The Role of Preview Time in the Effect of The Müller-Lyer Illusion on Saccade Amplitude

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Introduction

The finding that visual recognition impairments can occur without affecting visually guided action led to the view that visual processes split into two distinct pathways, responding to the specific requirements of perception and action[1].

- **Perception** slowly computes objects' metrics in relation to the visual context;
- **Action** quickly estimates the absolute metrics right before movement execution.

Action should therefore be insensitive to illusions induced by the visual context, especially when preview time is short.

⚠ Experimental validation of this prediction remains debated due to conflicting results in hand-object interaction studies[2].

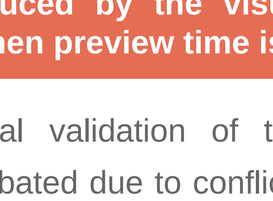
⚠ A key issue is the motor system's ability to correct the effects of such illusions as the hand approaches the object, in contrast to perception.

Methods

We investigated saccadic eye movements, which are difficult to correct once initiated, and specifically measured the amplitude of saccades along a horizontal line embedded in the Müller-Lyer illusion.

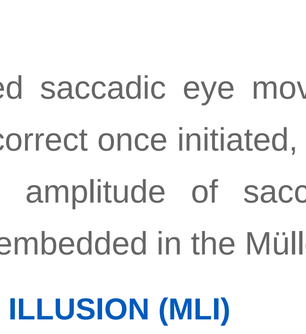
MÜLLER-LYER ILLUSION (MLI)

Identical lines appear to differ in length due to the orientation of arrows attached to their ends.



CENTER OF GRAVITY EFFECT (CoG)

Saccades directed toward a configuration of multiple nearby visual elements, such as arrows, tend to deviate towards the center of this configuration[3], potentially mimicking the effect of the illusion.



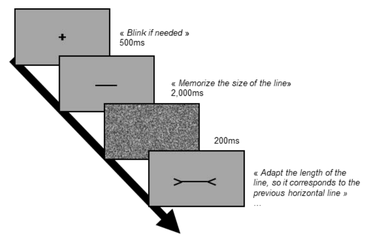
Experiment 1

We varied the angle between the fins and the horizontal segment of inward- and outward-pointing MLI figures while keeping the horizontal projection of the fins, and thus the CoG, constant **(A)**.

XP1 verified that angle variations with a constant CoG lead to changes in the perceptual bias, akin to the classical MLI with constant fin length (B).

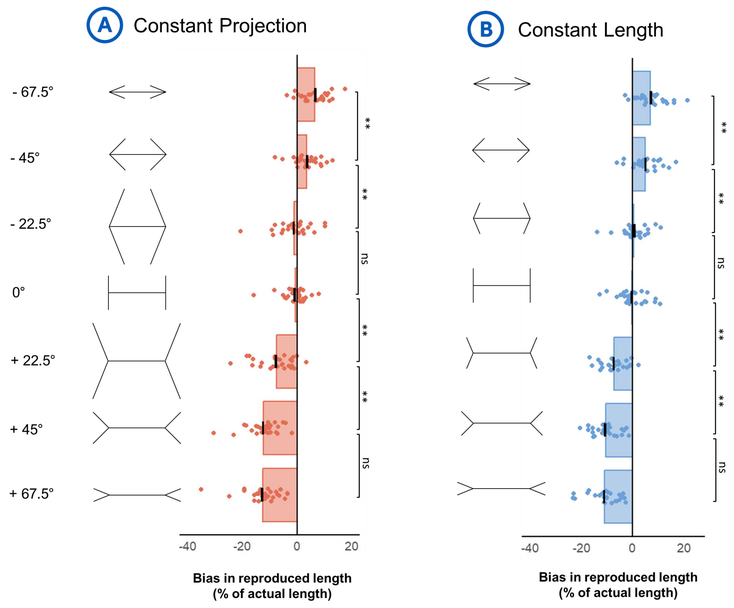
LENGTH REPRODUCTION TASK

Participants (N = 28) had to reproduce the length of a horizontal line they had just seen, while the line being reproduced was embedded in a MLI figure with either a constant fin projection or constant fin length.



RESULTS

- At least one significant difference was found between angles pointing in the same direction, demonstrating **modulation of illusion strength across angles with the same CoG;**
- The effect of the illusion **was similar across variants** (β = -0.14, p < .001; no interaction, p = .228).

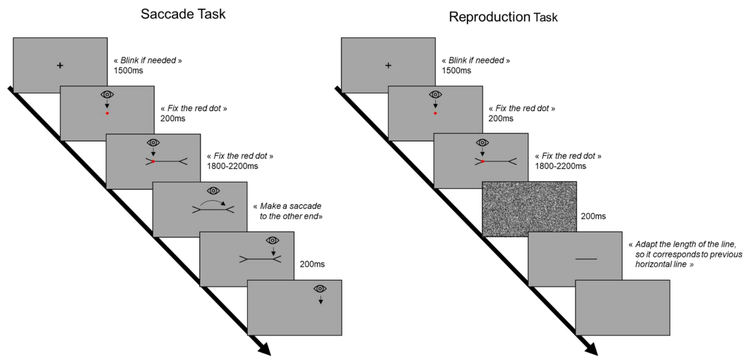


Experiment 2

XP2 tested whether the MLI effect on saccades persists when controlling for the CoG and is similar to the effect observed in perception.

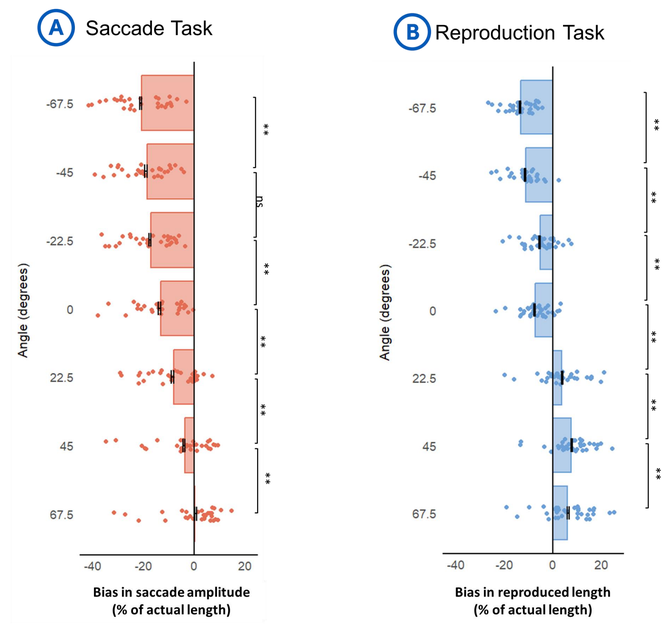
TASKS

Participants (N = 30) performed saccades along the horizontal segment of constant-projection MLI figures and completed a length reproduction task similar to that of XP1.



RESULTS

- At least one significant difference was found between same-direction angles, indicating that the **effect of the MLI on saccades persists beyond the CoG effect;**
- The effect of **illusion was consistent across the motor and perceptual tasks** (β = 0.16, p < .001; no interaction, p = .966).



Experiment 3

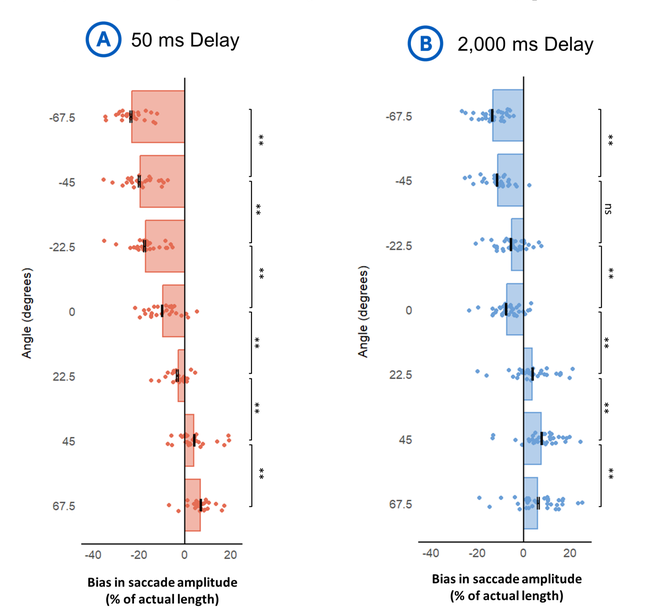
XP3 tested whether the effect of the illusion on saccades decreases with short preview time.

TASKS

Participants (N = 28) performed the same saccade task as in XP2, with the addition of a short preview condition (50 ms instead of 2,000 ms).

RESULTS

- At least one significant difference was found between angles pointing in the same direction, indicating that the **MLI effect on saccades persists with a short preview**.
- **Illusion effect was stronger with 50 ms** (β = 0.24, p < .001) **than 2,000 ms** (β = 0.14, p < .001) **preview.**



Conclusion

- Saccades are influenced by the Müller-Lyer illusion beyond the center-of-gravity effect.
- The illusion's effect on saccades is further enhanced with short preview time.

Contrary to the perception-action model, the visual processes underlying action are sensitive to visual context, especially when integration time is short.

References

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3. Findlay, J. M. (1982). Global visual processing for saccadic eye movements. *Vision research*, *22*(8), 1033-1045.