Diplomarbeit

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Mobile User Interfaces For People On The Move

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Research Questions

Thumb-based one-handed interaction with touch screens while walking

interacting	selecting buttons, text, links, map applications, …
reading	web pages, texts, e-mails, …

1. effect of target and text size on performance?
2. how does walking affect performance?
3. how to counteract the additional cognitive load while walking?

Agenda

Related Work

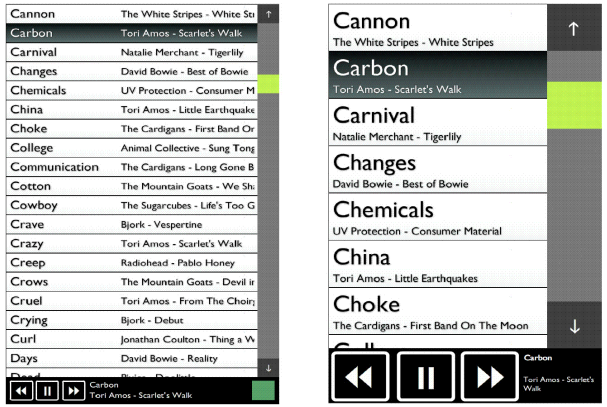
Target Acquisition & Reading User Study

Selection Techniques User Study

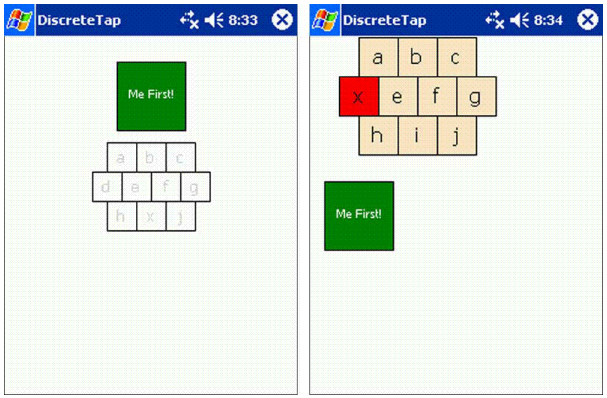
Conclusion & Future Work

Discussion

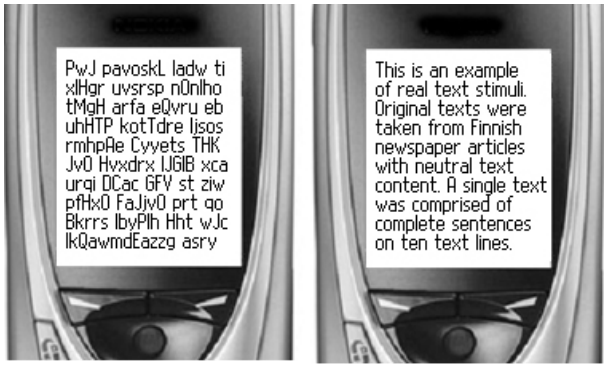
Related Work



Walking UI Music Player [Kane et al. 2008]



Thumb-based target selection [Parhi et al. 2006]



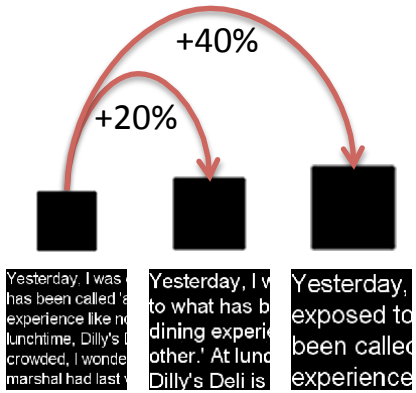
Legibility with small screens [Mustonen et al. 2004]

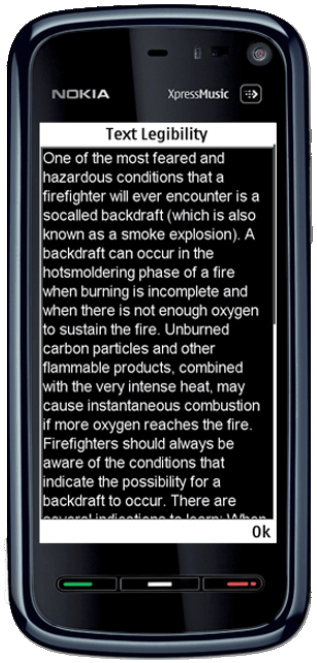
Use-in-motion evaluation guidelines [Barnard et al. 2007]

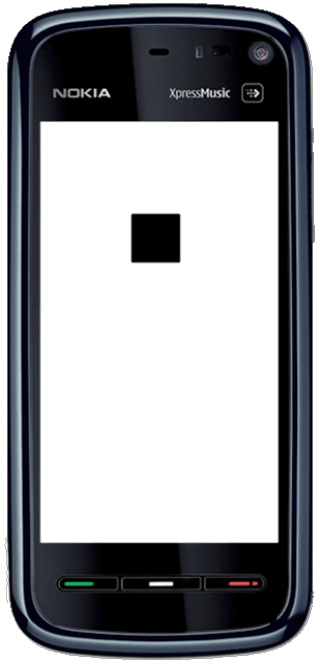
User Study

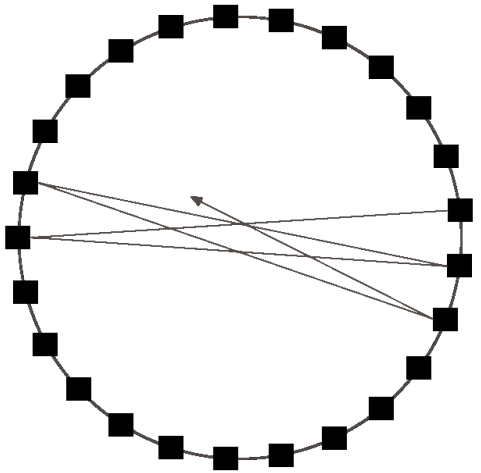
Target Acquisition and Reading – Experimental Design

- within-subjects experimental design (n = 16)
- *Fitts' Law task*: three target sizes based on iPhone Human Interface Guidelines
- *reading comprehension task*: three text sizes based on mobile platforms analysis
- outdoor walking course controlled & realistic environment
- two control conditions standing condition & normal walking speed



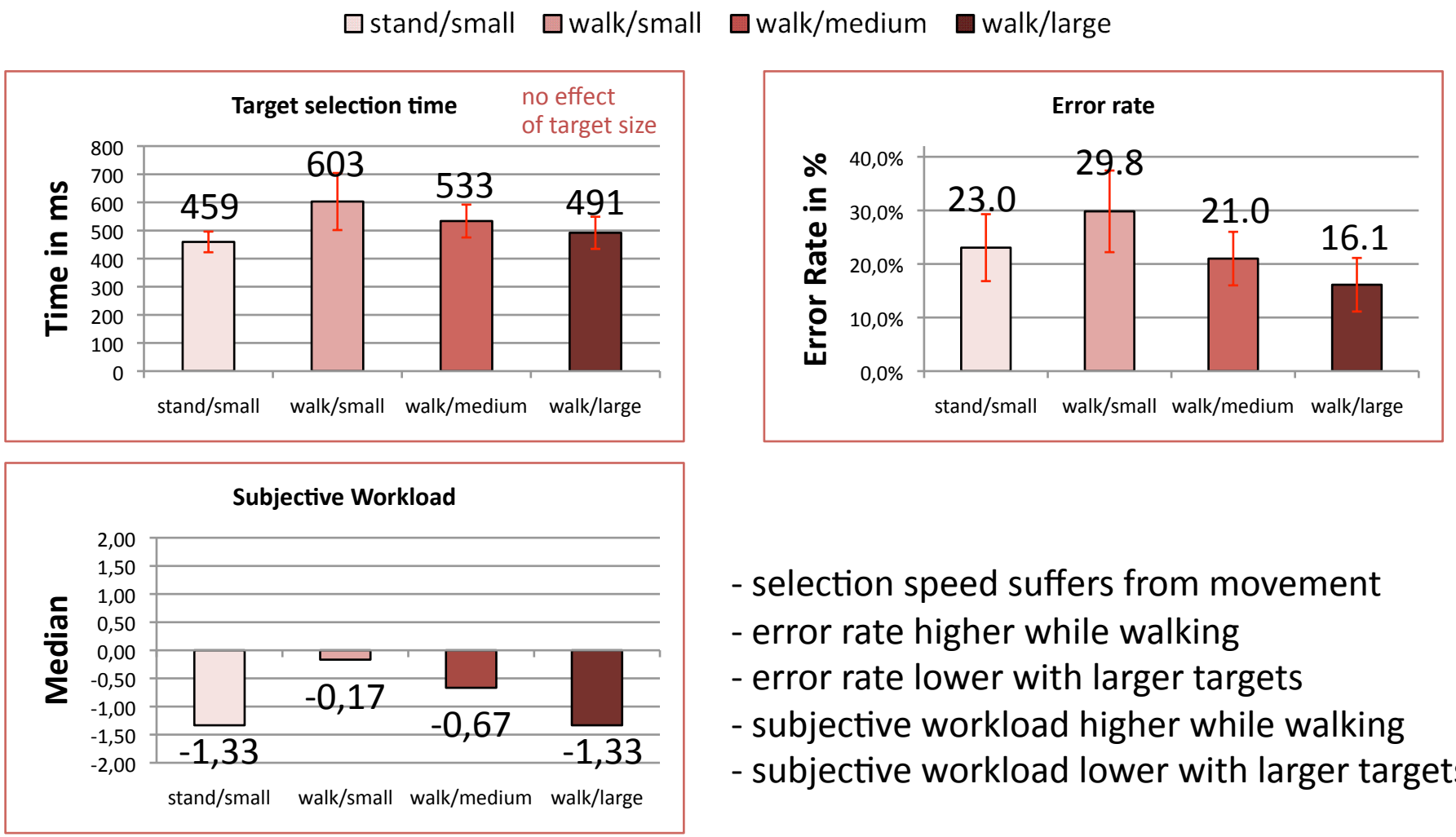






Results

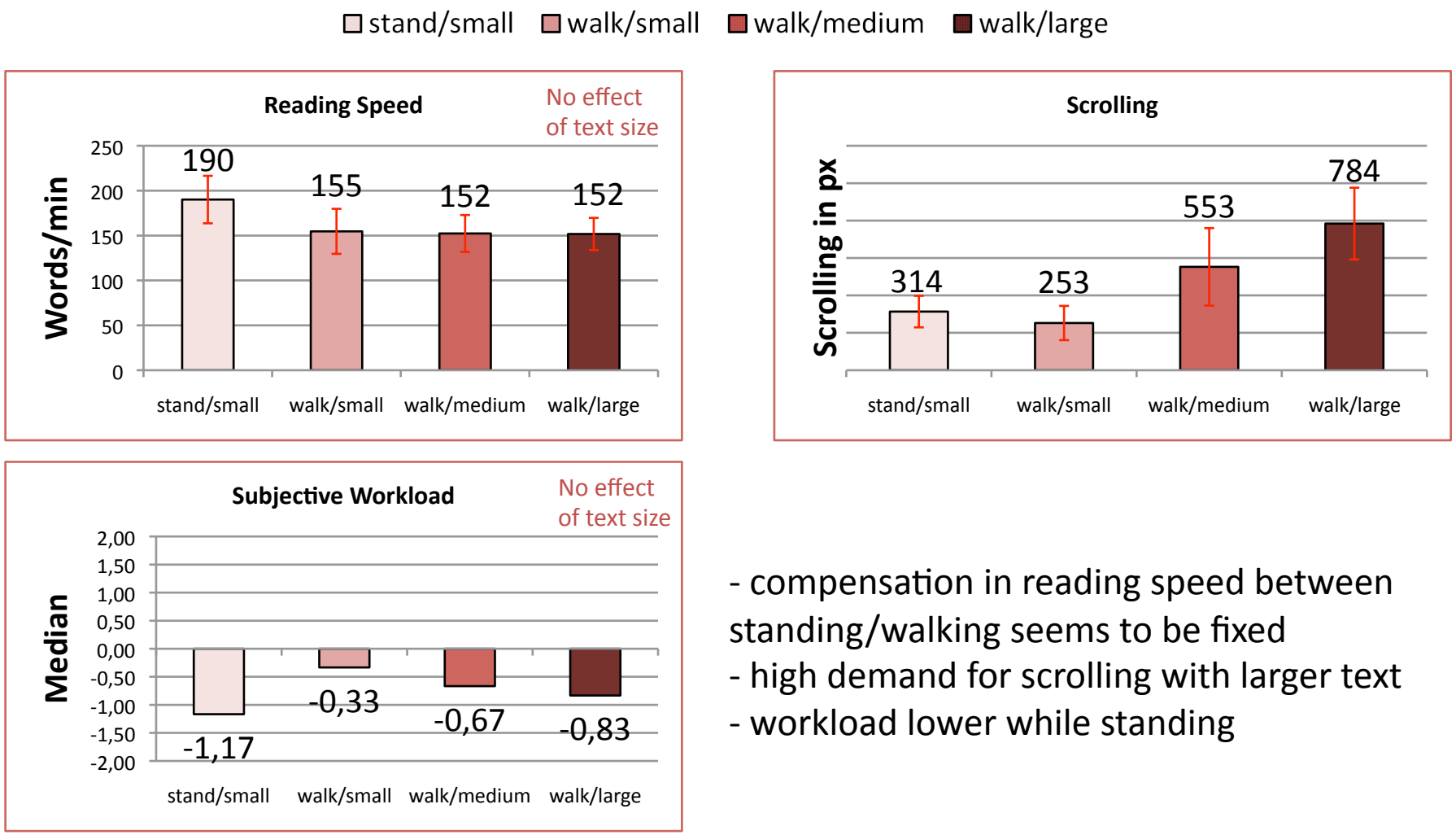
Target Acquisition



- selection speed suffers from movement
- error rate higher while walking
- error rate lower with larger targets
- subjective workload higher while walking
- subjective workload lower with larger targets

Results

Reading

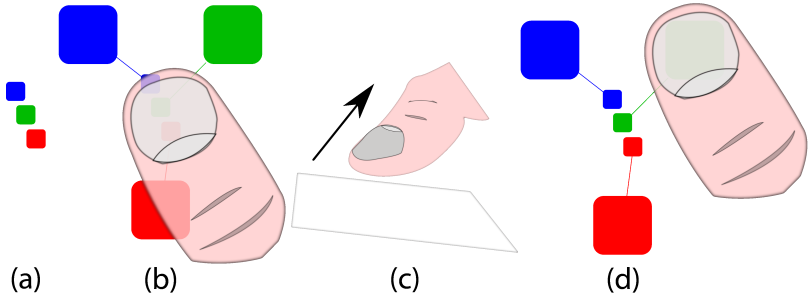


- compensation in reading speed between standing/walking seems to be fixed
- high demand for scrolling with larger text
- workload lower while standing

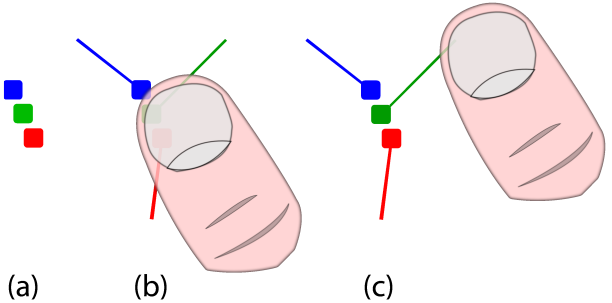
Selection Techniques

"fat finger problem" map application, web browser, buttons, games, …

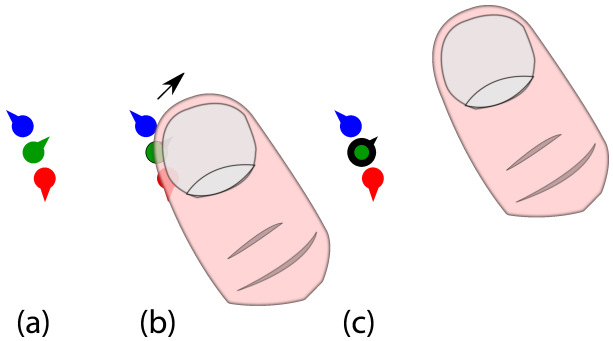
TapTap



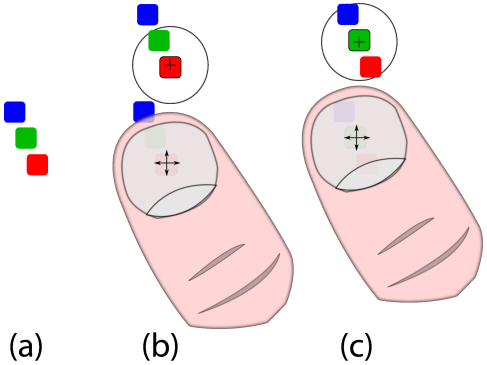
Touch'n'Slide



Escape



Shift



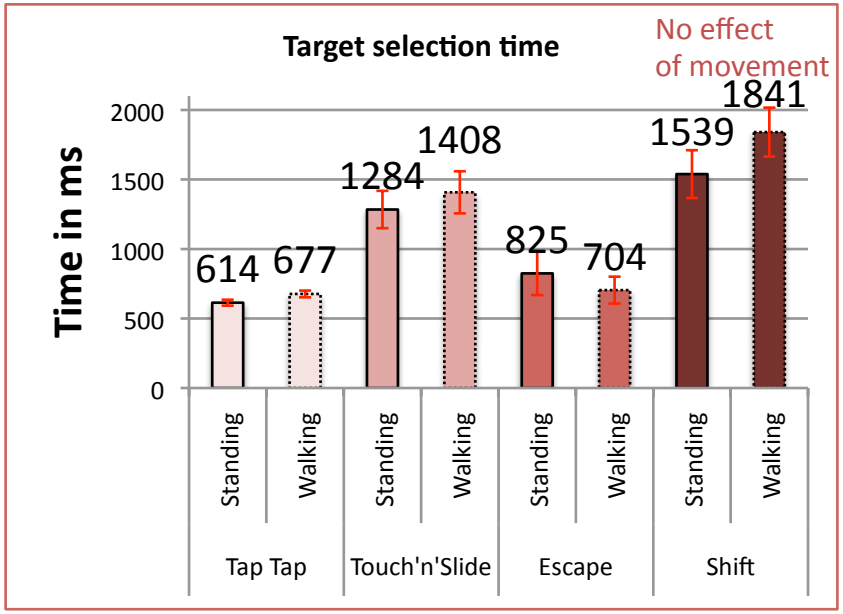
User Study

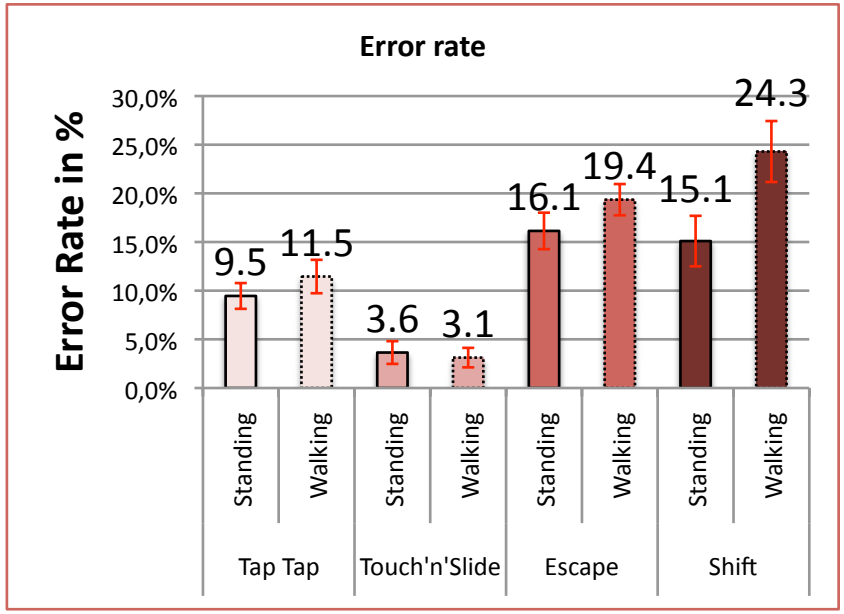
Selection Techniques – Experimental Design

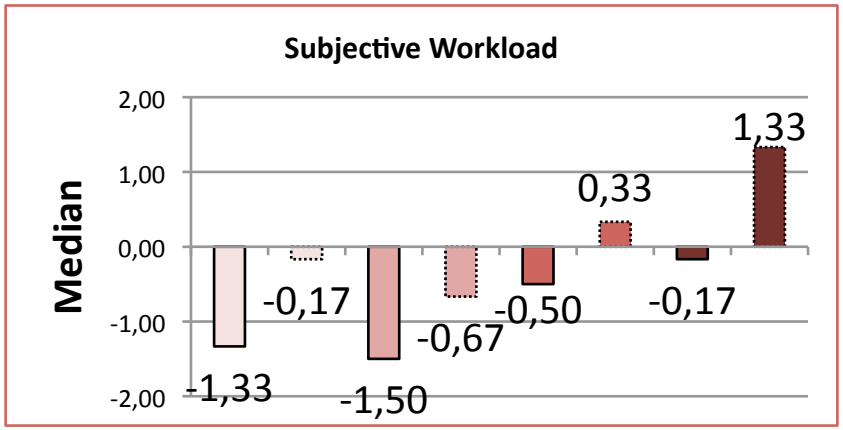
- 4x2 within-subjects experimental design (n = 16)
- outdoor walking course controlled & realistic environment
- four selection techniques {TapTap, Touch'n'Slide, Escape, Shift}
- two movement conditions {standing, walking}
- one control condition normal walking speed

Results

Selection Techniques (I)





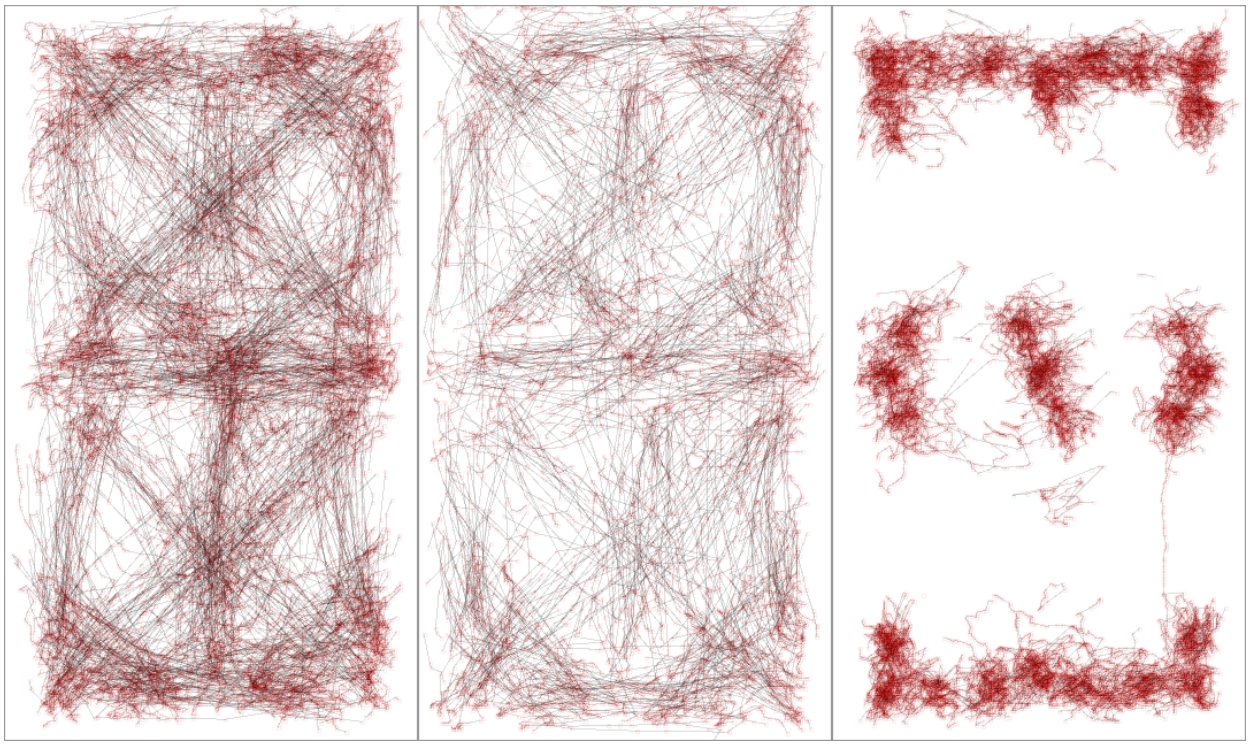


- TapTap/Escape faster than Touch'n'Slide/Shift
- Touch'n'Slide/TapTap have low error rates
- Touch'n'Slide/TapTap less demanding

Results

Selection Techniques (II)

Dragging behaviour



Touch'n'Slide Escape Shift

User Studies

Summary

Reading Task while walking

change in text size has **no effect** on legibility

Target Acquisition while walking

selections are not performed significantly faster, but:

***120% target size**:* 9% less errors

***140% target size** :* 14% less errors

Selection Techniques

***target selection time**:* TapTap / Escape faster than Touch'n'Slide / Shift

error rate: TapTap / Touch'n'Slide less errors than Shift / Escape

Conclusion & Future Work

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Conclusion

- Increase text size if this does not lead to a higher demand for scrolling or text wrapping
- Increase target size if possible (but keep usability design guidelines in mind)
- Introduced selection techniques TapTap & Touch'n'Slide performed well

Future Work

- Combination of TapTap (fast) and Touch'n'Slide (low error rate)
- Integration of TapTap / Touch'n'Slide into 'walking user interfaces'
- Use of accelerometer data

Contribution

- Full paper for Mobile HCI 2010 conference (target acquisition and reading user study)
- Tech note for UIST conference (selection techniques user study)

Discussion

References

- Shaun K. Kane, Jacob O. Wobbrock, and Ian E. Smith. Getting off the treadmill: Evaluating walking user interfaces for mobile devices in public spaces. In MobileHCI'08: Proceedings of the 10th international conference on Human Computer Interaction with mobile devices and services, pages 109–118, New York, NY, USA, 2008. ACM.
- Pekka Parhi, Amy K. Karlson, and Benjamin B. Bederson. Target size study for one-handed thumb use on small touchscreen devices. In MobileHCI '06: Proceedings of the 8th conference on Human-computer interaction with mobile devices and services, pages 203–210, New York, NY, USA, 2006. ACM.
- Terhi Mustonen, Maria Olkkonen, and Jukka Häkkinen. Examining mobile phone text legibility while walking. In CHI '04: extended abstracts on Human factors in computing systems, pages 1243–1246, New York, NY, USA, 2004. ACM.
- Leon Barnard, Ji Soo Yi, Julie A. Jacko, and Andrew Sears. Capturing the effects of context on human performance in mobile computing systems. Personal Ubiquitous Computing, 11(2):81–96, January 2007.
- International Organization for Standardization. ISO 9241-9: Ergonomic requirements for office work with visual display terminals (VDTs) – Part 9: Requirements for non-keyboard input devices. 2000.

References

- Daniel Vogel and Patrick Baudisch. Shift: a technique for operating pen-based interfaces using touch. In CHI ’07: Proceedings of the SIGCHI conference on Human factors in computing systems, pages 657–666, New York, NY, USA, 2007.
- Koji Yatani, Kurt Partridge, Marshall Bern,and Mark W. Newman. Escape: a target selection technique using visually-cued gestures. In CHI ’08: Proceedings of the SIGCHI conference on Human factors in computing systems, pages 285–294, New York, NY, USA, 2008. ACM.
- Anne Roudaut, Stéphane Huot, and Eric Lecolinet. Taptap and magstick: improving one-handed target acquisition on small touch-screens. In AVI ’08: Proceedings of the working conference on Advanced visual interfaces, pages 146–153, New York, NY, USA, 2008. ACM.