

# Looking while loaded: Differences in oculo-motor tendencies during three common visual tasks might be based on varying degrees of cognitive load.

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## Introduction

Studies have shown strong oculo-motor tendencies during viewing of natural scene picture, in particular at scene onset:  
 • Observer starts visualising natural scenes with short fixation durations and long saccade amplitudes [1-5].

In recent studies implementing free-viewing tasks [6,7] we did not replicate this effect; the inverse effect tended to appear: starts with longer fixations and shorter saccades.

Is that because of varying levels of cognitive loads elicited by the visual tasks?

Goal: 1) Show visuo-motor differences within the same protocol, 2) Show cognitive load variations of common visual tasks

## Method

### 29 Participants

### Three (main) visual tasks (presented in three separate blocks)

- Visual search
- Free-viewing
- Exploration followed by a question

### Secondary task

- React (press space key) to an auditory stimulus (beep) triggered once per trial (random interval) only during stimulus presentation

### Data processing

Removed fixation and saccade data that happened in a 1.5s window following a beep. Pupil diameter data are reported Z-scored with a by-subject mean/std baseline obtained from data gathered at the end of fixation checks (white cross on grey background).

### Dataset

- HD photos of indoor and outdoor scenes (31.2°x17.7° of visual field)
- 30 images per visual task (90 stimuli in total)

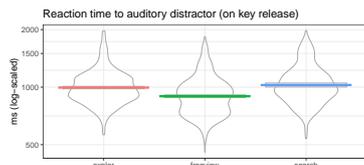
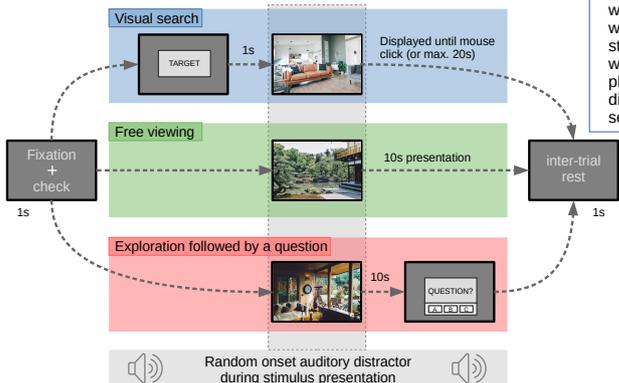
### Visuo-motor features measured

- Fixation durations
- Saccade amplitudes

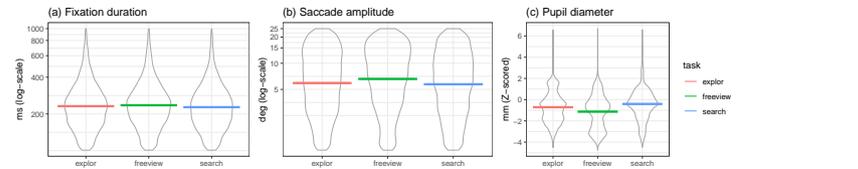
### Cognitive load proxy measurements

- Reaction times to a distractory audio beep
- Variations in pupil diameter

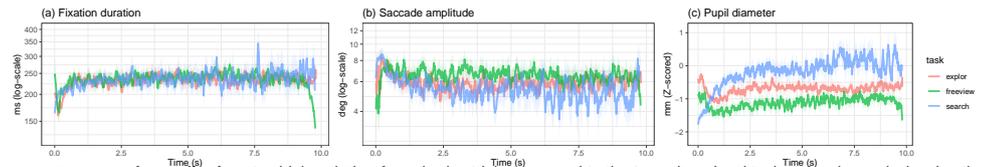
**Experimental design:** participants experimented with the three visual tasks in separate blocks. A word (target object to find in scene) preceded a stimulus during visual search. A free-viewing trial was comprised only of a stimulus presentation phase. Exploration trials were followed by a panel displaying a questions with three answers, one to select via a mouse click.



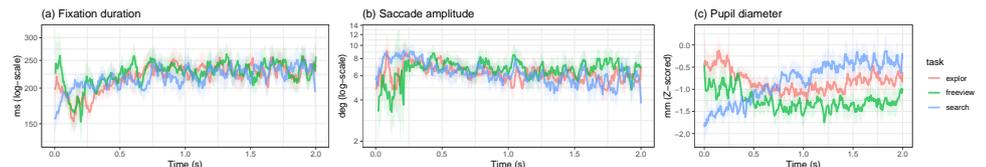
**Avg. reaction times** were lowest during free-viewing and similar during search and exploration trials.



**Oculo-motor variables:** slightly higher avg. **fixation duration** during free-viewing trials, higher avg. **saccade amplitude** during free-viewing. **Pupil diameter** was lowest during free-viewing and highest during search trials.



**Time course:** **saccade amplitudes** stay higher during free-viewing trials compared to the two other visual tasks, **visual search** showing the lowest amplitudes. Differences in **pupil diameter** are important throughout trial duration.



**Scene onset:** in the half second following the apparition of a stimulus **fixation durations** are comparable between free-viewing and exploration trials, while **search** trials start with shorter fixation durations. Avg. **fixation durations** increase at first during free-viewing and exploration, but decrease during search trials. Free-viewing trials start with comparatively lower **saccade amplitudes** which increase over the first half second, **exploration** and **search** trials start with higher avg. amplitudes but decrease over 2s. **Pupil diameter** is affected by avg. luminosity of the screen before scene onset, it adapts to scene luminosity and task within 2s.

## Conclusions

- We replicated (scene onset) oculo-motor tendencies, we showed differences between visual tasks.
- We showed that cognitive load is higher during visual search and exploration tasks compared to free-viewing, via increased avg. reaction times and pupil dilations.
- We hypothesize that the different scene onset effect observed in free-viewing trials is due to the limited top-down requirements of that task reducing cognitive loads and in particular the need to efficiently build a scene gist and explore scenes fully within the allotted time.

## References

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