



The role of exploratory decision-making in enhancing episodic memory

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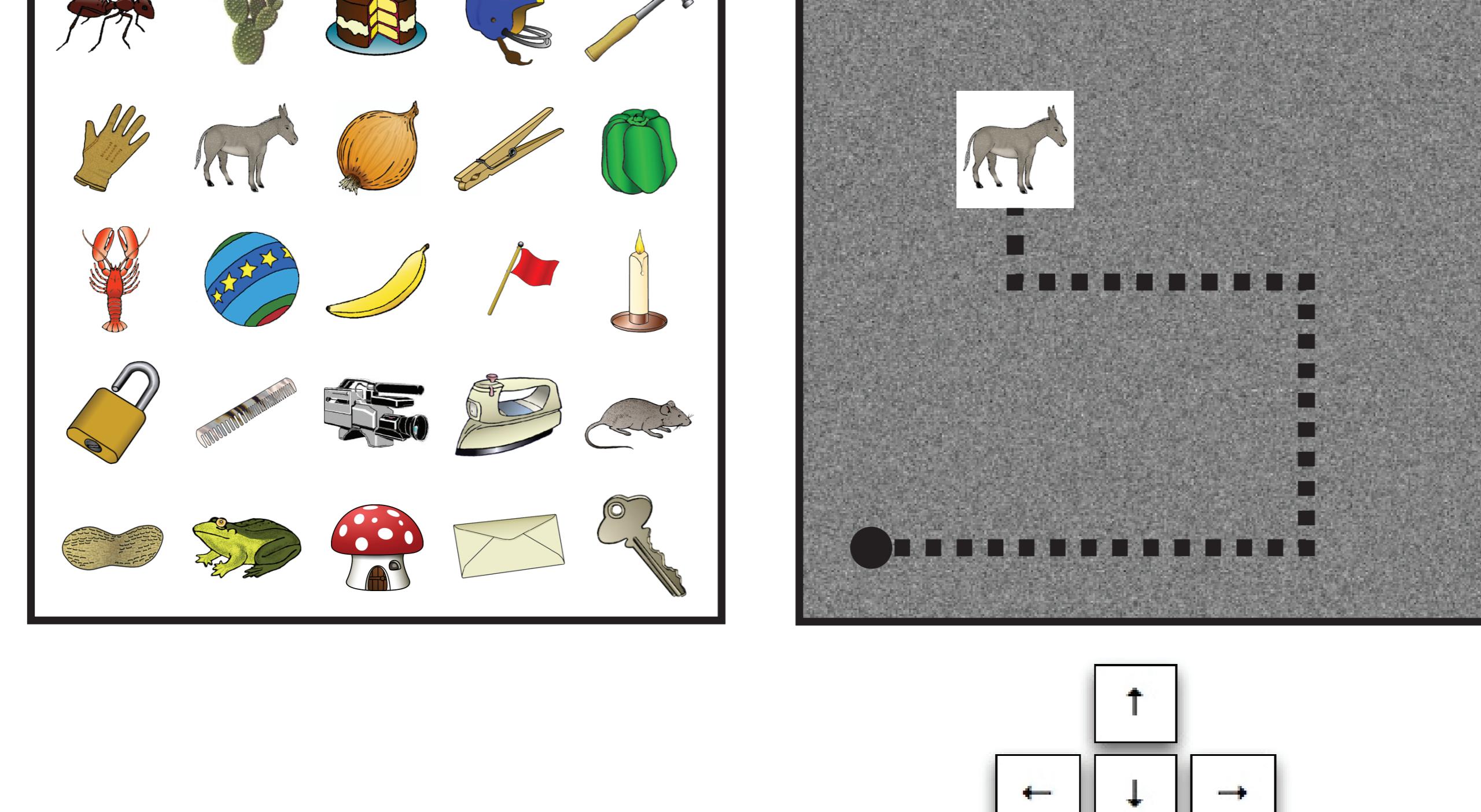
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Why does making decisions about how to study a set of items lead to better memory than passive observation of the same data?

Enhancements in memory for “volitional” exploration during encoding compared to “passive” observation

In a recent study, Voss et al. (2011a,b) found that “volitional” exploration during learning led to improved memory for the items studied compared to passive observation of the same study sequence. Participants were shown six grids of objects to memorize, but each grid was masked such that only one object was visible at a time through a moving window:



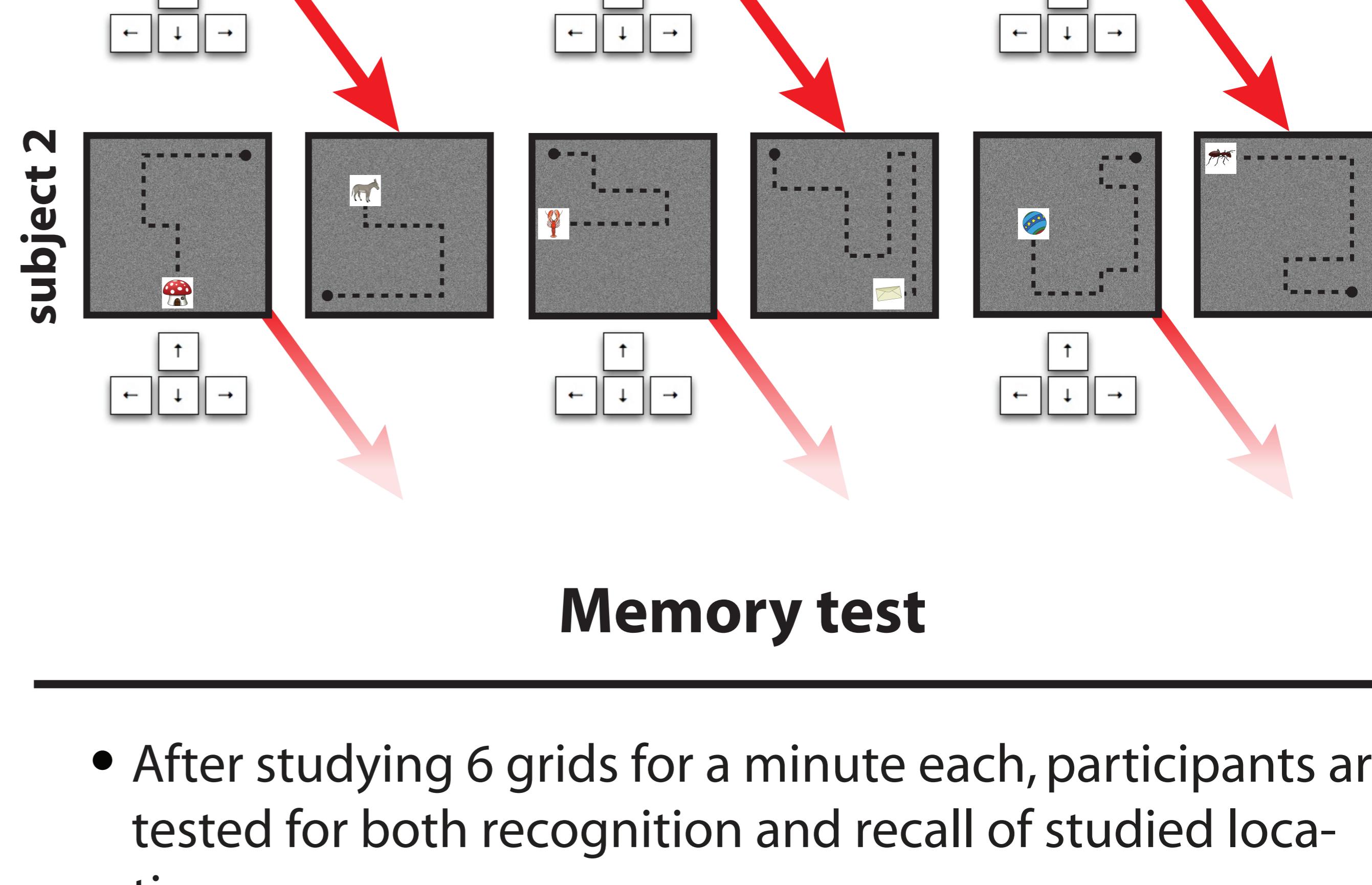
Multiple levels of control during volitional study: Choosing what, when, and for how long

Volitional study entails multiple kinds of adaptive control over the encoding experience:

- Attentional coordination with the sequence of study opportunities (i.e., knowing when and where the window is about to move)
- Choosing which items to study based on current memory (e.g., deciding to revisit an item that was poorly encoded)
- Choosing how long to dwell on an item before moving the window to a new location

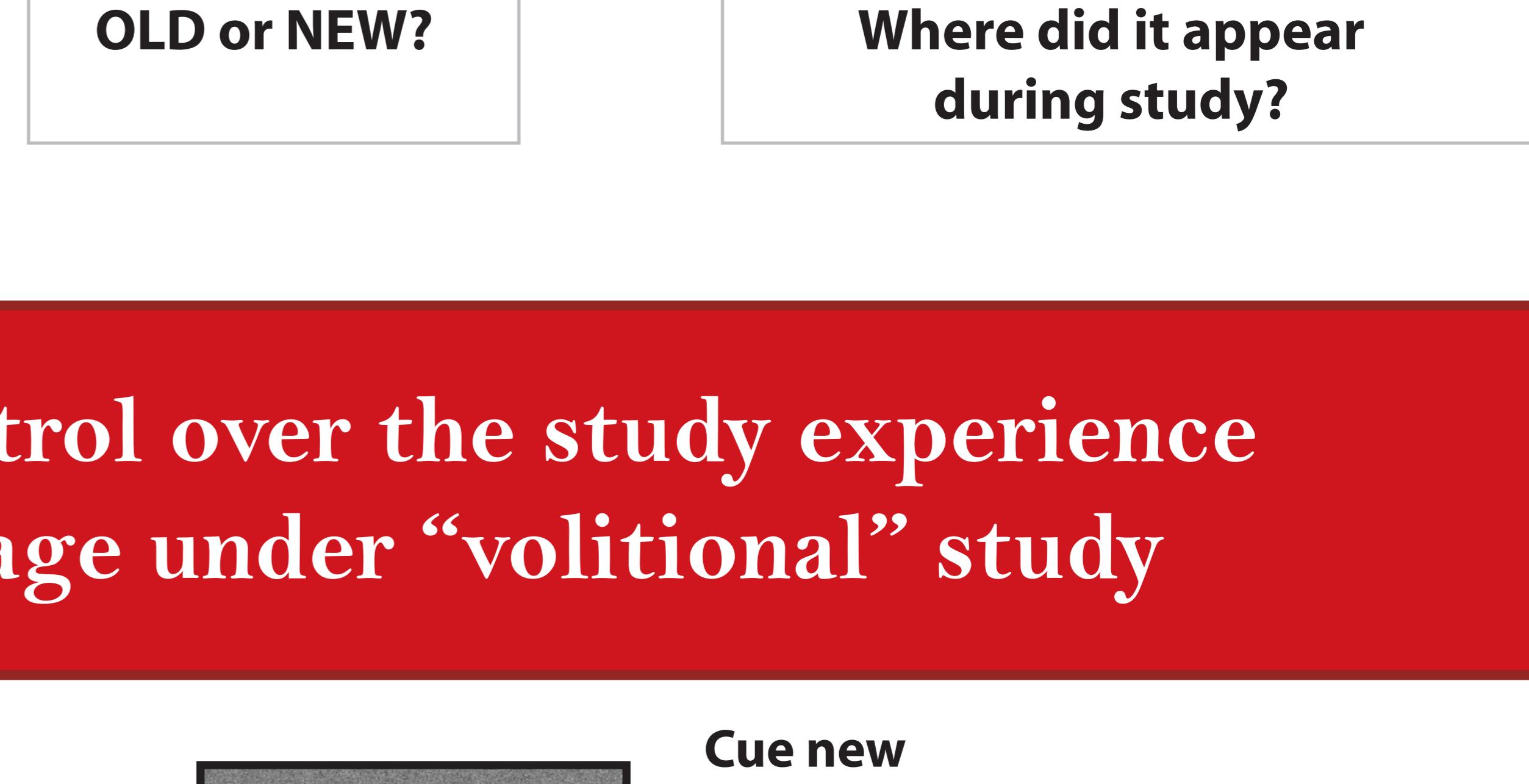
Isolating the effects of decision-making through “yoked” experiments

The information generated by one person during volitional study (a sequence of study episodes of their own choosing) is presented to a following participant during “yoked” study blocks. By fixing the order and timing of study opportunities, comparing volitional and yoked encoding measures the effect of making decisions about how to study on memory performance.



Memory test

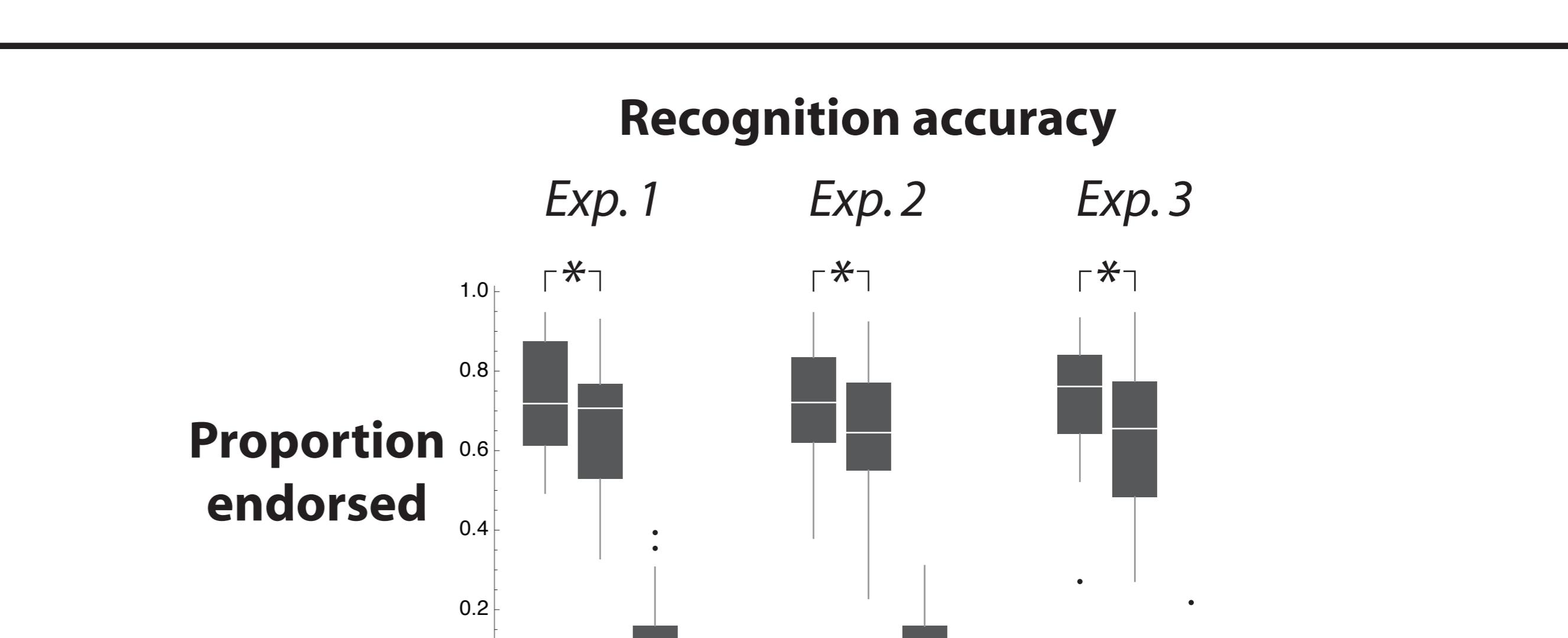
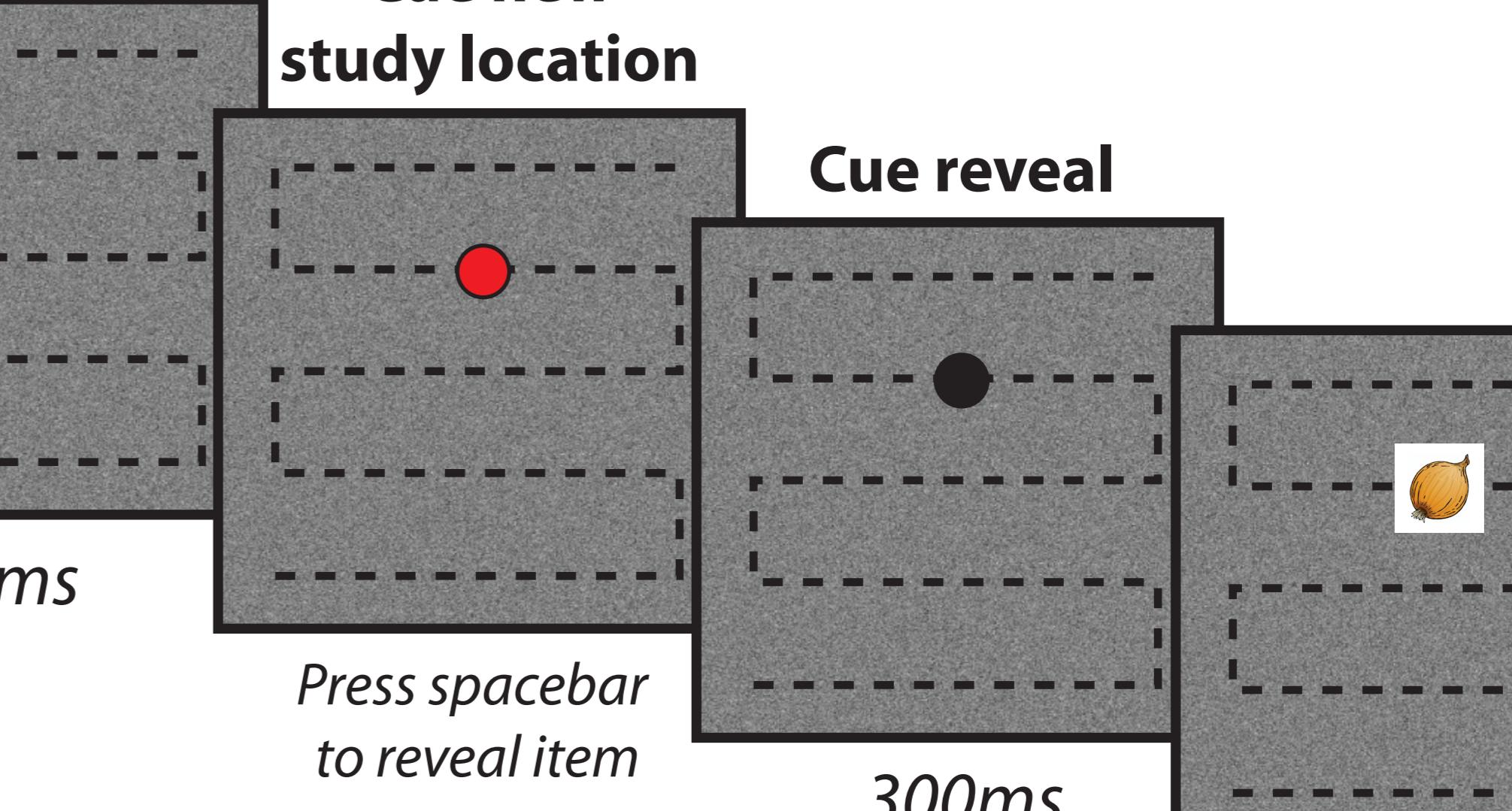
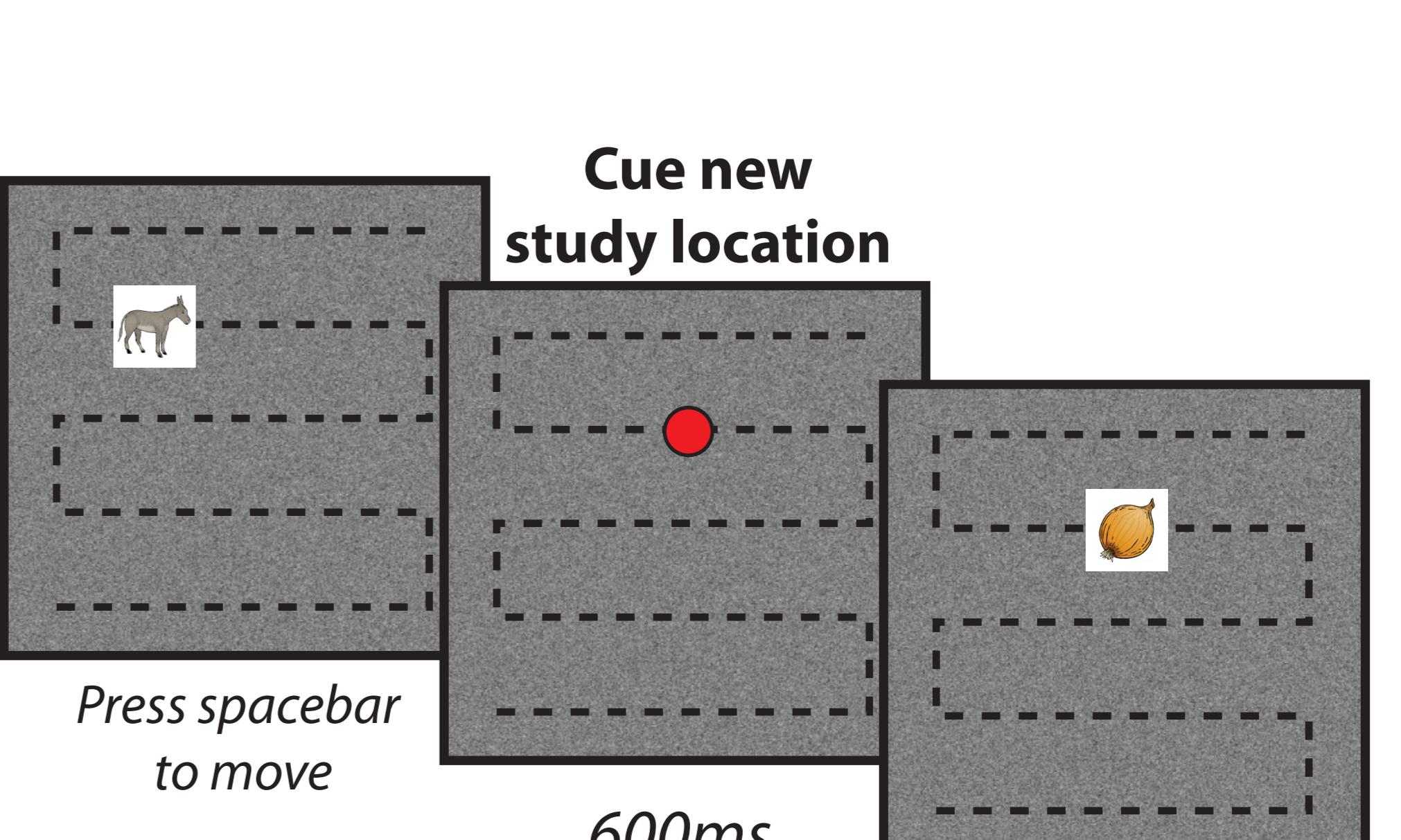
- After studying 6 grids for a minute each, participants are tested for both recognition and recall of studied location
- Only tested for spatial recall if responded “OLD” during recognition test



OUR GOAL: Identify the level of control over the study experience needed to produce a memory advantage under “volitional” study

Experiment 1: Cueing the next study location

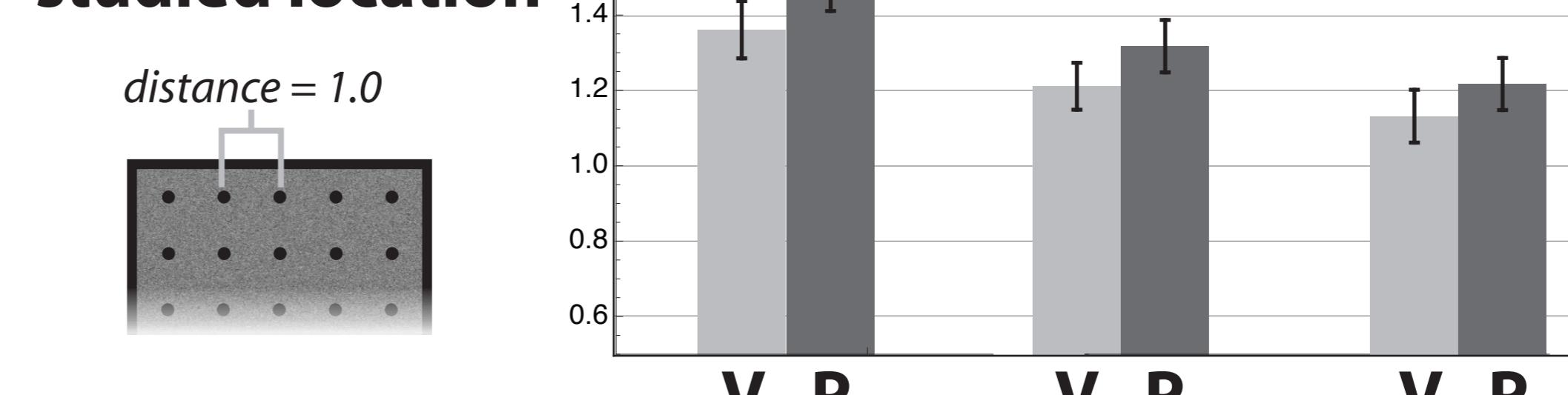
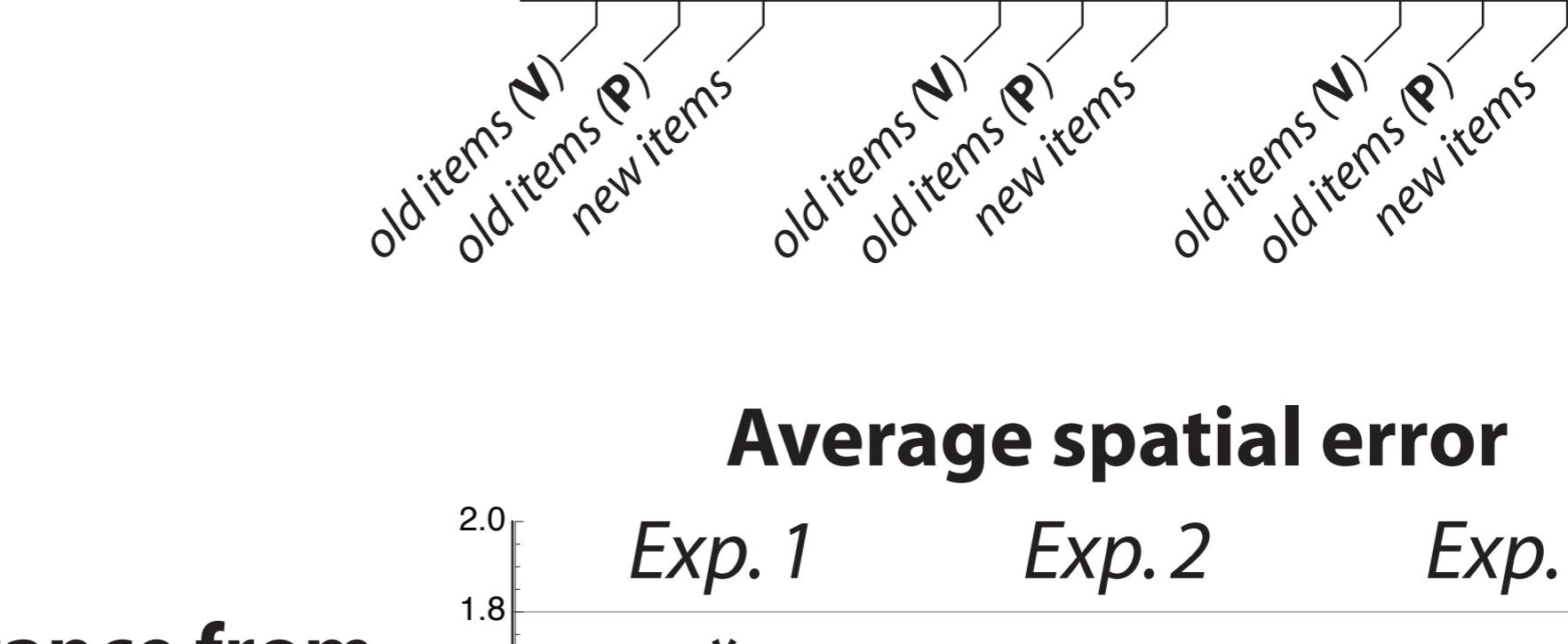
- During volitional study blocks the participant controlled both the order and timing of item presentation
- A cue indicating the next study location was used to improve attentional coordination during yoked study



Results

- In all three experiments, recognition memory was better for items studied under volitional encoding than yoked, passive encoding (paired t-test; **Exp. 1**: $t(29)=2.7, p=0.01$; **Exp 2**: $t(31)=2.85, p=0.008$; **Exp. 3**: $t(29)=2.8, p=0.01$)
- In Experiments 1 and 2, spatial recall was more accurate for volitional items than yoked items (paired t-test; **Exp. 1**: $t(29)=-2.6, p=0.013$; **Exp. 2**: $t(31)=-1.8, p=0.08$).
- In all three experiments, participants made significantly more “opt-out” spatial recall responses for yoked items than volitional items (signed rank test; **Exp. 1**: $p<.001$; **Exp. 2**: $p=0.002$; **Exp. 3**: $p=0.008$)

Advantage for volitional encoding found across all levels of control, including very limited decisions (simply choosing to “reveal” the next object)



References

J. Voss, B. Gonsalves, K. Federmeier, D. Tranel, and N. Cohen (2011). Hippocampal brain-network coordination during volitional exploratory behavior enhances learning. *Nature Neuroscience*, 14(1):115–120.

J. Voss, D. Warren, B. Gonsalves, K. Federmeier, D. Tranel, and N. Cohen (2011). Spontaneous revisitation during visual exploration as a link among strategic behavior, learning, and the hippocampus. *Proc. of the National Academy of Sciences*, 108(31):E402.