Object localization at speeds below and above the attentive tracking limit

Daniel Linares, Alex L. White, & Alex O. Holcombe

School of Psychology, University of Sydney

Purpose

Localization of moving objects is important but imprecise and prone to various biases, like the flash-lag effect[1].

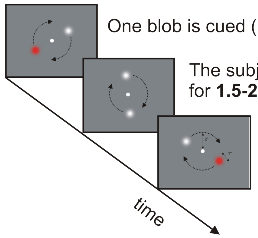
For localization, the role of **following an object with attention** is unknown.

To investigate this, we explore localization of objects moving too fast to be followed by attention.

- The **speed limit to follow an object with attention** was measured using a shell game task.
- **Object localization** was measured using a position judgment task and a sensorimotor synchronization task.

Speed limit to follow an object with attention (shell game task)

Subjects fixate the central point in all experiments



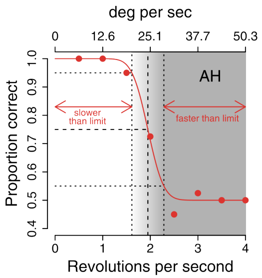
One blob is cued (red color) for **1 sec**

The subject must keep track of the cued blob for **1.5-2.5 sec**

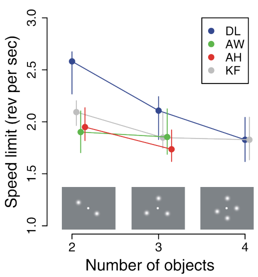
One blob is cued again

Is this the same blob that was cued at the beginning?

Relatively low speed limit (~2 rps)[2]



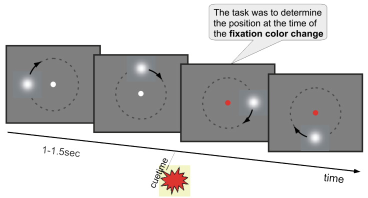
Number of objects has little effect on speed limit[2]



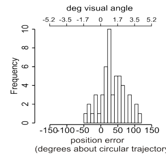
The limit might be high level[2]

Object localization

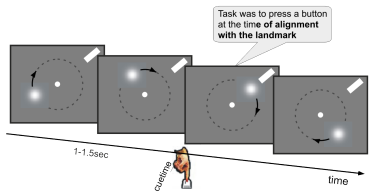
Position judgments



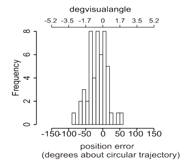
Following the stimulus, subjects report the position perceived by using a mouse to move the blob about the circular trajectory to the position they wish to report.



Sensorimotor synchronization

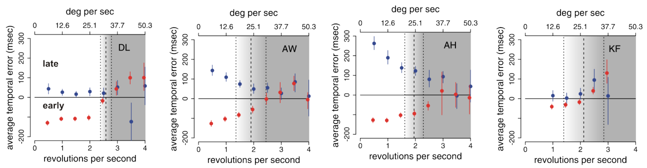


We calculate the position of the blob at the time the subject pressed the button.



Using circular statistics we calculated the **average** and the **variability (standard deviation)** of the errors and convert them to temporal units:

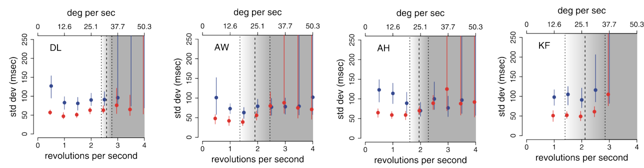
Average temporal error



For **position judgments**, most subjects report a position corresponding to after the fixation color change (flash-lag effect[1]). There is no consistent difference between speeds above vs. below the attentional limit.

For **sensorimotor synchronization**, subjects press the button before the time of spatial alignment (negative asynchrony effect[3]) for speeds **below** the attentional limit, but are late for speeds **above** the limit.

Variability (standard deviation)



For **position judgments**, blob speed has little effect on temporal variability[4]. There is no consistent difference between speeds above vs. below the attentional limit.

For **sensorimotor synchronization** and speeds below the attentional limit the temporal variability is constant but smaller than that for position judgments. For speeds above the limit there is little differences.

Conclusions

When an object is moving too fast to be followed by attention:

- For position judgments, the flash-lag effect still happens and surprisingly, the temporal precision is not worse.
- For sensorimotor synchronization, the typical anticipatory responses turn into late responses and the temporal precision becomes worse suggesting that **following an object with attention might be necessary to anticipate actions when interacting with moving objects**.

References

1. Nijhawan, R. (1994). Nature, 370, 256–257.

2. Verstraten, F. A. J., Cavanagh, P., Labianca, A. (2000). Vision Research, 40(26), 3651-3664.

3. Aschersleben,G., Prinz, W. (1995). Perception and psychophysics, 57(3), 305-317.

4. Murakami, I. (2001). Journal of Vision, 1(2), 126-136.

www.dlinares.org // danilinares@gmail.com