Pupillary Response Indicates the Resolution of Proactive Interference in a Visual Working Memory Task

Jamie Beshore¹, Erik Blaser¹, & Zsuzsa Kaldy¹
¹Developmental and Brain Sciences, University of Massachusetts Boston, Boston, MA

Motivation
Cognitive effort, as indexed by pupil diameter, affects proactive interference (PI) resolution during verbal memory retrieval (Johansson et al. 2018). It is unclear how effort is implicated in PI resolution in visual working memory.

In Study 1 (online), we tested the strength of PI in a VWM task. In Study 2 (in lab), we assessed the role of cognitive effort in PI resolution.

Introduction
Working memory (WM) is a capacity-limited system that temporarily increases information availability for in-the-moment processing (Cowan, 2017).

WM’s capacity limits are in part due to proactive interference (PI), which occurs when currently irrelevant, previously learned information disrupts the retrieval of relevant, more recently learned information.

Cognitive effort is needed to resolve proactive interference. In a verbal task, Johansson et al. (2018) showed that pupil diameter, a proxy for cognitive effort, was associated with PI level and PI resolution dynamics during a verbal word list recall task.

In visual working memory (VWM) paradigms, the importance of PI is debated (e.g., Endress & Potter 2014; Lin & Luck 2012). The role of cognitive effort in PI resolution in VWM has not yet been studied.

Methods
Delayed Match Retrieval Task (Johansson et al. 2016)

Sample Trial
- PI was induced by repeating two images during encoding across each trial in a block.
- If the response item was a repeated item, the trial was a PI trial. Otherwise, it was a NoPI trial.

Sample block (encoding periods only)
- We employed a within-participants design
- Behavioral responses were recorded by keyboard number press

Participants
Study 1: N = 32; mean = 25, range = 18 - 33 (online)
Study 2: N = 33, mean = 20, range = 18 - 30 (in lab)

*Exclusion criteria: accuracy not significantly >25% (chance), >75% pupil data missing, or performance on verbal questions < 70%.

Acknowledgment & References
This project was supported by NIH #R15HD086658.


Pupil dilation was larger in the PI condition, indicating that participants exerted more cognitive effort in those trials.

However, the amount of pupil dilation did not correlate with performance. We interpret that by the time the target item is presented, increased effort does not afford better performance.

Future directions include replicating Study 1 with a larger sample and adapting the task to children.

Discussion

Results
Performance is lower during PI trials

Study 1 (Online)
Study 2 (In Lab)
Study 2 (In Lab)

Performance is lower during PI trial retrieval

Visualization of the pupil trace collapsed across participants and trials (Study 2, In Lab)

PI does not accumulate across trials (Study 2, In Lab)

Success rate is unrelated to pupil size (Study 2, In Lab)

Contact
jamie.Beshore001@umb.edu
References


Future directions include replicating Study 1 with a larger sample and adapting the task to children.

Pupil dilation was larger in the PI condition, indicating that participants exerted more cognitive effort in those trials.

However, the amount of pupil dilation did not correlate with performance. We interpret that by the time the target item is presented, increased effort does not afford better performance.

Future directions include replicating Study 1 with a larger sample and adapting the task to children.