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Dynamics of gaze and body while viewing omnidirectional stimuli

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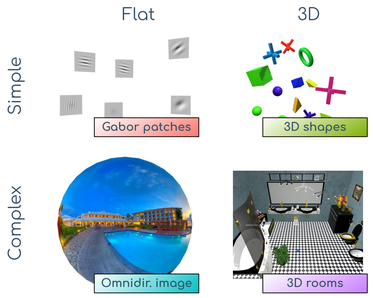
Introduction

How do we use our gaze and body to observe **360° scenes**? We used a VR HMD, different **stimuli/ tasks**, and **tracked eye, head, torso,** and **leg** rotations to answer that question.

Data collected extend our knowledge of **visuo-motor tendencies** to **360° scenes** [1, 2, 3]. We previously showed effects of the task and of reduction of the field of view. Separating head motion from torso and leg's allow us to tease apart their contributions to visuo-motor tendencies.

Method

360° Stimuli



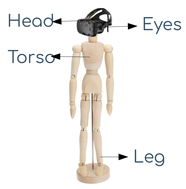
Participants

N = 24

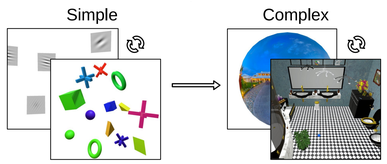
Aged 19 to 31 (M=22.2)

14♀ 10♂

Tracking



Sequence



Simple stimuli first then **complex**

10s of 360° scene exploration

Each stimulus type repeated **10** times: **40 trials** per phase

Phases

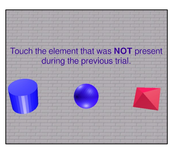
I

Free-viewing – No mask

Participants observe without instructions

II

Recall – No mask



Scene presentation followed by **odd-one-out** task

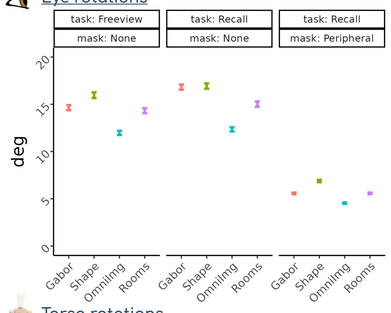
III

Recall – Peripheral mask

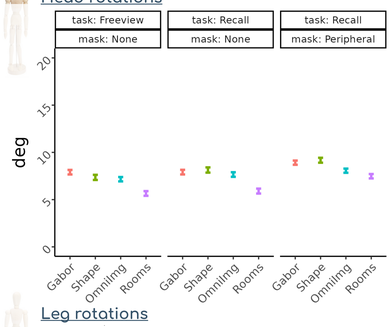
Head-contingent mask reduces FoV (**20°**)

Results

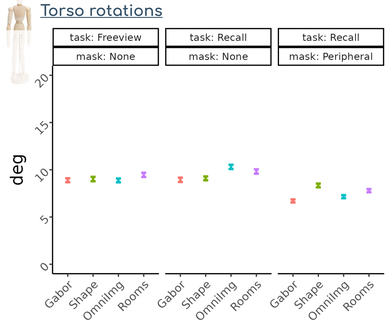
Eye rotations



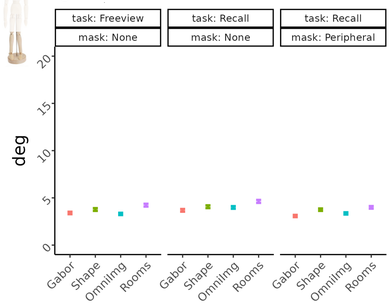
Head rotations



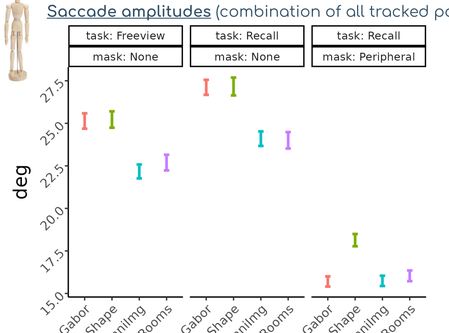
Torso rotations



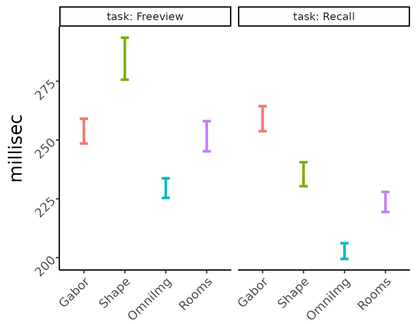
Leg rotations



Saccade amplitudes (combination of all tracked parts)



Fixation durations



Stimulus effect

Fixation durations increase with *simple* compared to *complex* stimuli. Same for gaze **saccade amplitude** (due to eye and head movements). Maybe due to the sparseness of *simple* stimuli. **Torso** and **leg** are relatively **unaffected**.

Task effect

Exploration strategy [2, 3]: in recall trials **fixation durations** get **shorter**, and **eye** and **leg** movements **increase** to scan more of the 360° scenes in the allowed time (10s).

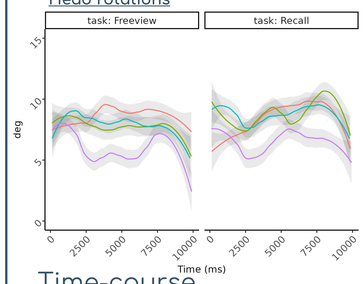
Legend

- Gabor patches
- 3D shapes
- Omnidir. image
- 3D rooms

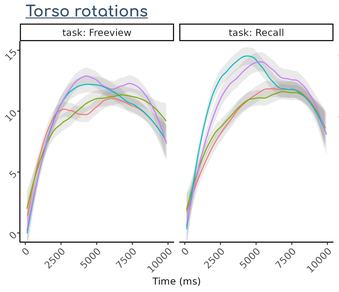
Field of view reduction

A **smaller FoV** strongly **reduced eye** movement amplitude. Surprisingly, **head** rotations **increased**; a previously reported headset movement decrease [2, 3] is actually related to a strong decrease in **torso** rotations.

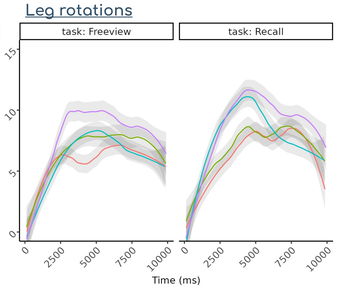
Head rotations



Torso rotations



Leg rotations



Time-course

A tendency previously attributed to the head (**onset effect** [2, 3]) is actually due to torso movements: **observers start with minimal torso and leg rotations**. Eye and head are mobile from the start.

Conclusion

Tracking torso and leg movements allowed us to investigate what was actually head motion and what was related to the rest of the body.

Some results we previously attributed to the head are actually related to the torso (onset effect; peripheral masking effect).

Artificial/Abstract stimuli (Gabor patches, 3D shapes) resulted in different visuo-motor behaviors (longer saccades).

Masking strongly affects eye movement programming. Only the head is show increased motion maybe to compensate for the eye. At which masking radius does the amplitude-decreasing effect disappear (useful field of view)? Does it always exist in VR?

Future: movements in interactive environments (active conditions with eye/body-coordination), or while viewing narrative content (ROI related to scenario).

Ref.

[1] Bischof, W. F., Anderson, N. C., & Kingstone, A. (2023). Eye and head movements while encoding and recognizing panoramic scenes in virtual reality. Plos one, 18(2), e0282030.

[2] David, E., Beitner, J., & Võ, M. L. H. (2020). Effects of transient loss of vision on head and eye movements during visual search in a virtual environment. Brain sciences, 10(11), 841.

[3] David, E. J., Lebranchu, P., Da Silva, M. P., & Le Callet, P. (2022). What are the visuo-motor tendencies of omnidirectional scene free-viewing in virtual reality?. Journal of Vision, 22(4), 12-12.

Ack.

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