

Investigating gaze-controlled input in a cognitive selection test

Background

- Growing interest in using eye tracking to enhance safety and efficiency in the field of aviation (Glaholt, 2014; Ohneiser, Jauer, Gürlük & Uebbing-Rumke, 2016)
- Development of the Eye Movement Conflict Detection Test to investigate the potential role that eye tracking play in the selection process for pilots and air traffic controllers



Figure 1: Air traffic controller, tower Munich

Research Objectives

- Investigate the application of gaze-controlled input in a cognitive selection test
- Replace mouse input with gaze commands in order to remove the need for eye movements that follow the mouse cursor during analysis

Method

Eye Tracking Equipment

- The EyeFollower of LC Technologies
- NYAN software

Sample

- Study 1: N=6
- Study 2: N=7
- Air traffic control applicants, DLR staff



Figure 2: Tower Munich

Eye Movement Conflict Detection Test

- Task: Detect conflict between aircraft in a given airspace as fast and as accurately as possible

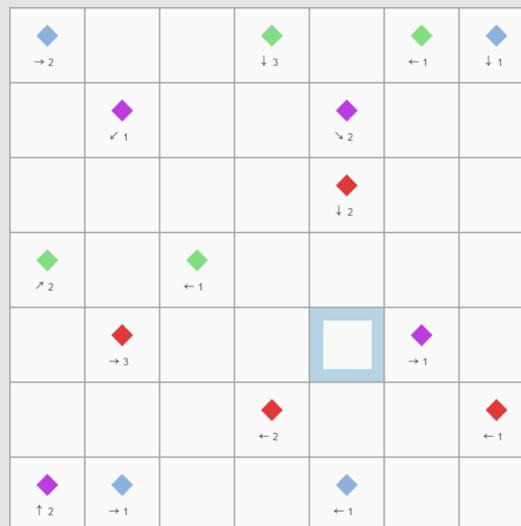


Figure 3: Example task of the Eye Movement Conflict Detection Test

Gaze-controlled input

- Eye movements related to the search task are differentiated from fixations as commands (Midas touch problem):
 - Command 1: Select conflict field using gaze, indicated by a color change from the border to the middle of the respective field
 - Command 2: Input confirmation using gaze or keystroke, indicated by a permanent color change

Gaze field selection – Gaze confirmation



Gaze field selection – Keystroke confirmation



Procedure

- Neutral text on aviation (eye adaption phase) → 13-point calibration → device input instruction & practice → task instruction & practice → 20 test tasks

Measurements

- Field selections, input confirmations
- Feedback from subjects

Results

- Gaze-based field selection with keystroke confirmation leads to a higher input success rate
- Participants assessed accuracy problems as the main reason for input problems, although in ~ 45% of the cases their “dwell time 2” on the target field was too short
- The very low amount of unintentional input confirmations indicates that the challenge of differentiating eye movements between scanning and input commands was addressed adequately

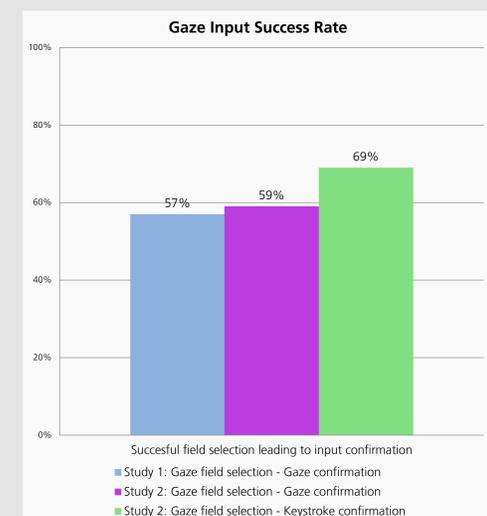


Figure 4: Gaze input success rate

Discussion

- Participants preferred to work with gaze input, although they sometimes felt frustrated with unsuccessful gaze commands
- Improvements in gaze input reliability should be made before being applied in a cognitive selection test

Next Steps

- Use the mouse as an input device in the next study
- Investigate if eye movements indicate psychological test performance

References

- Photos: DFS Deutsche Flugsicherung GmbH, https://www.dfs.de/dfs_homepage/de/Presse/Mediathek/
- Glaholt, M. G., 2014, Eye tracking in the cockpit: A review of the relationships between eye movements and the aviator's cognitive state, Scientific Report No. DRDC-RDDC-2014-R153, Defence Research and Development Canada (DRD C), Toronto, CA.
- Ohneiser, Oliver und Jauer, Malte-Levin und Gürlük, Hejar und Uebbing-Rumke, Maria (2016) *TriControl – A Multimodal Air Traffic Controller Working Position*. The Sixth SESAR Innovation Days, 08.-10. Nov. 2016, Delft, Niederlande.