The impact of momentary lapses in attention during encoding on spatial context memory performance

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Introduction

- Attention and episodic memory interact in fundamental ways, yet the component processes of these cognitive domains are primarily examined systematically in isolation.
- Questions regarding how these two systems may interact and the behavioural consequences of those interactions remain vastly underexplored.
- Previous studies in healthy younger adults have shown that when participants' attention is divided during memory encoding by asking them to perform a secondary task (e.g., monitoring certain tones), memory performance is impaired, especially for contextual details surrounding items (Troyer et al., 1999; Troyer & Craik, 2000) .
- Results from these divided attention paradigms have been interpreted to suggest that memory encoding processes require attentional resources (Craik et al., 2018; Naveh-Benjamin & Guez, 2013).
- However, It remains unclear how the natural fluctuations in levels of attention during memory encoding, or the occurrence of brief interruptions in attention, affects memory performance.

The goal of this study was to examine how brief lapses in attention during memory encoding may impact memory performance using a novel paradigm

We predict that attentional lapses during encoding will be associated with memory decrements for contextual details.

Methods

- 34 healthy younger adults successfully completed this study. 4 were excluded from our analysis post-hoc after being deemed outliers. ***N = 30 (17 females).***
- Participation involved completion of 2
  - Session1: neuropsychological test battery
  - session 2: Completion of novel spatial context memory task while undergoing fMRI testing (*only behavioural results will be discussed*).

Behavioural questionnaires included:

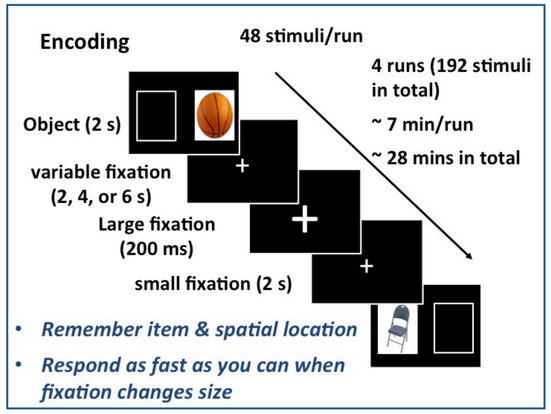
- California Verbal Learning Test (CVLT): To assess verbal learning memory
- Delis Kaplan Executive function system (D-KEFS); Wisconsin Card Sorting test (WCST): To assess executive function
- Cognitive Failures Questionnaire (CFQ) and Mindful Attention Awareness Scale-Lapses Only (MASS-LO): To assess the frequency of everyday attentional lapses
- Thinking Content component of the Dundee Stress State Questionnaire (DSSQ): To assess the content of thinking during the spatial context memory task

Demographics & Behavioural Measures		
	Mean	**S.E**
Age	25.77	0.77
Education (years)	15.80	0.35
CFQ - Forgetfulness	10.57	0.82
CFQ - Distractibility	11.10	0.86
CFQ – False triggering	6.67	0.62
MASS - Lapses	30.33	1.34
DSSQ – Task related interference	20.53	1.08
DSSQ – Task unrelated interference	14.63	0.94

* Mean scores for all questionnaires fall within the normal range for healthy younger adults.

Task Design

To explore the effects of lapses in attention on context memory performance, we created a novel hybrid task of attention and spatial context memory. We combined a typical object-location associative memory paradigm with a psychomotor vigilance/sustained attention task (PVT; Dinges & Powell, 1985) where vigilance is assed via RTs to a stimulus that appears at random duration (relatively slower RTs reflect lapses in attention).



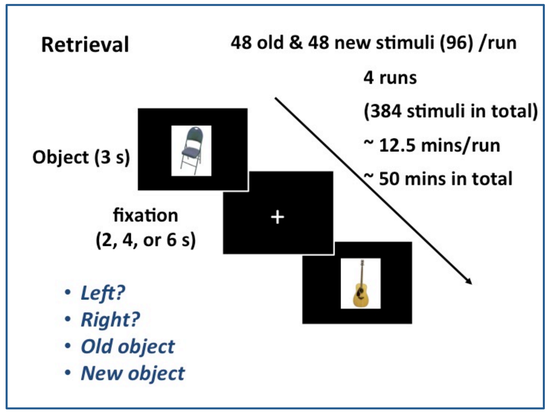
Encoding phase

- Participants were asked to:
  a. Memorize each object and their location
  b. Respond as quickly as possible when the fixation cross changes size

Both these instructions were emphasized equally

Retrieval phase

- Participants were asked to indicate whether each object was:
  a. Previously presented on the left side
  b. Previously presented on the right side
  c. An old object but unsure of it's initial location
  d. A new object

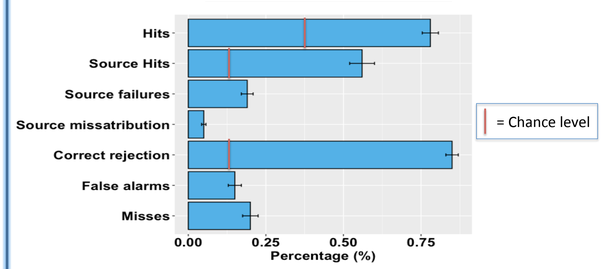


Results

Performance criteria

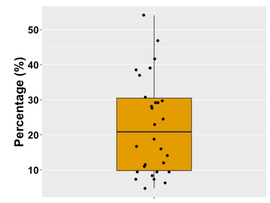
Subject Response \ Stimulus type	Left	Right	New
Left	Source Hit	Source misattribution	False Alarm
Right	Source misattribution	Source Hit	False Alarm
New	Miss	Miss	Correct Rejection
Old	Source failure	Source failure	False alarm

Plot of task accuracy results



- **Attentional lapses were operationalized as RTs exceeding top 10th percentile of group mean (447 ms) + failures in response to fixation cross at encoding**

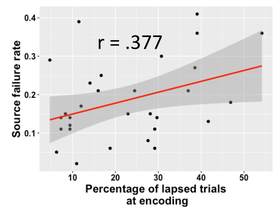
Boxplot of percentage of encoding trials classified as attentional lapses



- Number of lapses were correlated with source memory hits and failures to determine whether lapses in attention (as operationalized above) impact context memory performance.

Number of lapses did not significantly predict source hits, however there was a significant positive association ($p < .05$) between number of lapses at encoding and source failure rate at retrieval

No. of lapses vs. Source failures



Number of lapses was not significantly correlated with CFQ or MAAS-LO, however, failures in response to fixation cross at encoding (a component of our attentional lapses measure) showed a significant positive association with the distractibility component of the CFQ measure ($p < .05$, $r = .38$)

Summary/Conclusion

- The goal of this study was to explore the effects of lapses in attention at encoding, on context memory performance at retrieval using a novel paradigm
- Our results indicate that lapses in attention that occurred at memory encoding predicted source memory failures in healthy younger adults
- This suggest that encoding-related processes related to forming successful object-location associations may be disrupted during brief lapses in attention
- Future directions will involve a) examining the neural basis of the association between attentional lapses and source memory failures and b) exploring the relationship between attentional lapses and context memory performance in healthy aging.

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