Visual Accessibility and Readability in User Interfaces: An Eye-Tracking Study

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About the Presenter

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Education

- M.Sc. Eng. in Computer Science
- Faculty of Electrical Engineering and Computer Science
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Research Interests

- Human-Computer Interaction
- Accessibility & Usability
- Cognitive Load
- Eye Tracking
- Artificial Intelligence

Research Context & Problem

User interfaces strongly influence visual attention before cognitive processing

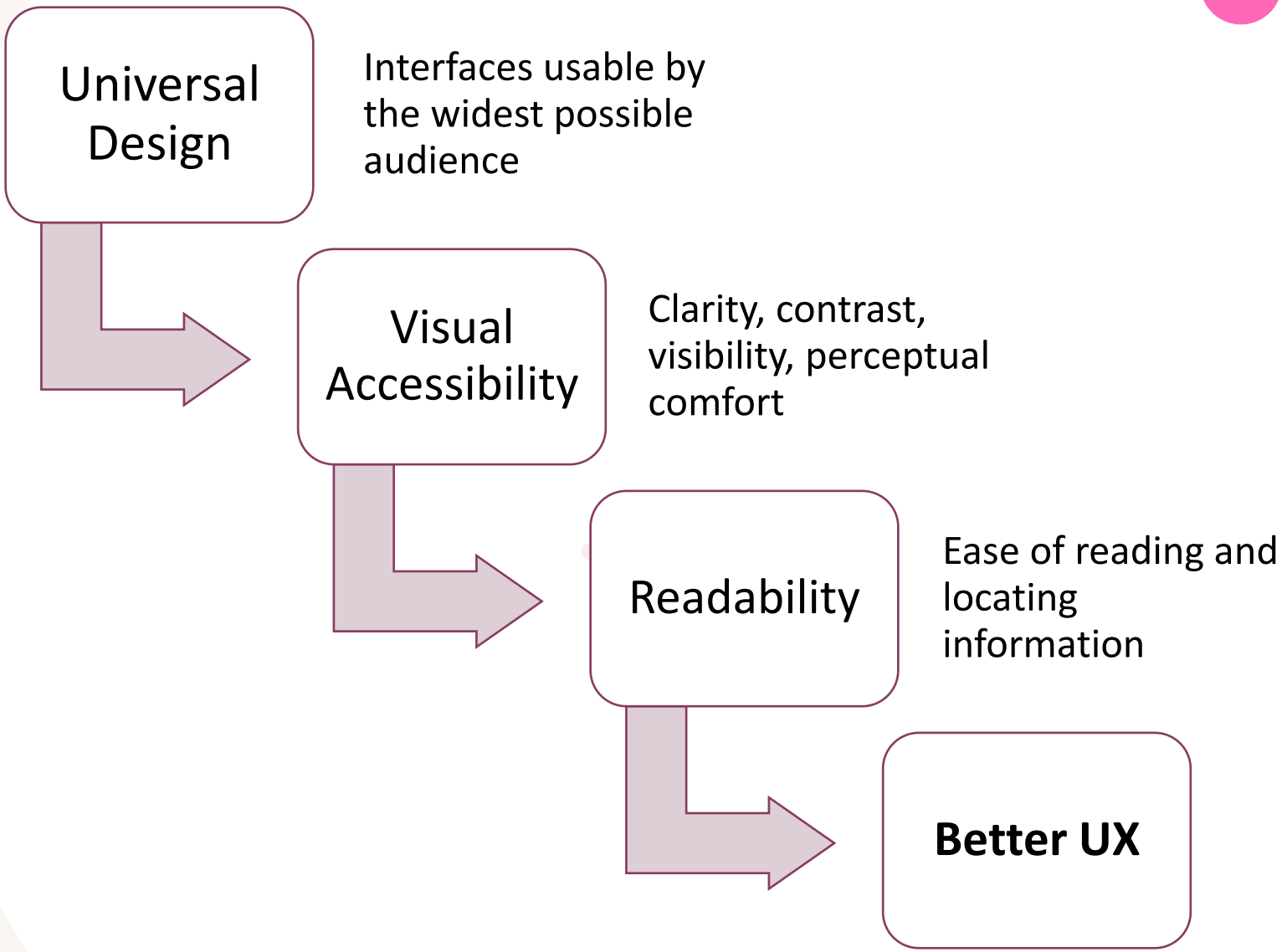
Visual accessibility and readability often evaluated only via guidelines

Limited empirical evidence based on actual user perception

Museum systems require intuitive and inclusive navigation

Poor visual accessibility increases cognitive effort and reduces efficiency of information search

Key Concepts

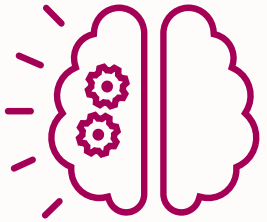


Visual Accessibility and Readability in Museum Systems

Diverse audience

Information-heavy interfaces

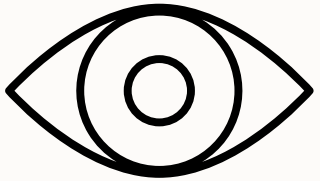
High expectations for clarity and intuitiveness

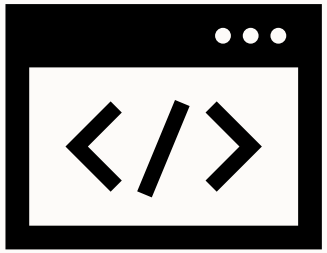


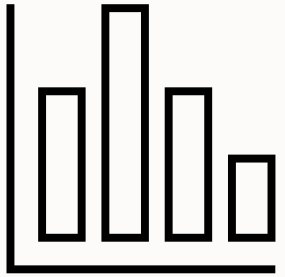
Impact on engagement and satisfaction

Research Objective

To investigate how visual accessibility and readability influence the effectiveness of information localisation in museum interfaces using eye-tracking techniques







Methodology: Study Design

1

Participants recruitment

- 15 participants
- Mean age: 23.2 years (SD = 0.54)
- Experienced web users

2

Interface design

- Interface 1: universal design principles applied
- Interface 2: reduced readability, no good practices
- Additional interface-independent stimuli

3

Eye-tracking experiment

- 13 task-based commands
- Navigation, text, and visual search tasks

4

Data analysis

- Quantitative and qualitative analysis

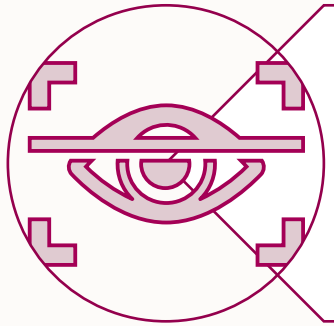
Methodology: Data Acquisition & Analysis

Data analysis:

- Heatmaps (qualitative analysis)
- Mean values calculations (quantitative analysis)
- Normality and heterogeneity testing, Wilcoxon tests (statistical analysis)

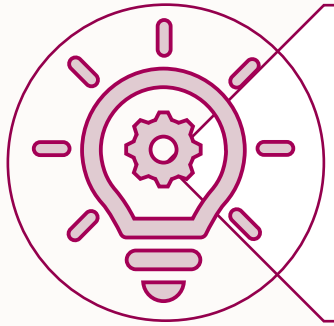
Task-based interaction

- Participants completed 13 tasks (commands)
- Each task required locating a specific interface element
- Tasks tested contrast, layout, hierarchy, typography, and visibility
- Randomised task order



Eye-tracking recording

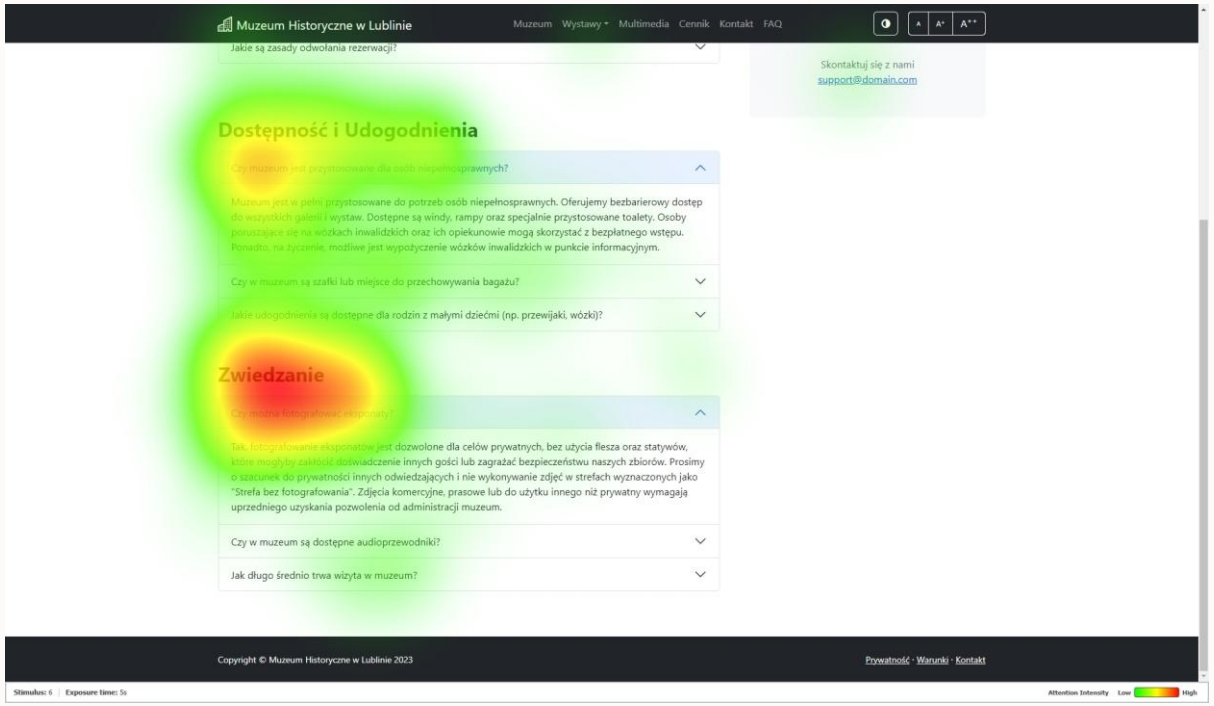
- Gaze behaviour recorded during each task
- Areas of Interest (AOIs) defined
- Heatmaps generated for attention distribution



Performance and eye-tracking measures

- Task completion time
- Time to first fixation (TTFF) (AOI)
- Fixation dwell time (AOI)
- Number of fixations (AOI)

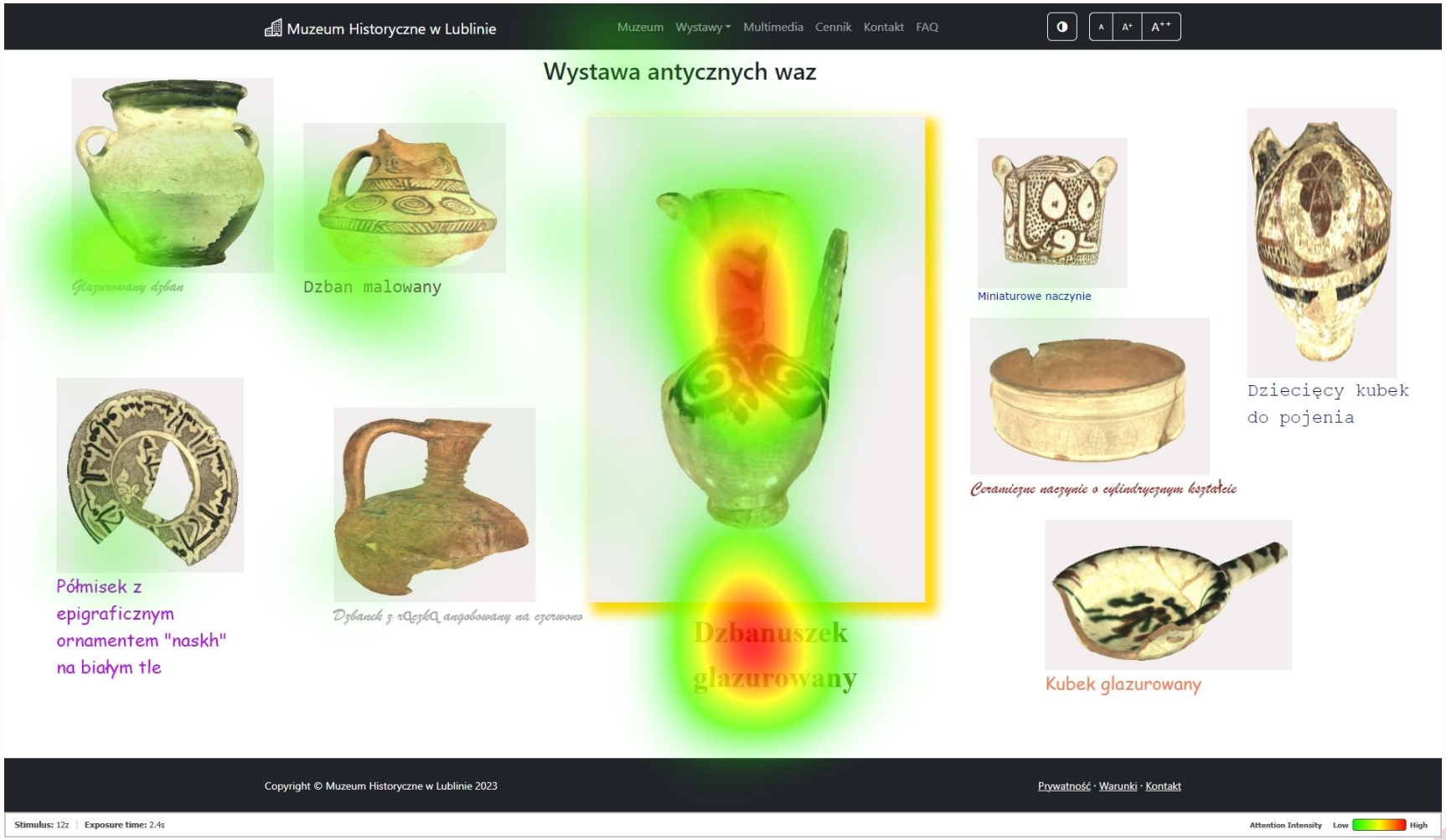
Results (1): Heatmaps



Example of a heatmap of task 2 in the case of Interface 1.

Example of a heatmap of task 2 in the case of Interface 2.

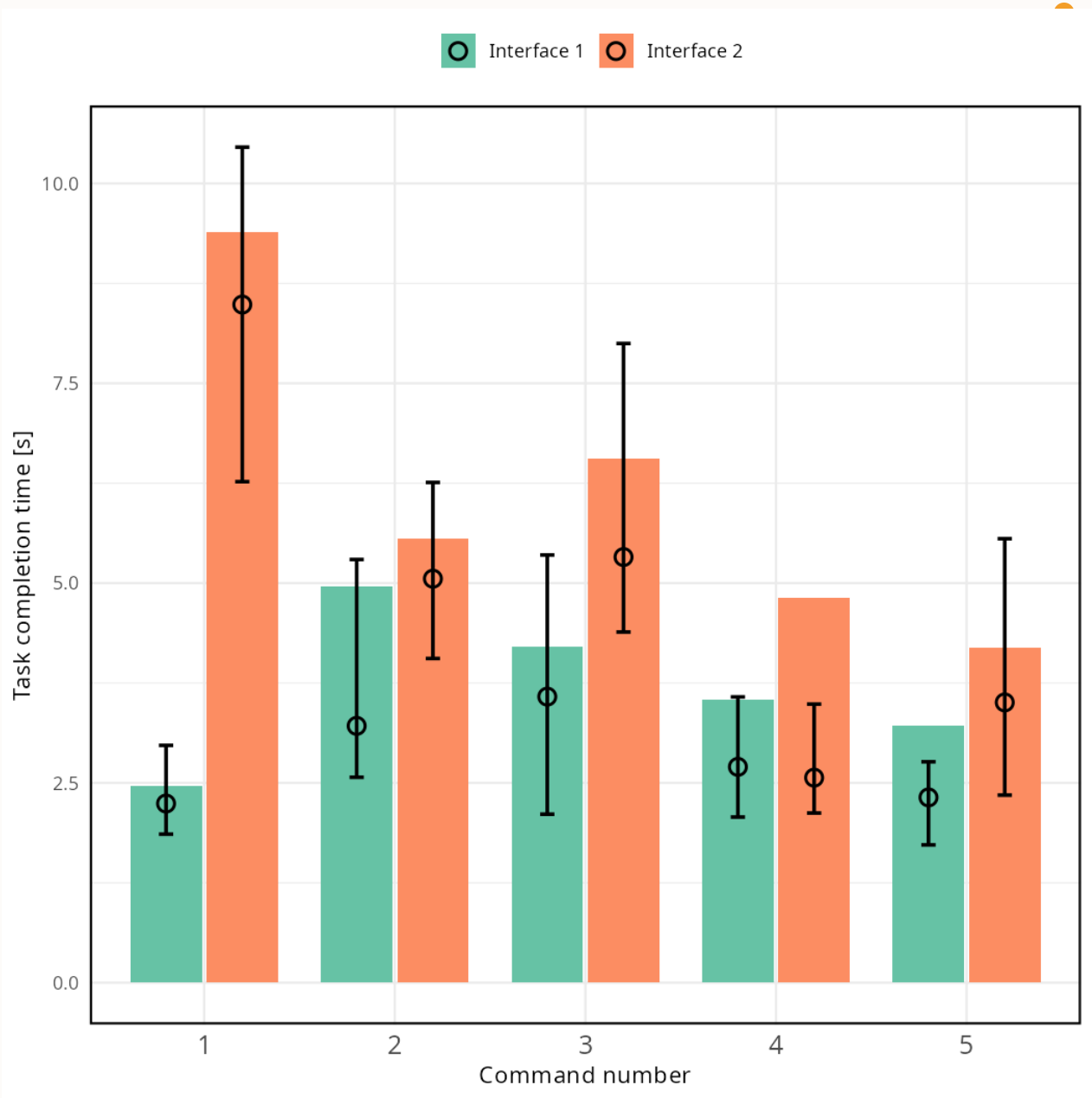
Results (2): Heatmaps



Example of a heatmap of task 8.

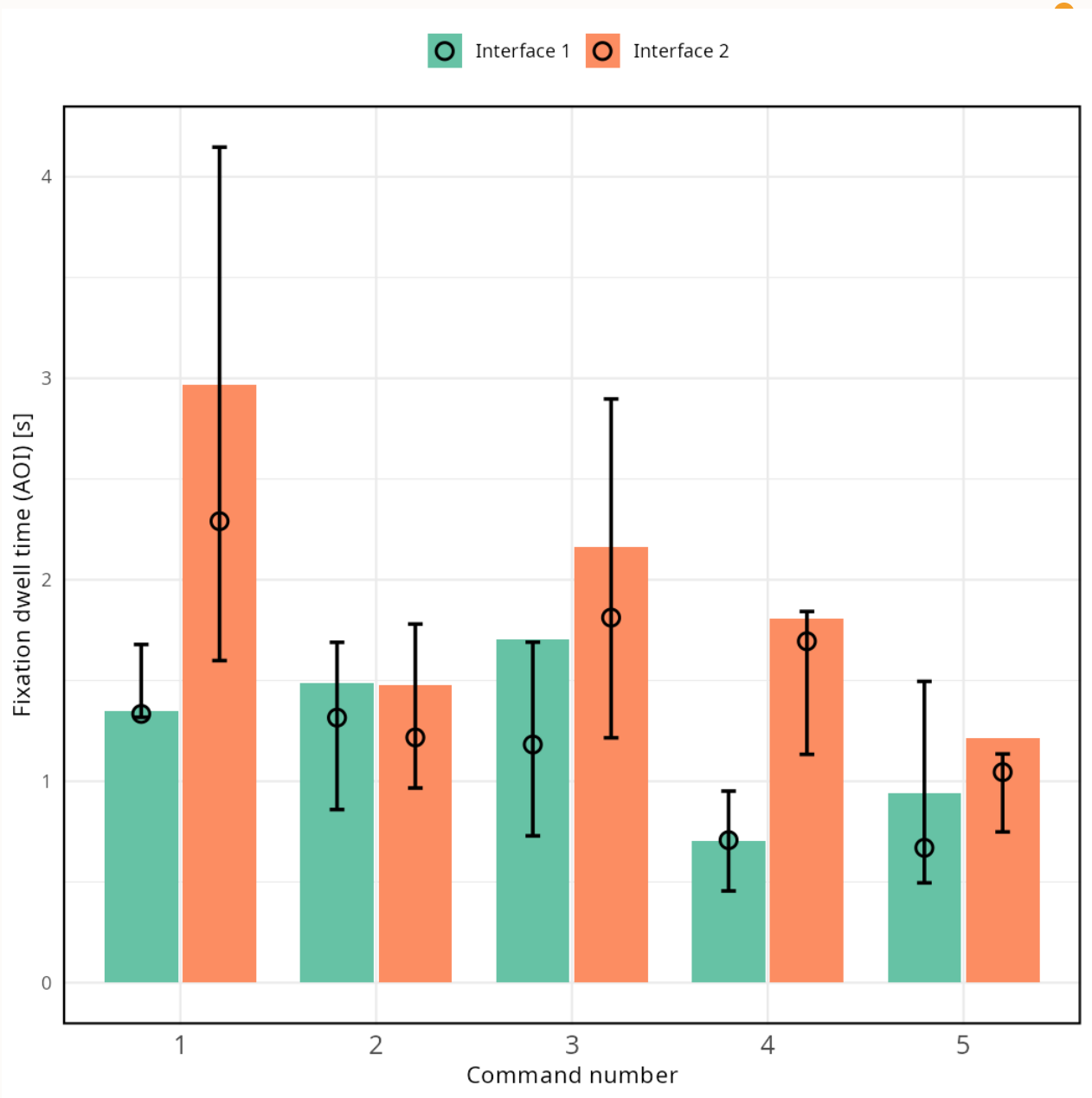
Results (3): Task Completion Time

Mean task completion time per task according to the interface obtained for all participants.



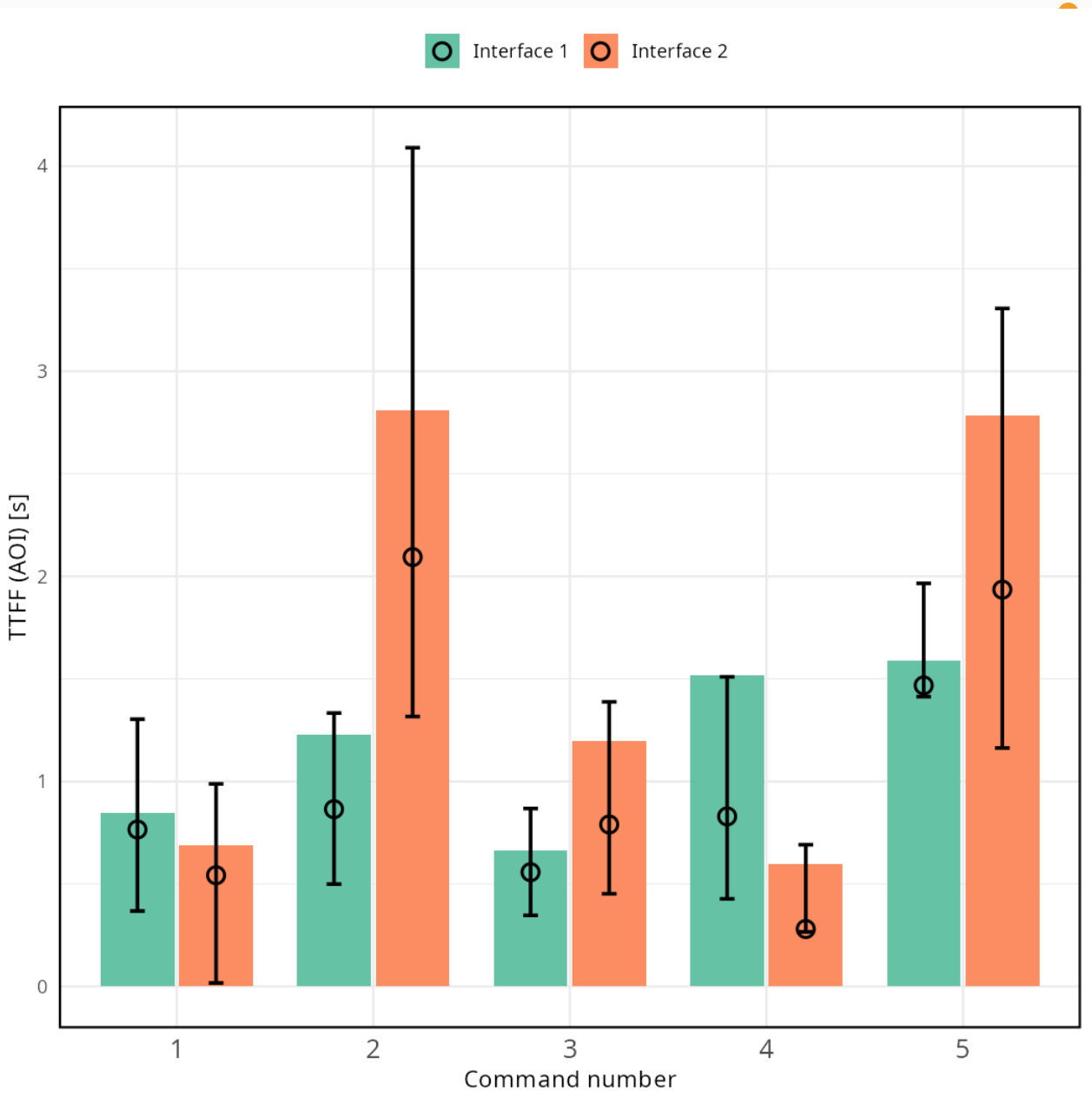
Results (4): Fixation Dwell Time (AOI)

Mean fixation dwell time (AOI) per task according to the interface obtained for all participants.



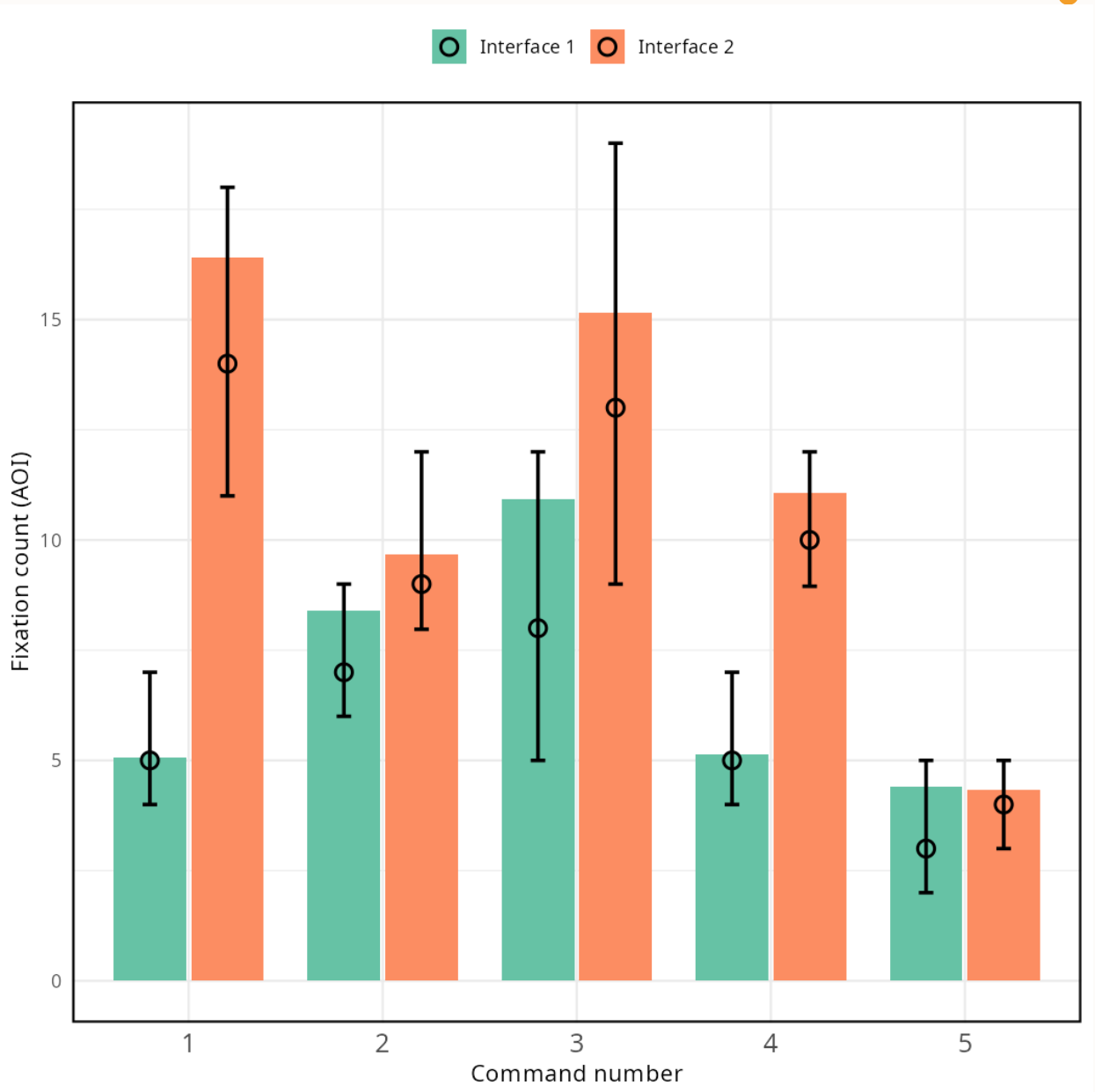
Results (5): Time to First Fixation (AOI)

Mean TTFF (AOI) per task according to the interface obtained for all participants.



Results (6): Number of Fixations (AOI)

Mean number of fixations (AOI) per task according to the interface obtained for all participants.



Statistical Analysis Results

Statistically Significant Differences Between Interfaces (Wilcoxon signed-rank test).

Measure	Command number	p-value
Task Completion Time	1	**<0.001**
Task Completion Time	2	**0.042**
Dwell Time	1	**<0.001**
Dwell Time	4	**<0.001**
TTFF	2	**0.007**
Fixation Count	1	**<0.001**
Fixation Count	3	**0.025**
Fixation Count	4	**<0.001**

- The tests compared paired eye-tracking measurements between Interface 1 and Interface 2 for each command.
- Significant differences between interfaces were observed only for selected commands, indicating task-dependent effects.

Key Findings

High visual contrast, larger font sizes and logical layout structure significantly reduce the effort required for visual searching and shorten the time needed to locate information.

Elements that are clearly emphasised and visually distinctive, particularly large graphics and strongly highlighted components, attract users' attention more effectively than less distinctive elements.

Interfaces designed in accordance with universal design principles lead to more concentrated visual attention and more efficient task performance than interfaces with reduced readability.

The layout of the interface and its dominant visual elements can influence attention patterns independently of accessibility principles, indicating that spatial composition also plays a critical role in locating information.

Improving visual accessibility and readability significantly enhances users' efficiency in locating information within digital interfaces, thereby confirming the study's primary objective.

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