Trade-off between search costs and accuracy in a visual and manual search task

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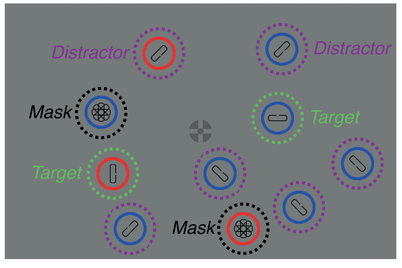
Introduction

- While one study showed similarities in exploration behavior with eyes and fingers [1], another study found differences due to higher costs of manual actions [2]
- For decision-making in visual search, one study demonstrated a trade-off between discrimination difficulty and the temporal costs of eye movements [3]
- **Is this trade-off is specific for eye movements, or does it generalize to manual actions?**

Methods

Task: find one of the two targets and discriminate the gap location; choose freely between targets, and complete as many trials as you can in 6:30 min.

Ten stimuli in each trial



Feedback after each trial

Time

+/– 0.02€ Reward/punishment for right/wrong resp.

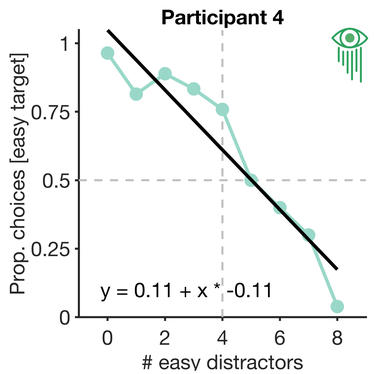
Two conditions: use finger taps (manual search) or eye movements (visual search)

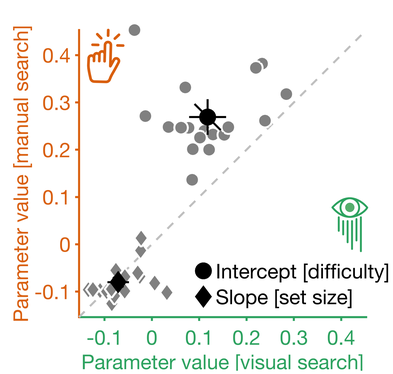
Stimuli are masked, unless fixated or touched

Manipulation 1: discrimination difficulty (easy- and difficult-to-discriminate target)

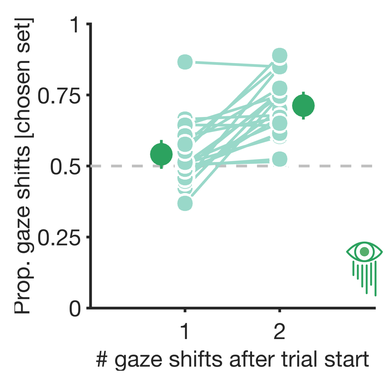
Manipulation 2: temporal costs of searching for a target (i.e., relative number of easy and difficult distractors in trial)

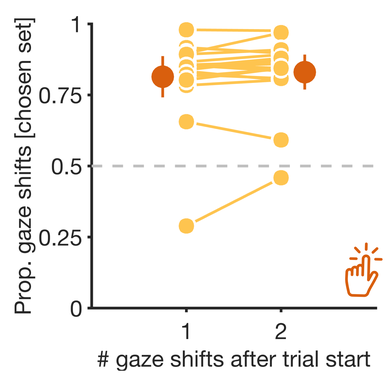
Results



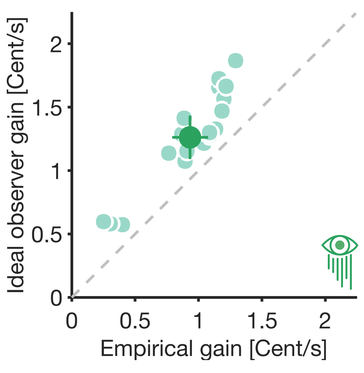


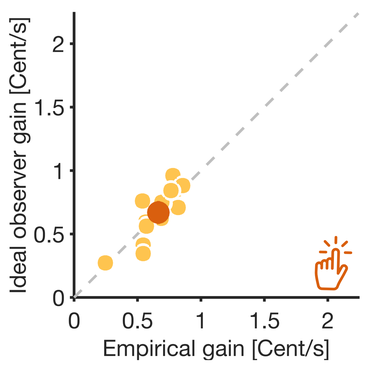
Both effectors: participants considered search costs and discrimination difficulty when choosing targets



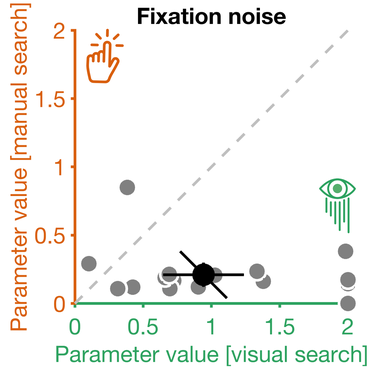


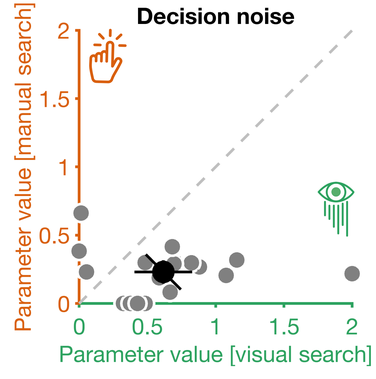
Participants had a stronger preference to fixate elements from both sets during visual search





Failure to maximize monetary gain per unit of time (i.e., performance) during visual search





Model fitting reveals that performance is more strongly constrained by noise during visual search

Conclusion

- The previously reported near-optimal trade-off between search costs and discrimination accuracy [3] constitutes a general strategy for humans to optimize decision-making behavior
- However, the slower time course of manual actions makes choice behavior less susceptible to noise, compared to fast-paced eye movements [cf. 2]

References
[1] Lio, G., Fadda, R., Doneddu, G., Duhamel, J. R., & Sirigu, A. (2019). Digit-tracking as a new tactile interface for visual perception analysis. Nature Communications, 10(1), 5392.
[2] Diamond, J. S., Wolpert, D. M., & Flanagan, J. R. (2017). Rapid target foraging with reach or gaze: The hand looks further ahead than the eye. *PLoS computational biology*, *13*(7), e1005504.
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