Inferring target locations from gaze data: A smartphone study

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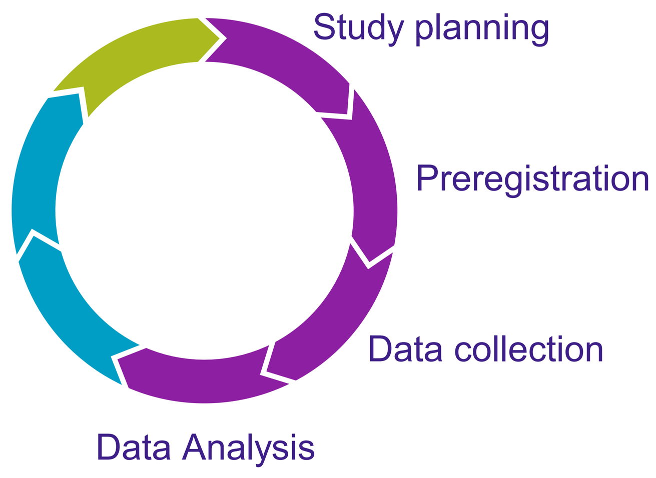


Introduction

To support the adoption of open science practices such as preregistering studies, sharing data, and publishing analysis code, a new infrastructure department has been established at ZPID.

One service of this department will be to conduct the data collection for researchers who preregistered their study in our lab - free of charge. To this end, the lab has been equipped with a range of different eye trackers that are currently tested in different setups.

The present study was conducted with the mobile eye tracker by Pupil Labs in a setup in which participants fixated closely spaced locations that were displayed on a smartphone.

The present study aimed to assess how recorded gaze positions correspond to the actual target locations in this setup and whether it is possible to infer from the gaze data at which target location the participant was looking.

Methods

Participants were asked to fixate small targets that were successively presented on the smartphone.

Each target appeared for 2 s at one of 30 locations arranged in a 5 x 6 grid. Adjacent targets were spaced by 1.0 x 0.9 cm.

Every participant completed three blocks that differed by the order of target locations (horizontal/vertical shift or random) in two conditions. In the mounted condition, the mobile phone was clamped in front of the laptop that was used for calibrating the eye tracker. In the hand-held condition, participants held the mobile phone in their hand.

Fiducial markers were placed around the screen of the smartphone, thus defining it as surface that could be recognized by the analysis software.

Analyses & Results

Gaze position was defined as the mean of all gaze positions within a trial occurring in a time window of 0.5 s to 2 s after trial onset.

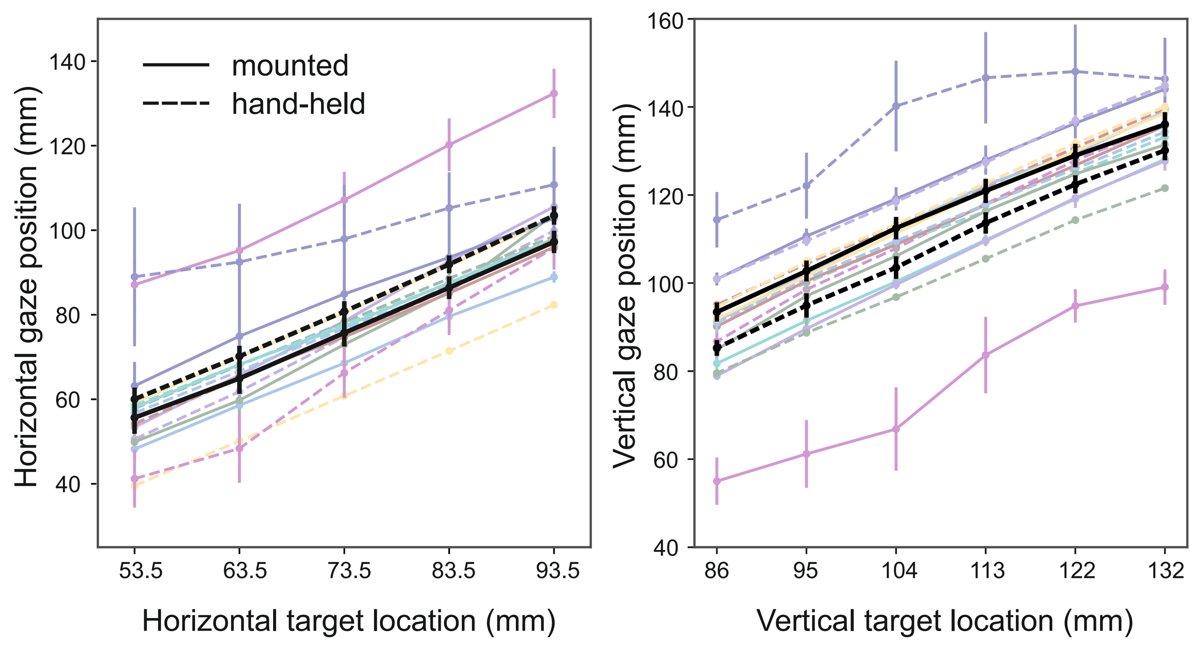
Gaze locations deviated from target locations

To examine the spatial congruence between target locations and gaze positions, horizontal and vertical root-mean-squared errors (RMSEs) were calculated between the given target location and the observed gaze position in every trial for every participant and condition.

Averaged across targets and conditions, t-tests of RMSEs revealed a significant offset between gaze and targets.

Horizontal and vertical gaze positions varied with target location

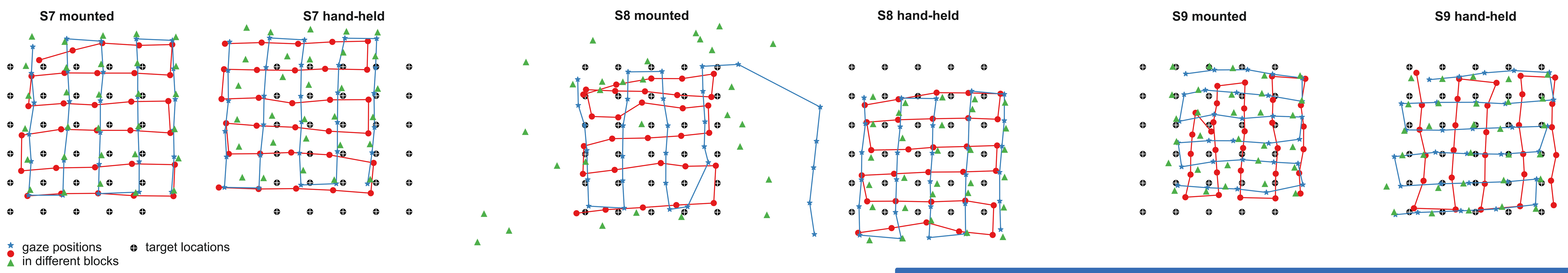
Linear mixed effects analyses of the horizontal and vertical gaze positions revealed a significant effect of target location, thus indicating that the target locations also resulted in distinguishable gaze positions.



Decoding accuracies for target locations

To investigate whether the target presented in a trial can be identified based on the gaze position, a k-nearest neighbours algorithm (KNN, k=3) was trained on the data of block 1 and 2 and tested on the data of block 3.

Exemplary single subjects



Accuracy scores of all subjects

	mounted	*hand-held*
S1	0.30	0.23
S2	0.87	0.63
S3	0.43	0.08
S4	0.93	1.00
S5	0.83	0.40
S6	0.90	0.27
S7	1.00	0.70
S8	0.33	1.00
S9	0.80	0.90

Overall, accuracy scores varied considerably between and within subjects.

Conclusions

Gaze deviated from the target position, thus revealing a bias that prevents superimposing measured gaze uncorrected on the presented stimuli.

Differences between gaze positions still reflected the pattern of target locations and classification of individual targets worked well for some participants/conditions.

For future studies, we plan to use the presented task to estimate and then account for the bias between gaze and target locations.

Find the preprint here:

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