

Eye Trackers: Are They Game?

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Introduction



Motivation

- How do eye trackers compare to other input devices?
- What design recommendations should be taken into account for a gaze controlled game?
- Can we use games to measure and compare the performance of different eye trackers?

Target selection

- Fitts' Law: models movement time in target selection tasks

$$MT = a + b \cdot ID_e = a + b \cdot \log_2 \left(\frac{A}{W} + 1 \right)$$

- Movement time:
 - Decreases when target size increases
 - Increases when distance to target increases
 - a, b constants empirically derived

Target selection II

- Throughput: Measure of performance in target selection tasks (ISO 9214-9)

$$\text{Throughput} = \frac{ID_e}{MT} = \frac{\log_2\left(\frac{A}{W_e} + 1\right)}{MT} \text{ bits/sec}$$

Index of difficulty

- Dependent on:

- Amplitude of movement
- Effective width of target
- Movement time

Mean movement time

Target tracking

- Time on target (TOT) metric

$$TOT = \frac{\sum_i^N In(t_i)}{N}$$

- Other metrics proposed in Klochek and MacKenzie (2006)
 - Target distance
 - Time to reacquire

Experimental setup

- 16 targets presented sequentially in a circular layout of radius 250 pixels
- 2 different target sizes: 75 and 150 pixels
- When selected, target moves towards the centre of the screen at 90 pix/sec
- 2 different types of feedback:
 - Sound feedback
 - Movement feedback

Video



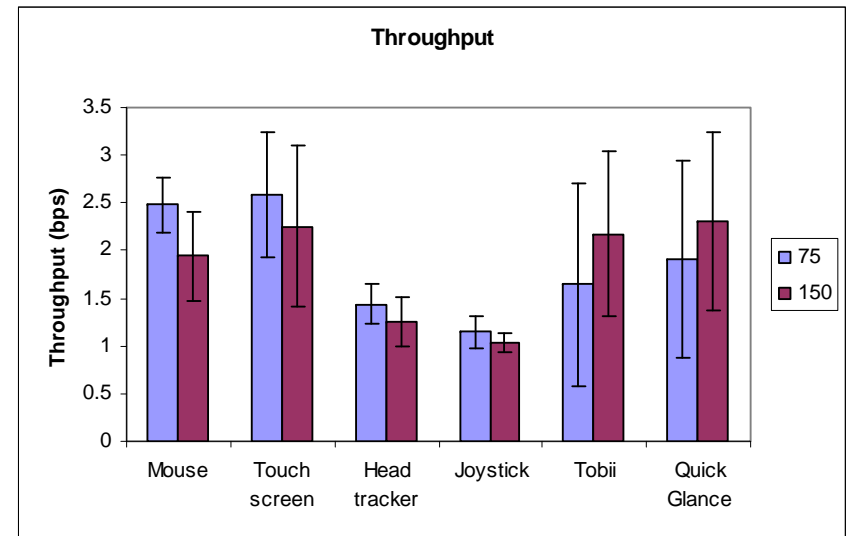
Experimental setup II

- 6 participants took part
- 6x2x2 factorial design
 - Device: mouse, touch screen, head tracker, joystick, Tobii, Quick Glance
 - Target size: 75, 150 pixels
 - Feedback: sound, sound+movement



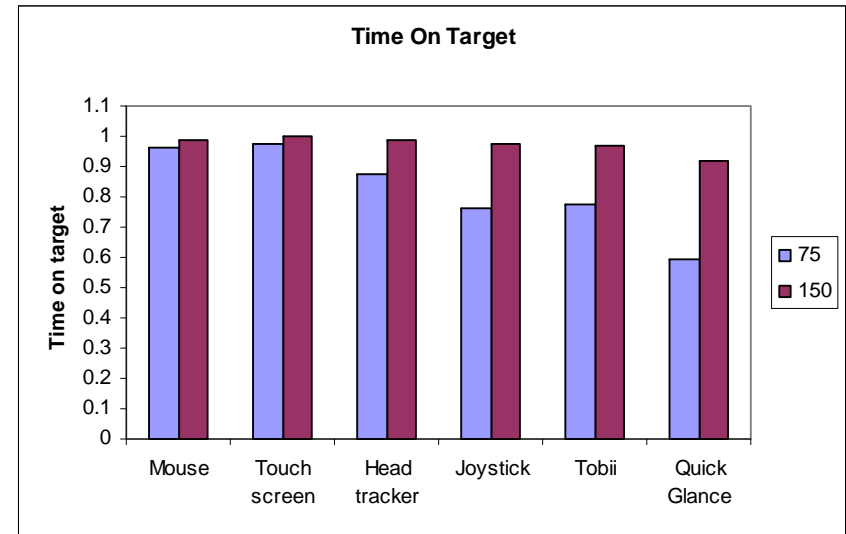
Results – Target selection task

- No statistical differences between the eye trackers
- Small targets:
 - Mouse and touch screen high throughput
 - Eye trackers better performance than head tracker and joystick
- Big targets:
 - Eye tracker performance is increased

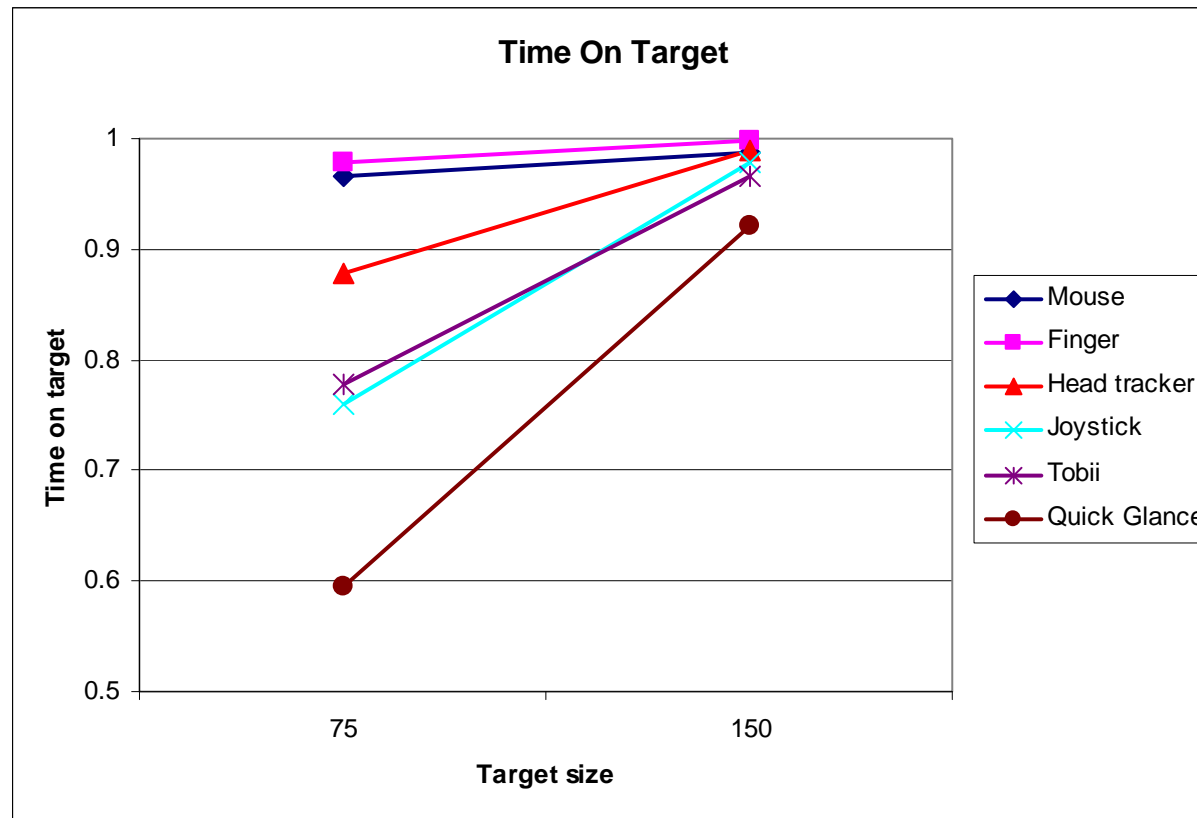


Results – Target tracking task

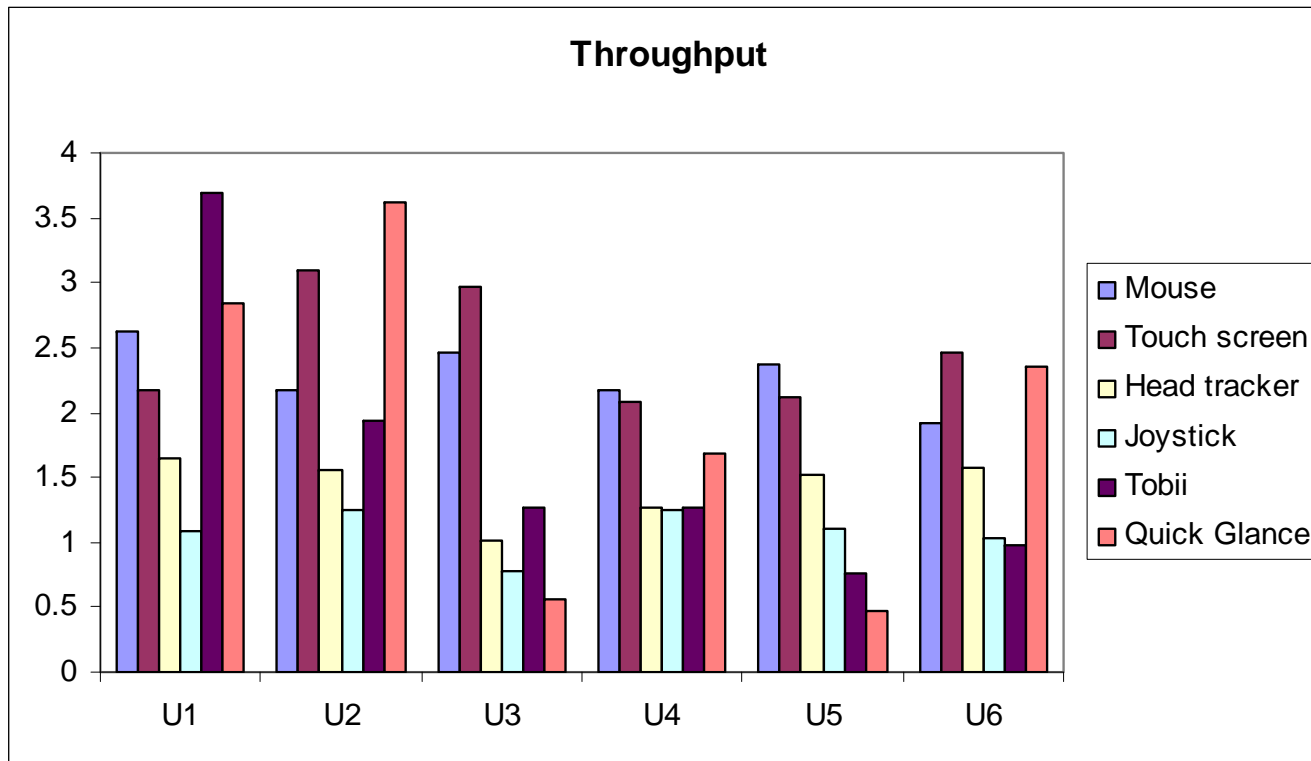
- Small targets:
 - Significant difference between Quick Glance and all other devices
 - Tobii not different from joystick and head tracker
- Big targets:
 - No statistical differences between any of the devices



Results – Target tracking task



Individual differences



Conclusions

- Eye trackers had lower throughput than mouse (as opposed to study by Sibert and Jacob)
- Eye trackers benefit from bigger targets in both tasks
 - Throughput improved with big targets
 - Bigger targets compensate for miscalibrations
 - Interfaces will benefit from big target areas

Conclusions II

- Games can be a tool to compare the performance between eye trackers
- Strong Eyes game
- Results could be sent over the Internet to compare eye trackers and other devices

Further work

- Study learning curve with a longer experiment
- Further study the effect of speed and target size
- Study individual differences in performance with the different devices

Thanks for your attention