K. Gayraud, C. Hasse, H. Eißfeldt & S. Pannasch:

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

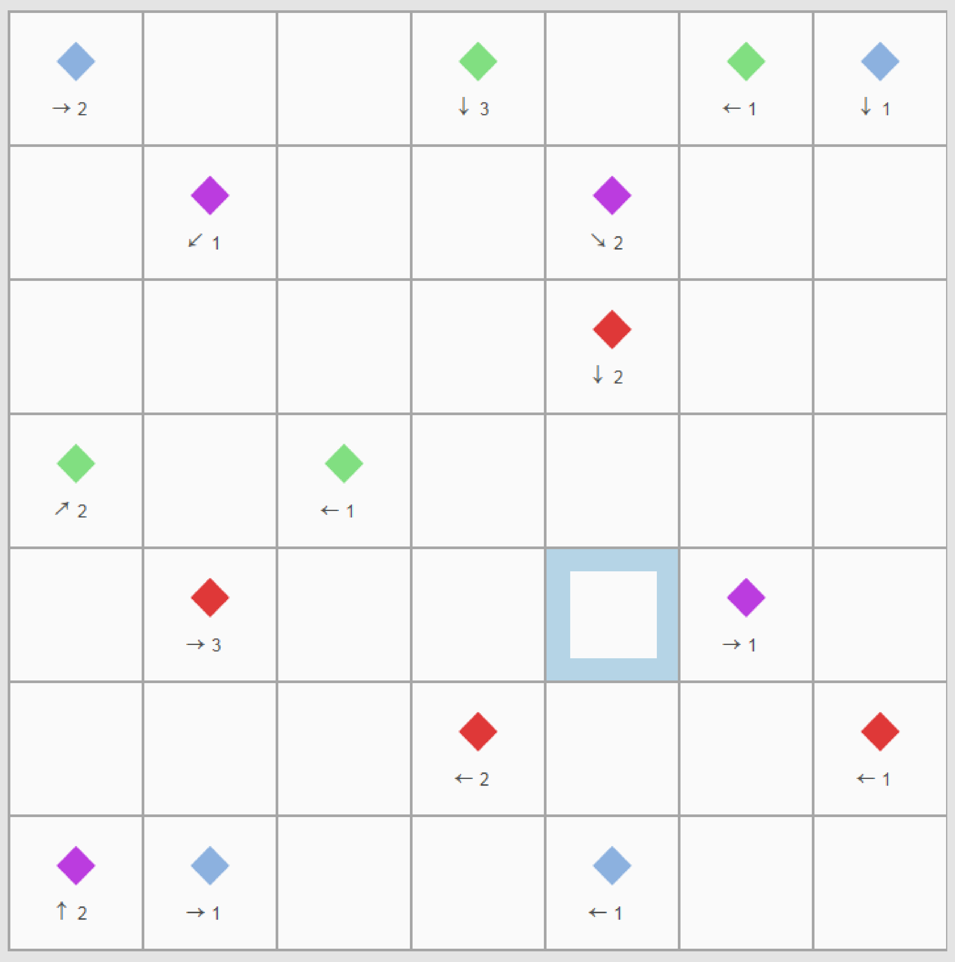
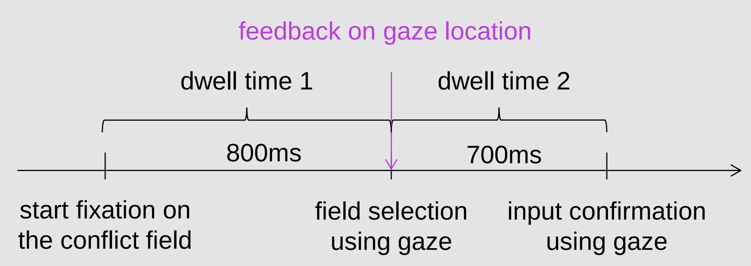


Figure 3: Example task of the Eye Movement Conflict Detection Test

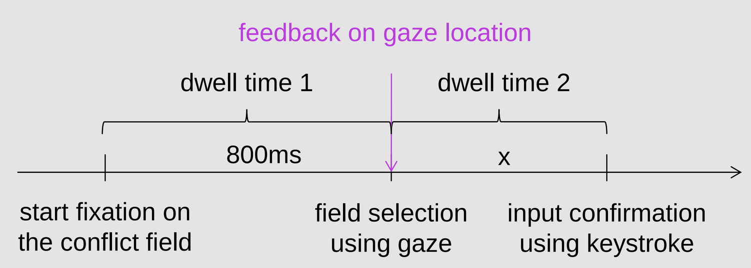
Gaze-controlled input

- 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

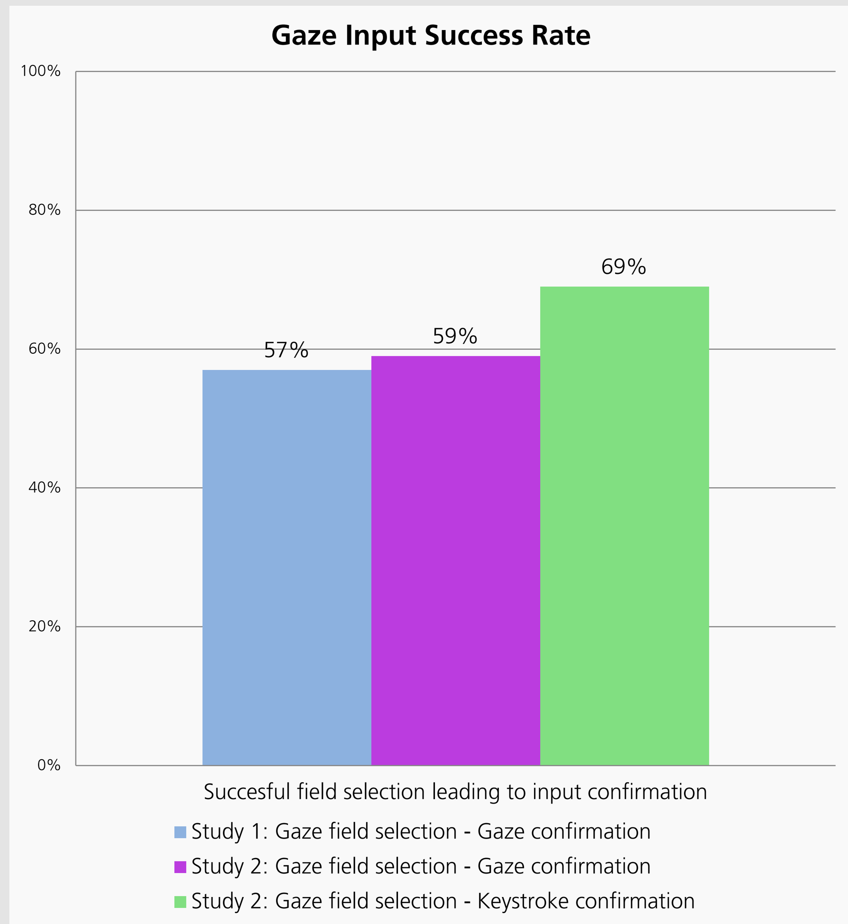


Figure 4: Gaze input success rate

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/

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