory Strength

Is the benefit of multiple opportunities without lag also reflected in objective memory strength?

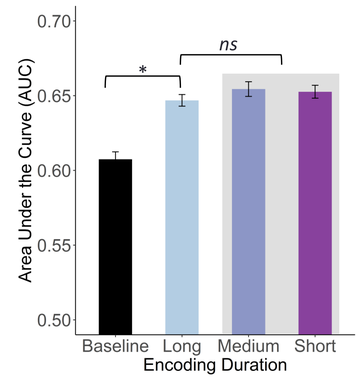
Response Offset Distribution



Cumulative Dist. Function (CDF)



Area Under the Curve of CDF



- **No**, similar to subjective accessibility, there was no benefit of **multiple** encoding opportunities to the MEB when the encoding duration was held constant at 4000ms
- Although, objective strength improved when the encoding **duration** was increased four times from 1000ms (Baseline) to 4000ms (Long)