Attentional tracking drives contralateral delay activity in a dual working memory and object tracking task

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Introduction

Visual working memory is very limited. One proposed limiting factor is the assignment of content-independent pointers to the to-be-remembered items (Thyer et al., 2023). This is very similar in notion to FINSTs (Pylyshyn, 1989), an indexing mechanism for the tracking of moving objects.

The contralateral delay activity (CDA) is an event-related potential component that tracks visual working memory load (Vogel and Machizawa, 2004). Recent work has suggested that the CDA tracks an object-based pointer system that underlies working memory (Balaban et al., 2019). The CDA also tracks the set-size in an attentional tracking task (Drew and Vogel, 2008).

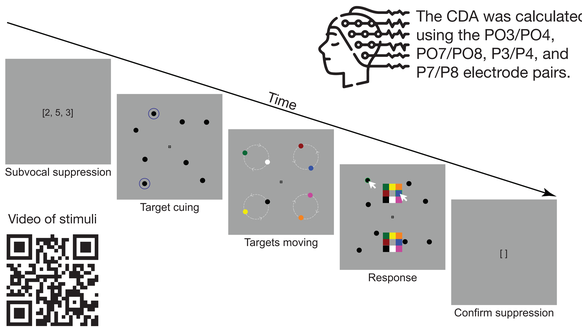
Here, we measured the CDA under conditions where both the number of targets that are tracked and the number of colors that need to be remembered are varied.

Method

On each trial, participants were cued to track one or two target discs, which had either one or two colors each.

In the first half of the experiment, participants only needed to track the moving targets (multiple object tracking). In the second half, participants tracked the targets as well as remembered the shown colors (multiple identity tracking).

Participants completed 96 trials in each condition in 16 blocks. Any eye movements or blinks during target cuing or moving stopped the trial, which was replaced at the end of the block.



The CDA was calculated using the PO3/PO4, PO7/PO8, P3/P4, and P7/P8 electrode pairs.

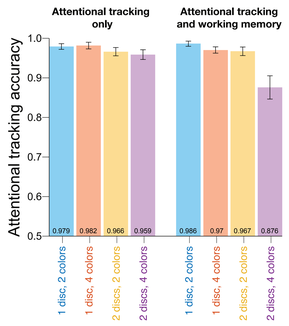
Video of stimuli

References

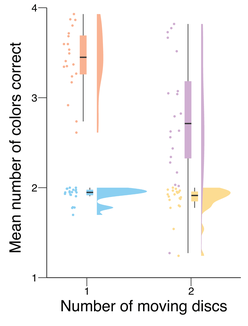
Thyer, W. et al. (2022). Storage in visual working memory recruits a content-independent pointer system. Psychological Science, 33(10), 1680-1694.
Pylyshyn, Z. (1989). The role of location indexes in spatial perception: A sketch of the FINST spatial-index model. Cognition, 32(1), 65-97.
Vogel, E. K., & Machizawa, M. G. (2004). Neural activity predicts individual differences in visual working memory capacity. Nature, 428(6984), 748-751.
Balaban, H., Drew, T., & Luria, R. (2019). Neural evidence for an object-based pointer system underlying working memory. cortex, 119, 362-372.
Drew, T., & Vogel, E. K. (2008). Neural measures of individual differences in selecting and tracking multiple moving objects. Journal of Neuroscience, 28(16), 4183-4191.

Results

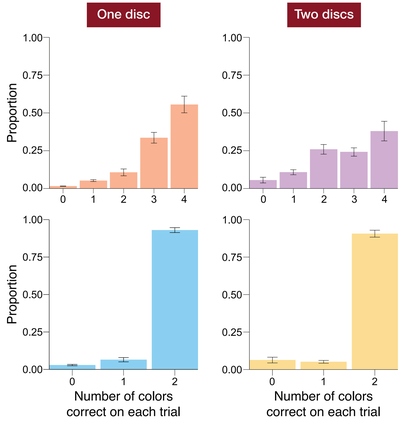
Attentional tracking performance (proportion correct)



Working memory performance (number of colors correct)



Working memory performance (distribution of colors correct)

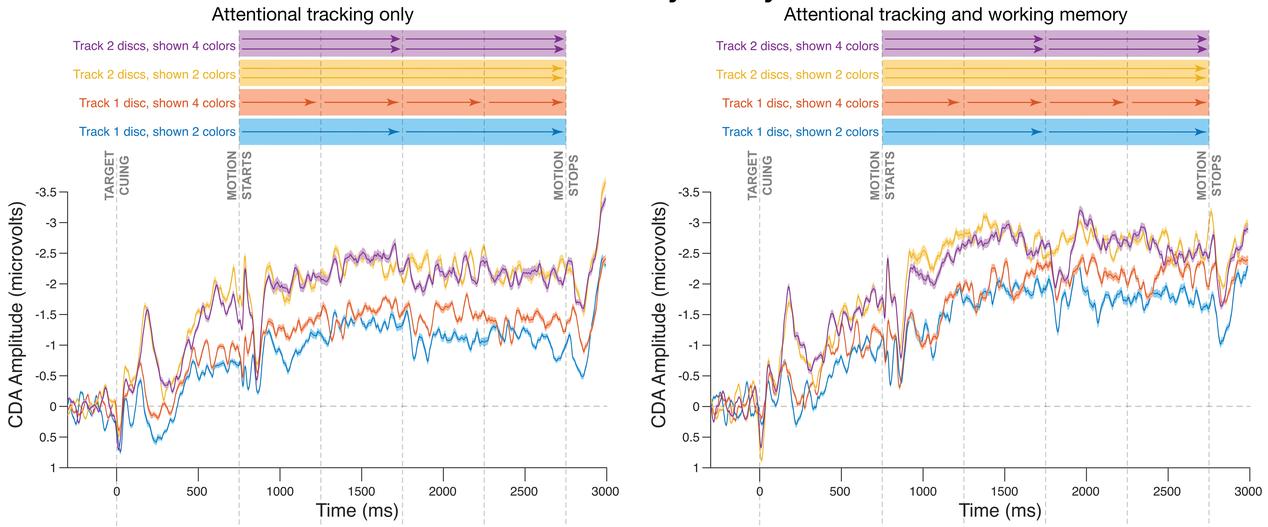


Working memory performance drops when split across two discs compared to one disc.

We observe swap errors on ~16% of trials in the two discs, four colors condition. This is likely owing to both discs changing color at the same time.

Working memory is very accurate for two colors in both one disc and two disc conditions.

Contralateral delay activity



Multivariate classification