



INCREASING THE CAPACITY OF VISUAL SHORT-TERM MEMORY THROUGH ATTENTION AND LONG-TERM MEMORY

BY INGRID OLSON¹ YUHONG JIANG² KATHERINE SLEDGE¹

¹University of Pennsylvania, Center for Cognitive Neuroscience & ²Harvard University



Introduction

- How do memory systems interact?
- Although short-term or working memory systems are thought to be separate from long-term systems, it is common for them to interact.
- There are few theories and little data about how that interact.

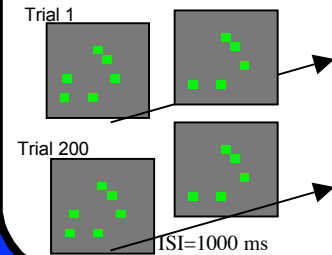
QUESTION

- (1) When and how do VSTM and visual LTM interact?
- (2) How does this interaction modify behavior?
- (3) What stage of mnemonic processing is altered by this interaction?
- (4) How does the brain code their interaction?

Methods

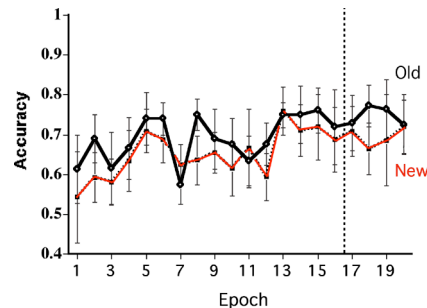
- Each experiment had 2 components
- 1. VSTM trials: Change detection task for spatial location
 - VSTM was assessed by a recall task - click on missing location.
 - Hidden within the trials: LTM was created by a training procedure
 - Old trials had repeated configurations.
 - New trials had randomly selected locations.
 - 1 hour of training
- 2. Recognition task that assessed LTM
 - recognition task - yes/no

Stimuli



Exp. 1-Non-Associative Learning

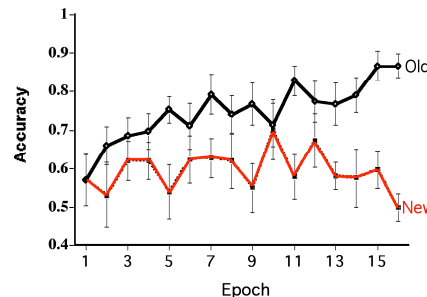
- Old sequences paired with random probe-item locations.
- Results: no learning effect; simple repetition will not improve VSTM performance



• But subjects could recognize displays!

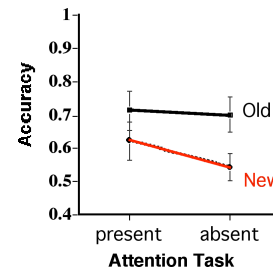
Exp. 2: Associative Learning

- Old configurations paired with fixed probe-item locations.
- Results: large learning effect.
- What is being learned? Subjects learn to anticipate where a probe-item will appear. LTM modulates attention.



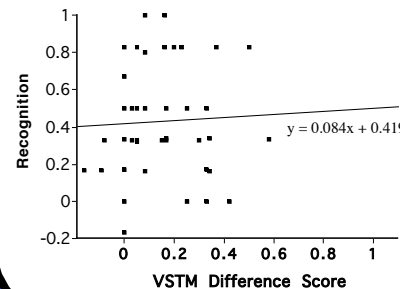
Exp. 3: Interference

- An interference task was inserted during the ISI.
- Results: no disruption in the Old condition suggesting that Old/New differences arose prior to memory retrieval



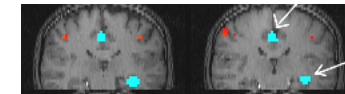
Recognition: Does it Predict Performance?

- Above- chance recognition in every experiment.
- Recognition performance did not correlate with learning effect.
- Learning effect was driven by attentional guidance, not the ability to recognize displays.

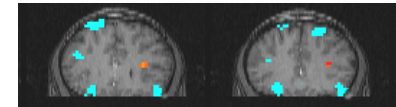


Exp. 4-fMRI

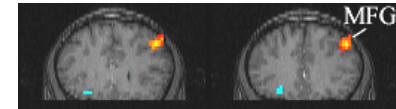
- Subjects were trained before scanning.
- Examined activations during VSTM maintenance.
- Three conditions: New, Old ass., Old non-ass.
- Results: New vs. Old*
- Activations in the hippocampus and anterior cingulate.



- Results: Old non-ass. vs. New (e.g. Exp. 1)*
- Activations in the IPS, posterior fusiform gyrus



- Results: Old ass. vs. New (e.g. Exp. 2)*
- Activations in the IPS, fusiform gyrus, and middle frontal gyrus.



Conclusions

- Training leads to LTM for the repeated displays - BUT -
- LTM only improves VSTM performance when it can be used to direct attention.
- This effect may be related to attentional processes in MFG, and lower need for effortful memory processes (cingulate).
- It occurs prior to memory retrieval.
- LTM does not help you to remember more information, or a bigger chunk, but *which* information.

iolson@psych.upenn.edu
<http://wernicke.ccn.upenn.edu/~iolson/>