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Investigating the Time Course of Face Perception Using Web-based Eye Tracking

University of Victoria

NSERC CRSNG

INTRO

- Gazer is a web-based eye tracking program developed at the University of Victoria using open-source Webgazer.js [1]
- Implemented in current study to record eye movements during an oddball task with faces
- Research indicates upright faces may be perceived more quickly than inverted faces due to holistic processing [2]

METHODS

- Participants (n=26) were presented with 2 x 2 arrays of upright and inverted faces
- The task was to detect the oddball face based on its orientation
- No queue given for oddball's orientation, it appeared in a randomized quadrant

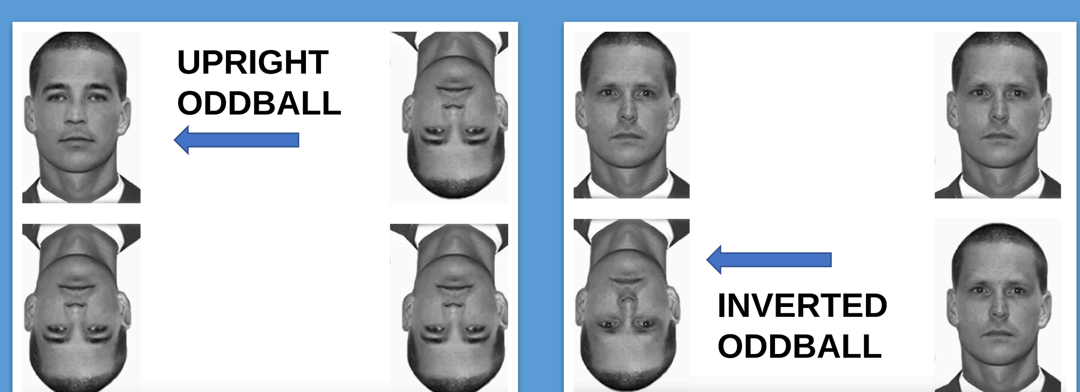


Figure 1. An example of a trial with an upright oddball, and a trial with an inverted oddball.

- Participants used their keyboards to indicate the quadrant of the oddball
- In each trial, eye gaze data and manual keyboard responses were recorded

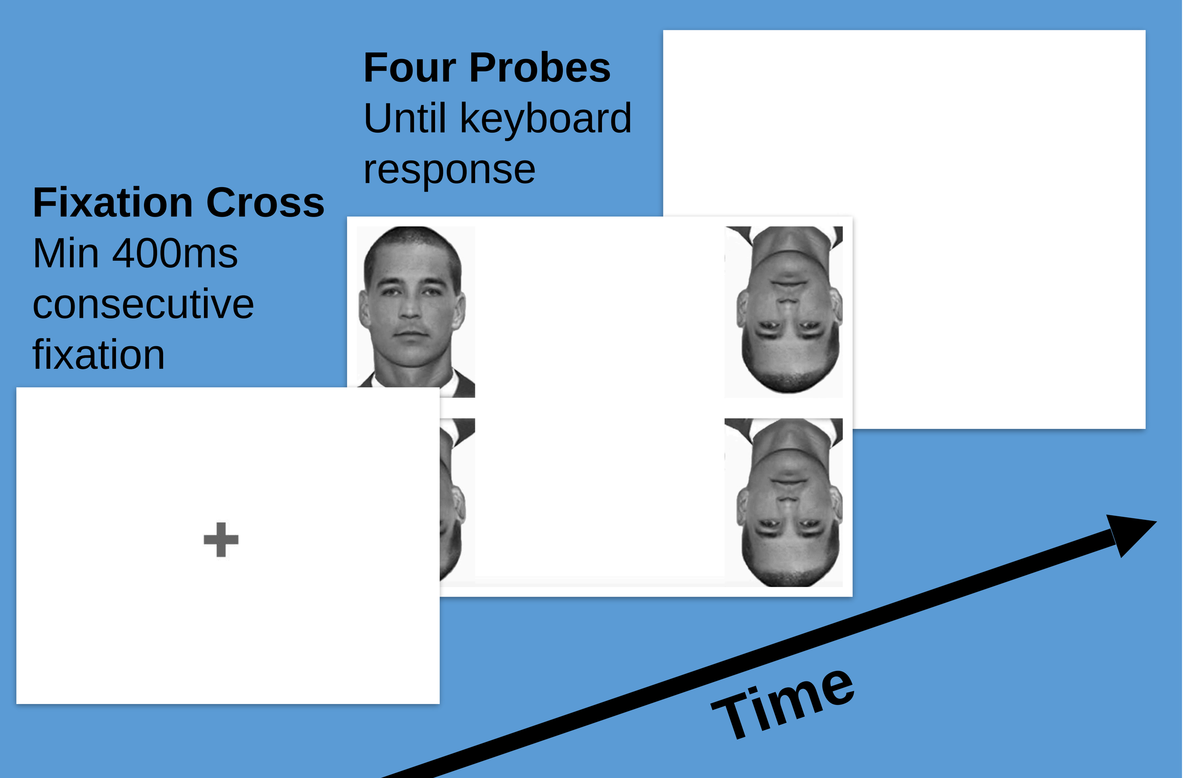


Figure 2. The timeline of one trial, on average trials were 1750ms.

GAZER METHODOLOGY AND DEMONSTRATION

CALIBRATION

- Participants use their mouse to click on calibration stimuli while gazing at them
- Clicks calibrate the eye tracker to associate the face orientation at the time of the click with a gaze at the click's location

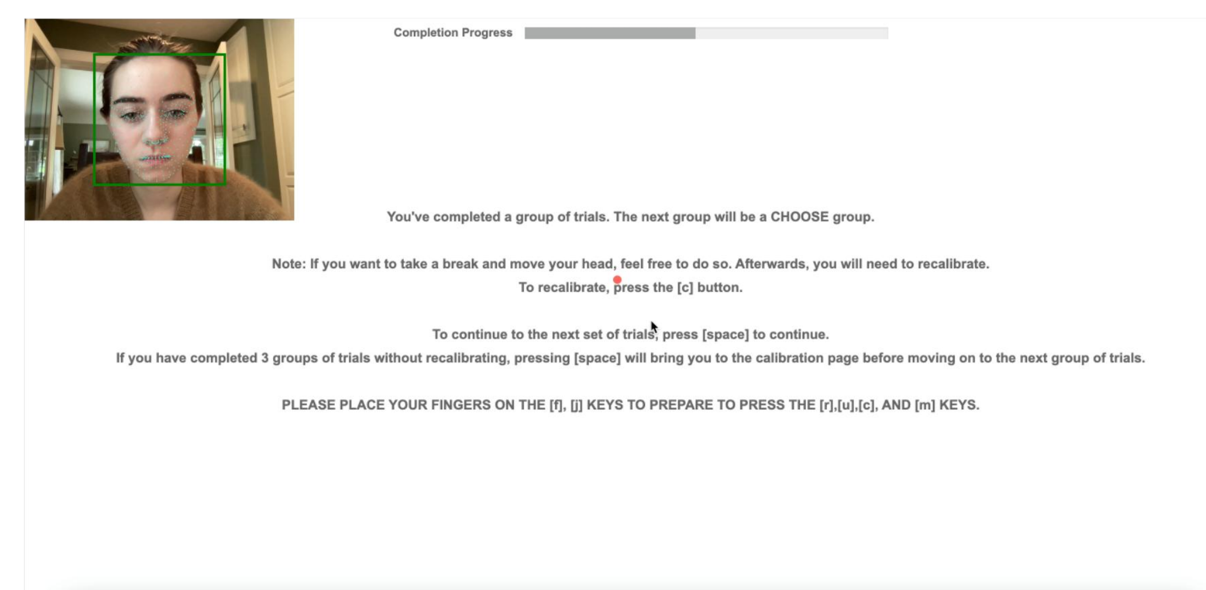
CLICK IMAGE BELOW FOR VIDEO LINK

Video 1. A demonstration of the calibration method used during the experiment on the four stimuli locations, and the cross location. Calibration occurred at the beginning of the experiment and after every 3 subsequent blocks of trials.

GAZE PREDICTION COLLECTION

- During each trial, a time series of (x,y) gaze location coordinates are recorded
- Participants **did not** see the gaze predictions; the red prediction dot is point shown for demonstration purposes only

CLICK IMAGE BELOW FOR VIDEO LINK



Video 2. A demonstration of the prediction points collected during a block of trials as shown in real-time using a red prediction dot.

Temporal Resolution
15Hz (average analysis 66ms)

Spatial Resolution
70px

RESULTS

- Orientation presented a significant main effect on the accuracy of keyboard responses (ANOVA, $p<.05$), but not reaction time
- Combined accuracy and reaction time into an inverse efficiency score (IES) for manual keyboard responses
- Based on IES scores, **an advantage was present for upright oddballs**

Accuracy of Keyboard Responses

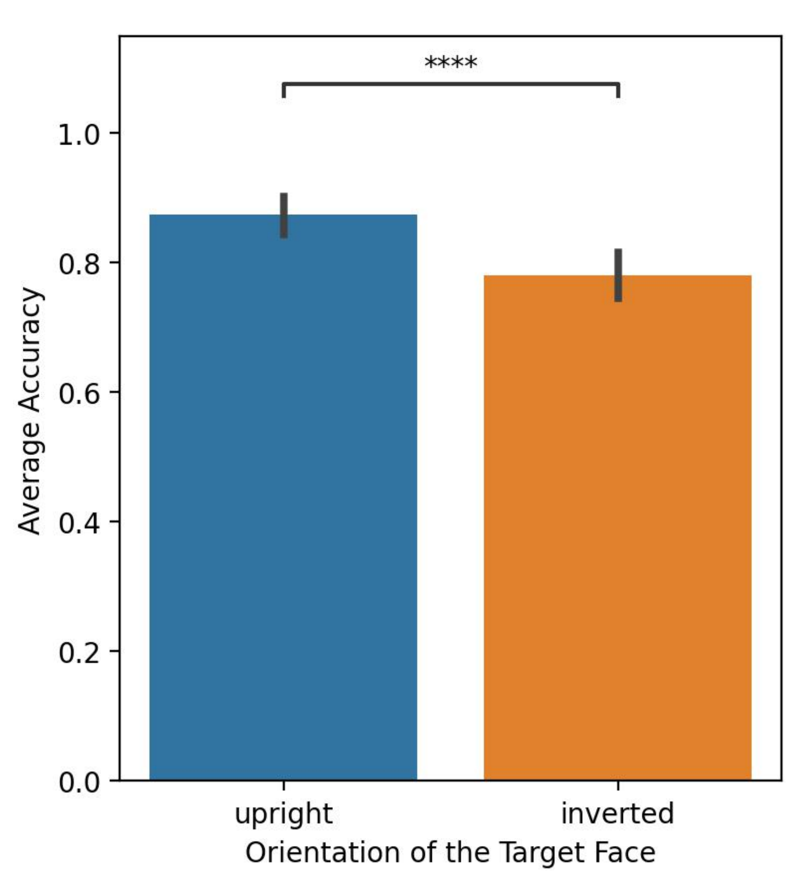


Figure 3. Orientation had a significant effect (one-way ANOVA, $p<.01$) on keyboard accuracy.

Reaction Time of Keyboard Responses

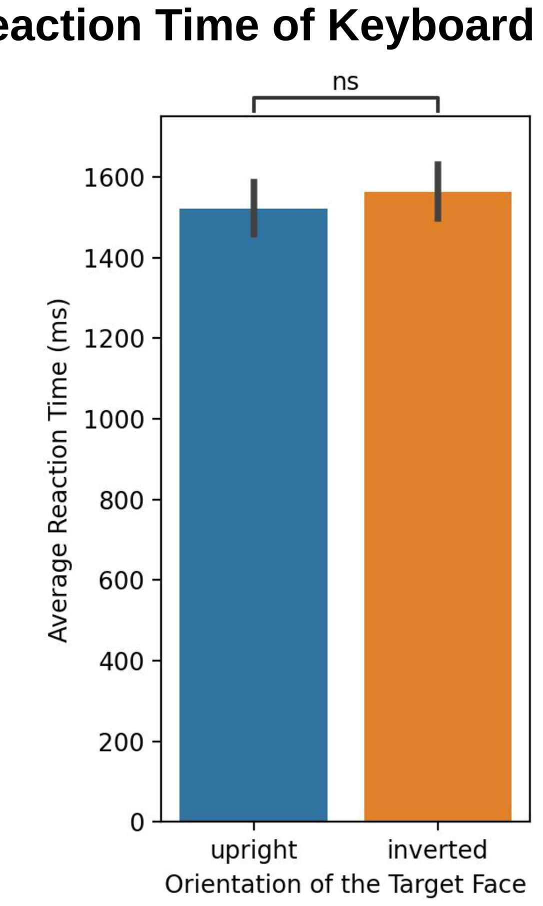


Figure 4. Orientation did not have a significant effect (one-way ANOVA, $p>.05$) on keyboard reaction time.

IES Scores for Keyboard Responses

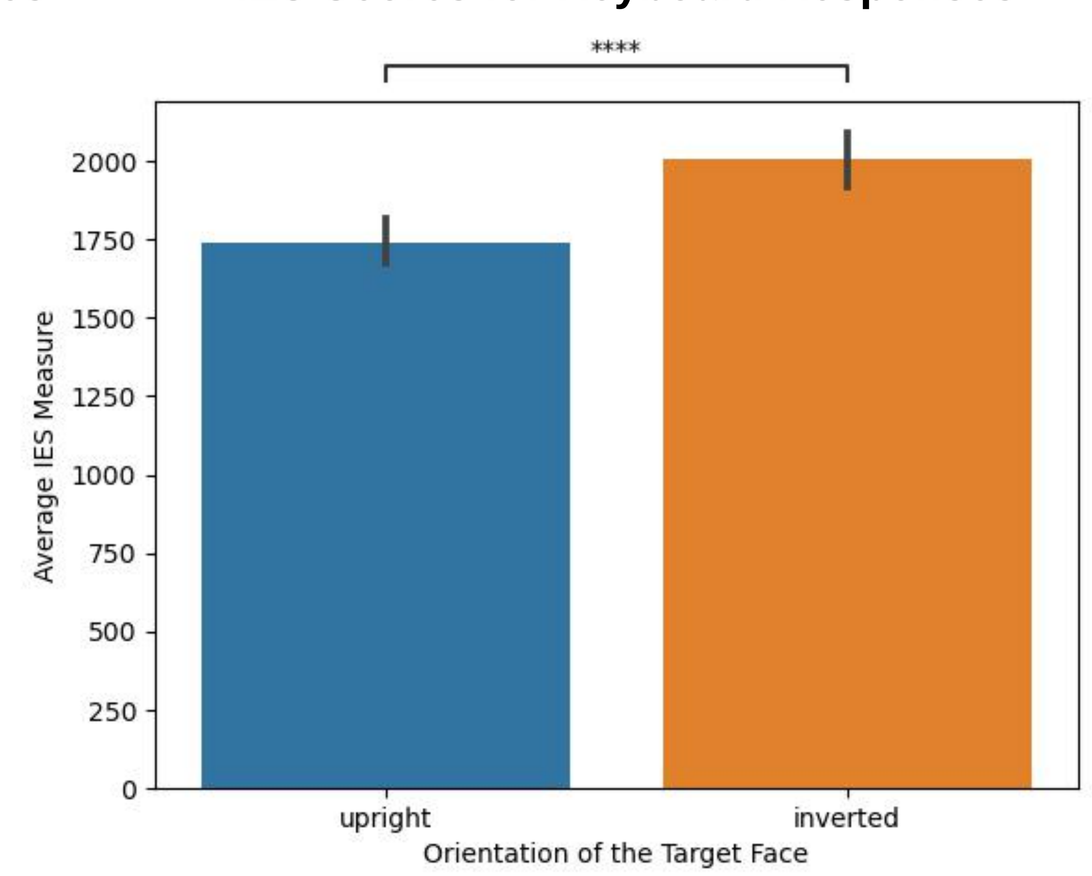


Figure 5. Orientation had a significant effect (one-way ANOVA, $p<.01$) on an inverse efficiency score that combines keyboard reaction time and accuracy measures.

GAZER RESULTS

- First saccades and fixations on regions of interest were explored for gaze strategy differences between oddball orientations

First Saccades

- The reaction time for a first saccade (avg. 170ms) was significantly faster than keyboard response times (t-test, $p<.05$)
- Oddball orientation had no significant effect on the accuracy or reaction time of the first saccade (ANOVA, $p>.05$)

Fixations

- Dwell time was calculated as the sum of fixation durations in specific quadrants, normed for trial length
- On-oddball: dwell time in the oddball quadrant
- Off-oddball: dwell time in a distractor quadrant
- An interaction between region of interest and orientation was present (ANOVA, $p<.05$)

Average Dwell Times Across Regions of Interest

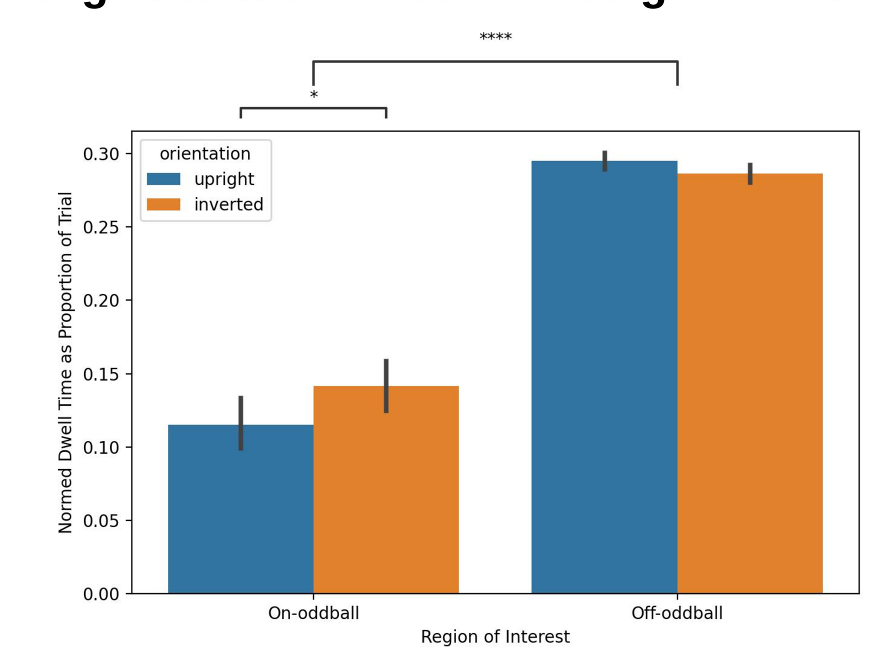


Figure 6. Dwell time off-oddball was longer (ANOVA, $p<.05$) across both oddball orientations. Dwell time on-oddball was longer for inverted oddballs (ANOVA, $p<.05$).

DISCUSSION

- Evidence of holistic perception, participants were more efficient with keyboard responses for upright faces with shorter fixation time on the oddball
- Participants were not queued with the oddball orientation; therefore, upright advantage is to locate an oddball rather than search differences

References

[1] Papoutsaki, A., Sangkloy, P., Laskey, J., Daskalova, N., Huang, J., & Hays, J. (2016). WebGazer: Scalable Webcam Eye Tracking Using User Interactions. Proceedings of the Twenty-Fifth International Joint Conference on Artificial Intelligence, 3839-3845.

[2] Martin, J.G., Davis, C.E., Riesenhuber, M., & Thorpe, S.J. (2018). Zapping 500 faces in less than 100 seconds: Evidence for extremely fast and sustained continuous visual search. Scientific Reports, 8, 12482.

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