

ICE-B 2012

Paper # 34, Session 4: Mobility, 10:45-12:15, Chair: N.N.

On the development of smart adaptive user interfaces for mobile e-Business applications: Towards enhancing User Experience – some lessons learned

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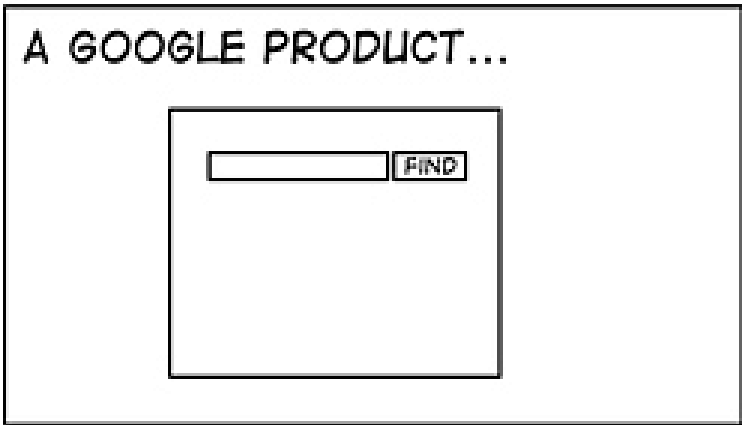
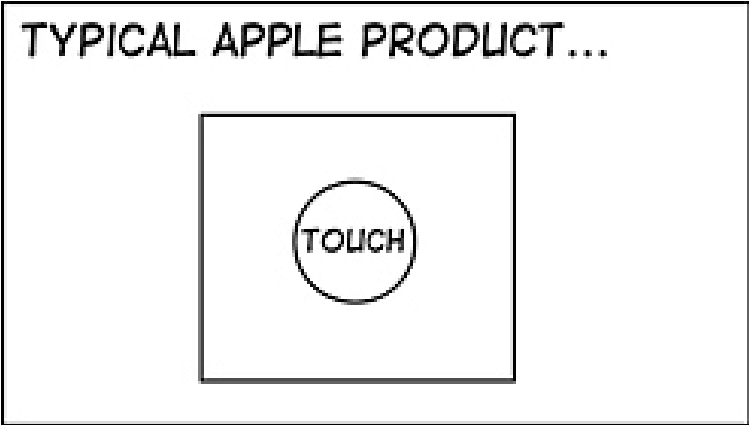


- 1. Introduction and Motivation**
2. Theoretical Background
3. Materials and Methods
4. Results
5. Discussion
6. Conclusion
7. Future Work

Motivation



Marca, D., Bulander, R., Kruslin, C., Shishkov, B., & Sinderen, M. (2012).
e-Business challenges and directions. *e-Business and Telecommunications*, 3-35.



YOUR COMPANY'S APP...

FIRST NAME: <input type="text"/>	TYPE CD: <input type="text"/>	4 - K
LAST NAME: <input type="text"/>	TQP STAT: <input type="checkbox"/>	AA2-
SSN: <input type="text"/>	FT/PT: <input type="checkbox"/>	DK9B
ID: <input type="text"/>	VER: <input type="text"/>	KKA?
PHONE 1: <input type="text"/>	CAT CD: <input type="text"/>	CN3
PHONE 2: <input type="text"/>	CITY: <input type="text"/>	AA-9
ADDR 1: <input type="text"/>	STATE: <input type="text"/>	NEW
ACCT #: <input type="text"/>	ZIP: <input type="text"/>	DEL
ORD #: <input type="text"/>		

OKAY APPLY SAVE UNDO HELP DELETE EDIT
SELECT BROWSE ERRORS

STUFFTHATHAPPENS.COM BY ERIC BURKE



Image source: Taken by the authors on 11.07.2012 in Palace Eggenberg, Graz



Holzinger, A., & Ebner, M. (2005). Visualization, Animation and Simulation for Mobile Computers: Experiences from Prototypes In J. Zara & J. Sloup (Eds.), *Central European Multimedia and Virtual Reality Conference (available in EG EuroGraphics Library) (pp. 37-41)*. Prague: Czech Technical University (CTU).



Image source: Flickr Photostream by Panasonic Toughbook

What is simple?

What is an intelligent interface?

- ✓ Introduction and Motivation
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- Are user interface elements (buttons, ...) large enough?
- Do controls look tappable? (Apple UI Guidelines)
- Do all screens support both portrait and landscape screen orientation?
- Is the state of the app preserved during unexpected interruptions and properly restored when resuming (e.g. phone calls)? (Android UI Guidelines)
- Is the need for text input reduced to a minimum?

Holzinger, A., & Errath, M. (2007). Mobile computer Web-application design in medicine: some research based guidelines. *Universal Access in the Information Society International Journal*, 6(1), 31-41.

Adaptive User Interface

- Tailored dynamically to the special **demands/requirements/needs** of the end user
- Takes the **context** into account for deciding which parts of the UI are currently needed and which are not.

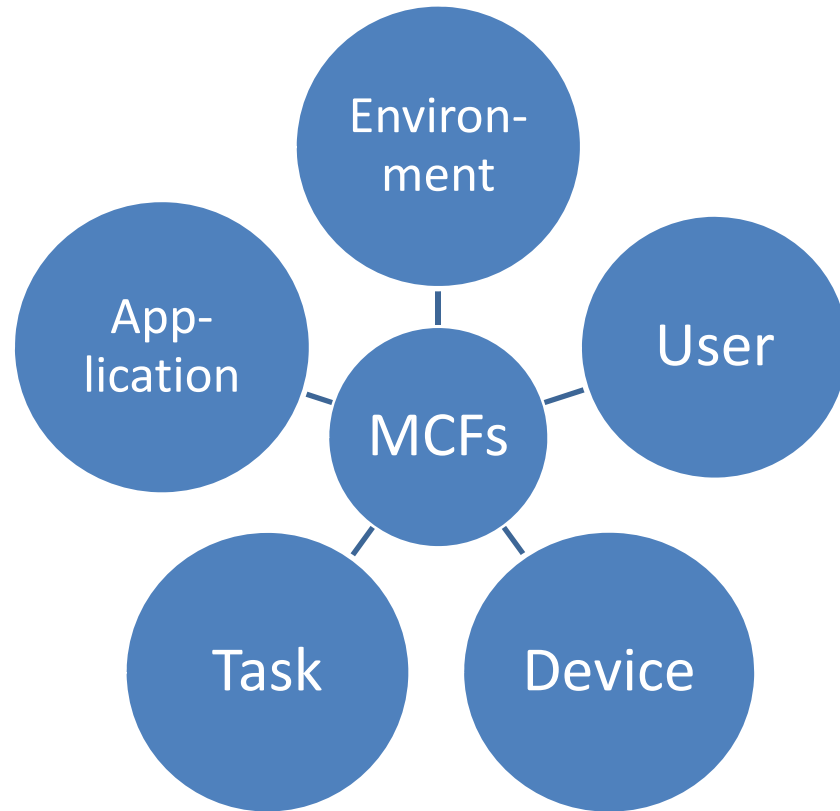
Adaptive = automatic adaption at runtime

≠

Adaptable = customizable at design time

Context

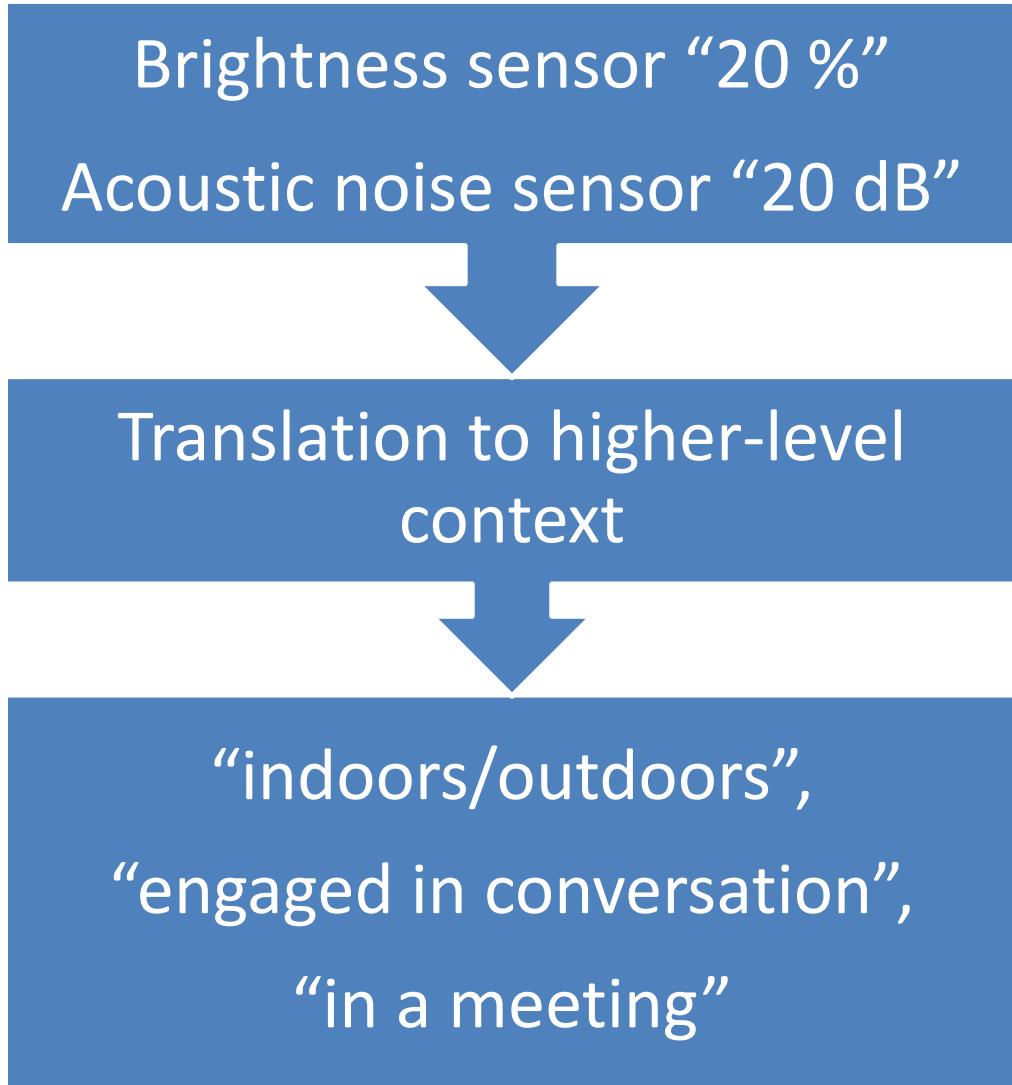
- End user's...
 - ...experience
 - ...special abilities
 - ...needs and feelings
- Environmental factors
 - surrounding light, noise
 - location, other sensors...
- Device's current state
- Time
- ...



Biel, B., Grill, T. & Gruhn, V. 2010. Exploring the benefits of the combination of a software architecture analysis and a usability evaluation of a mobile application. *Journal of Systems and Software*, 83, 2031-2044.

Environmental context

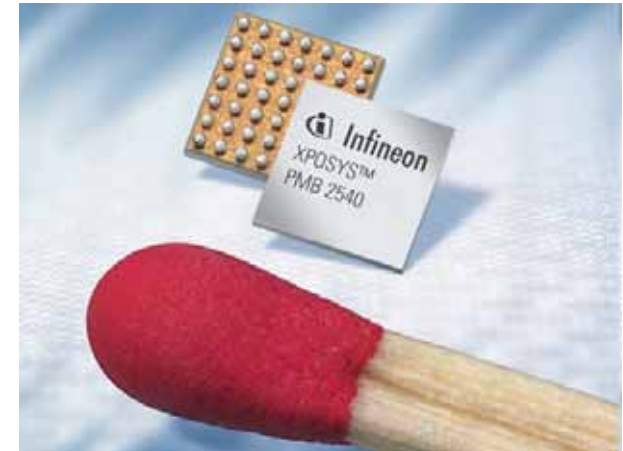
Giving the bare sensor data a meaning

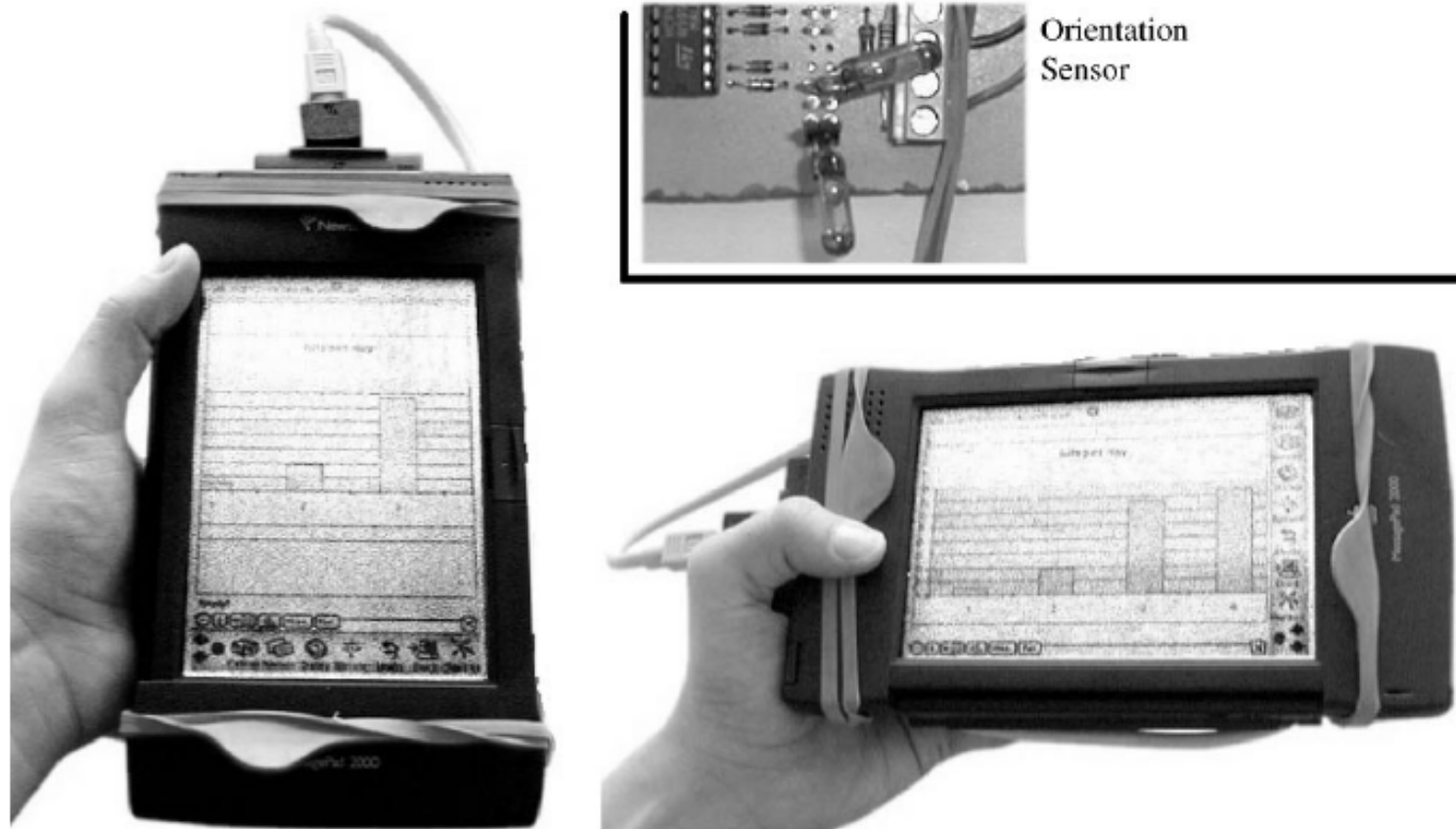


Schmidt A., Beigl, M. & Gellersen, H.-W. 1999.
There is more to context than location.
Computers & Graphics, 23, 893-901.

Very popular in current mobile applications: Location (GPS)

- Microphone
- Gyroscope, Compass
- Air pressure sensors
- many more...





Early experiments with UI adaptations based on mobile device orientation.

Schmidt, A., Beigl, M. & Gellersen, H.-W. 1999. There is more to context than location. *Computers & Graphics*, 23, 893-901.

- Time series of sensor data can be useful for forming higher-level contexts



Partial screenshot of “Sound Meter”
Android App

Himberg, J., Korpiaho, K., Mannila, H., Tikanmaki, J., & Toivonen, H. (2001). *Time series segmentation for context recognition in mobile devices*. Paper presented at the IEEE International Conference on Data Mining (ICDM 01), San Jose (CA).

User context

User profiles: different modes for different user groups who have different needs.

- students
- tourists
- children

→ ArcheoApp



Holzinger, K., Lehner, M., Fassold, M. & Holzinger, A. 2011. Archaeological Scavenger Hunt on Mobile Devices: From e-Education to E-Business - A triple adaptive mobile application for supporting Experts, Tourists and Children. *ICETE 2011 8th International Joint Conference on e-Business and Telecommunications*. Sevilla, Spain: SciTec.

Comprehensive **user profiles** where

- visual
- cognitive and
- emotional-processing parameters

are included, improve performance of adaptations.

Germanakos, P., Tsianos, N., Lekkas, Z., Mourlas, C. & Samaras, G. 2009. Realizing Comprehensive User Profile as the Core Element of Adaptive and Personalized Communication Environments and Systems. *Computer Journal*, 52, 749-770.



Anchored sections to floating menu. No diagrammatical presentation of content (Verbalizer)

Floating menu with anchors on the content (Wholist)

Content adaptation according to user's comprehensive profile (eCommerce)

Germanakos P., T. N., Lekkas Z., Mourlas C., Belk M., & Samaras G. 2009. Towards an Adaptive and Personalized Web Interaction using Human Factors. In: ANGELIDES, M. (ed.) *Advances in Semantic Media Adaptation and Personalization*. Taylor & Francis Group.

For text input: Adaptive on-screen keyboards

Developer defines expected input type:

- E-mail address
- Floating point number
- Telephone number
- Generic text
- ...



E-mail: `<input type="email" name="email" />`

Some ideas for context-based adaptations:

- Hiding unused fields
- Pre-selection
- Adaptions based on predictions of future actions

Challenge: Determining which variables to use as basis for developing adaptations

Germanakos P., T. N., Lekkas Z., Mourlas C., Belk M., & Samaras G. 2009. Towards an Adaptive and Personalized Web Interaction using Human Factors. *In: ANGELIDES, M. (ed.) Advances in Semantic Media Adaptation and Personalization.* Taylor & Francis Group.

Goal

Enhancement of end-user's performance.

→ Improving end-user's **speed** and **accuracy** for accomplishing a certain task.

→ Use needs **less time** for his/her tasks and, at the same time, does not make more or even **fewer errors**

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- > 50 employees
- Founded 1995
- Maintenance management, production control
- Total Customizing

www.boomsoftware.com

Image source: Boom Software AG



- BORA: “*Business Oriented Rapid Adaption*”
- “Total Customizing”



Source: Boom Software AG

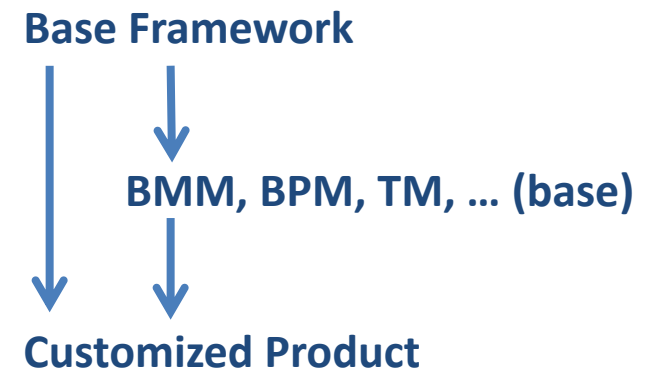




Image source: <http://www.zdnet.com>



Source: <http://www.bmodo.com/bmodo12.html> and google.de/nexus



Mockup



App Prototype for Android

Source: Boom Software AG

Hypothesis: *“Simpler user interfaces created by smart adaption increase the performance of end-users”*

Simplicity: Reduced selection space, disallow invalid input → Error prevention

Performance: Error rate and typing speed.

→ **Experiment:** AUI vs. classic non-AUI

- Android App: AdaptiveCalc
- non-AUI / “classic UI”:



AdaptiveCalc at Google Play

Image source TI calculator:
<http://education.ti.com/studentzone/StudentZoneUS/calculatorzone/calculators.html>

- Android App: AdaptiveCalc
- Context-based Adaptive UI:



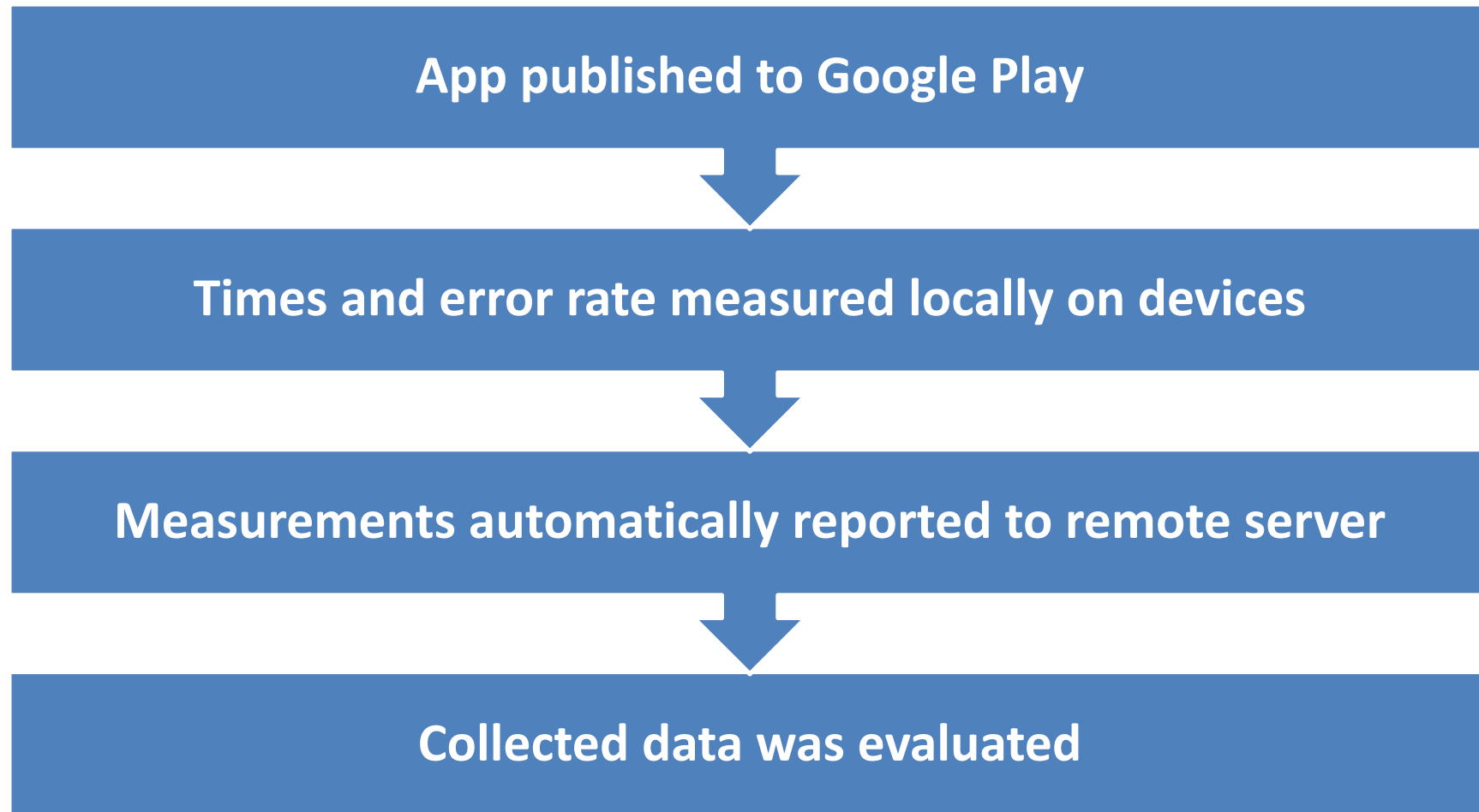
AdaptiveCalc at Google Play

Two different views of the adaptive UI

- As contextual information the application's state is taken into account.
- Based on previous inputs the application's state is changed.



Personal Interviews with six test users.



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AdaptiveCalc



AUI

VS.



Classic UI



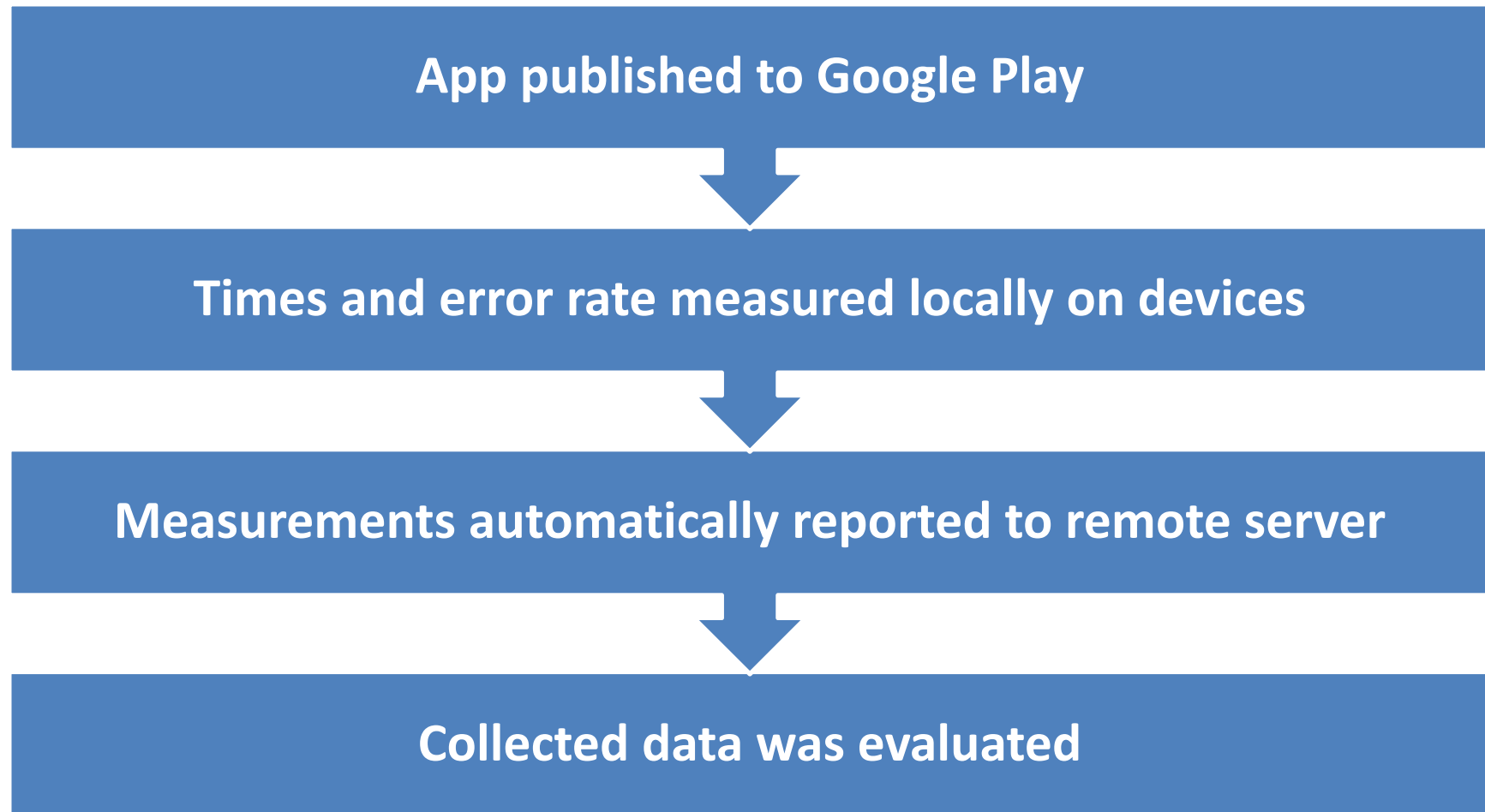
Personal Interviews with six test users.

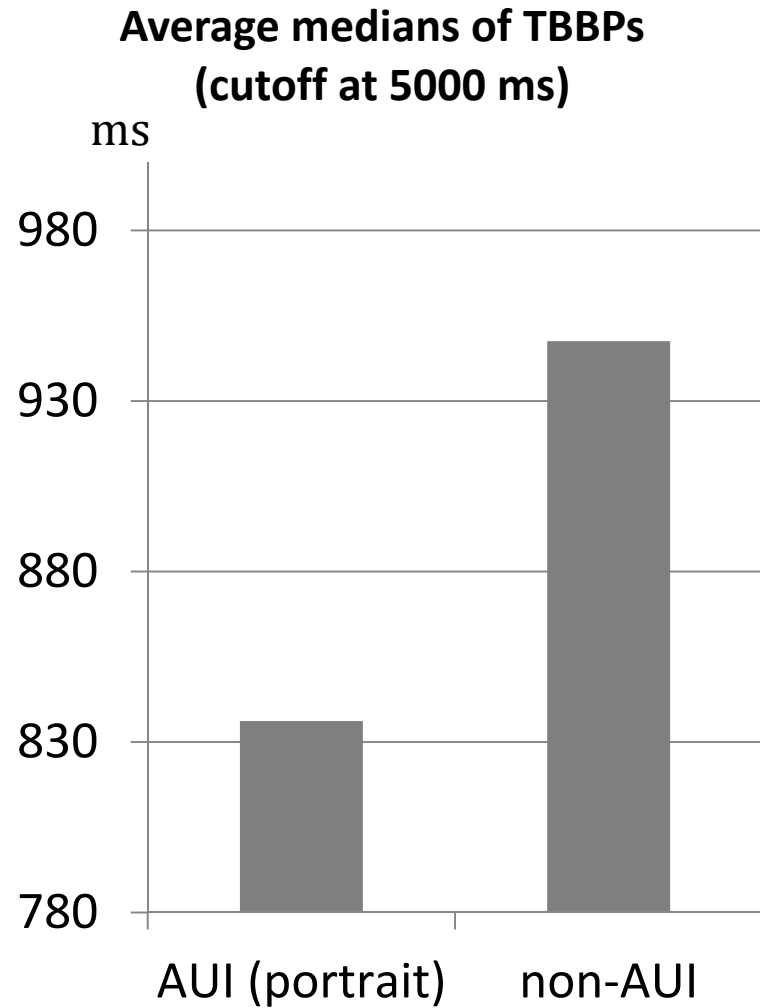
Adaptive UI

- + *“The buttons are larger”* (6/6 test users)
- + *“I like that you only see what is currently relevant”* (4/6 test users)
- *“It is confusing that the buttons (dis)appear”* (2/6 test users)

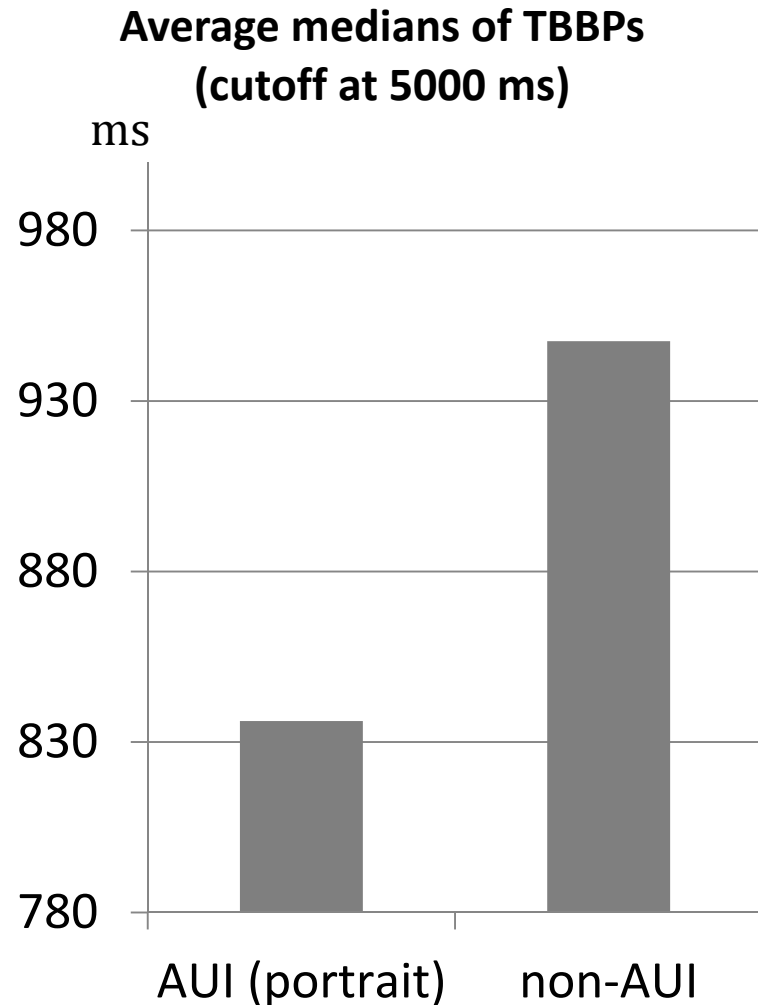
Classic UI

- + *“All buttons are always visible – it is clear what functions are available”* (2/6 test users)
- *“Buttons are quite small”* (2/6 test users)





Based on:
133 calculations with **non-AUI**
198 calculations with **AUI**



Based on:

133 calculations with **non-AUI**

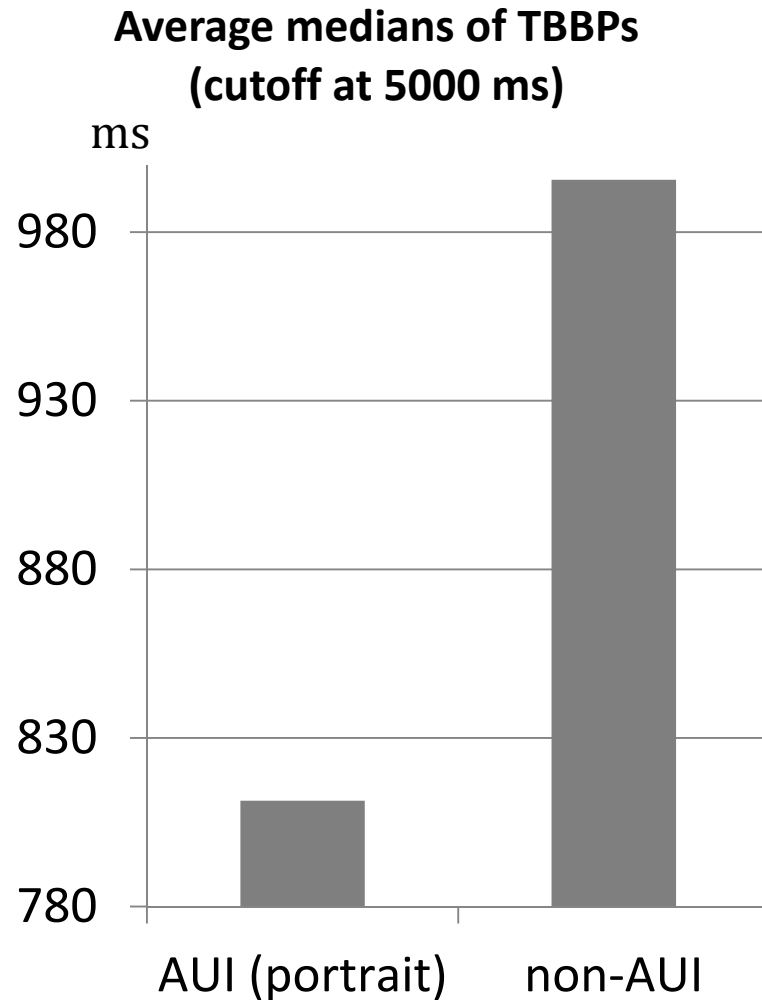
198 calculations with **AUI**

Example:

$3 + 6.8 * abs(-15)$

(11 button presses)

with AUI: 1114 ms faster



Based on:

236 calculations with **non-AUI**

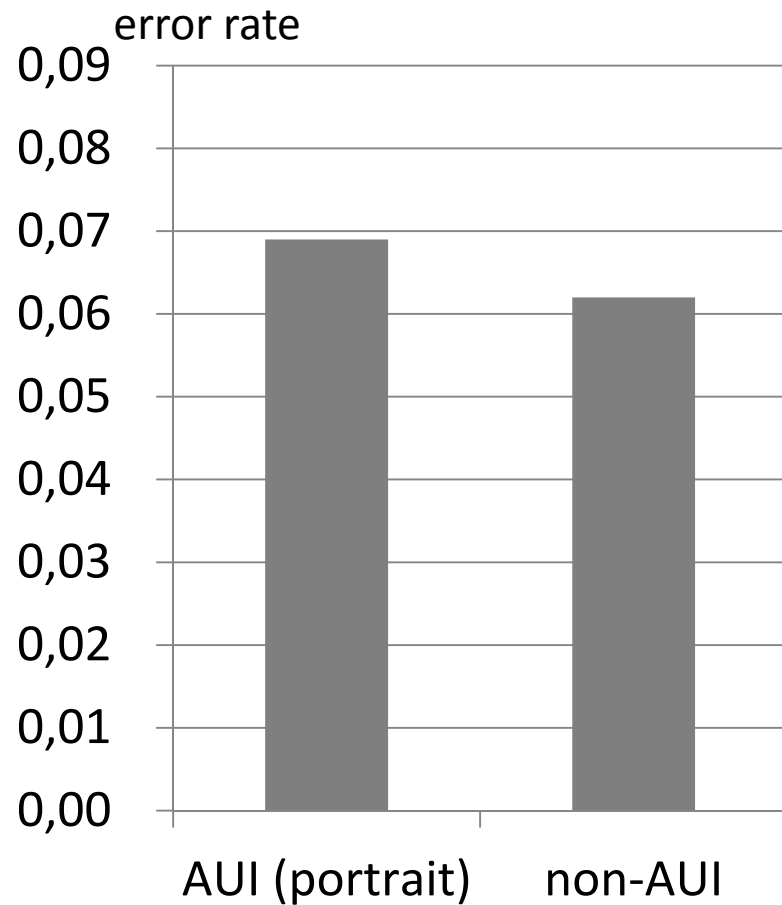
519 calculations with **AUI**

Example:

$$3 + 6.8 * abs(-15)$$

(11 button presses)

with AUI: 1840 ms faster



error rate =

 presses

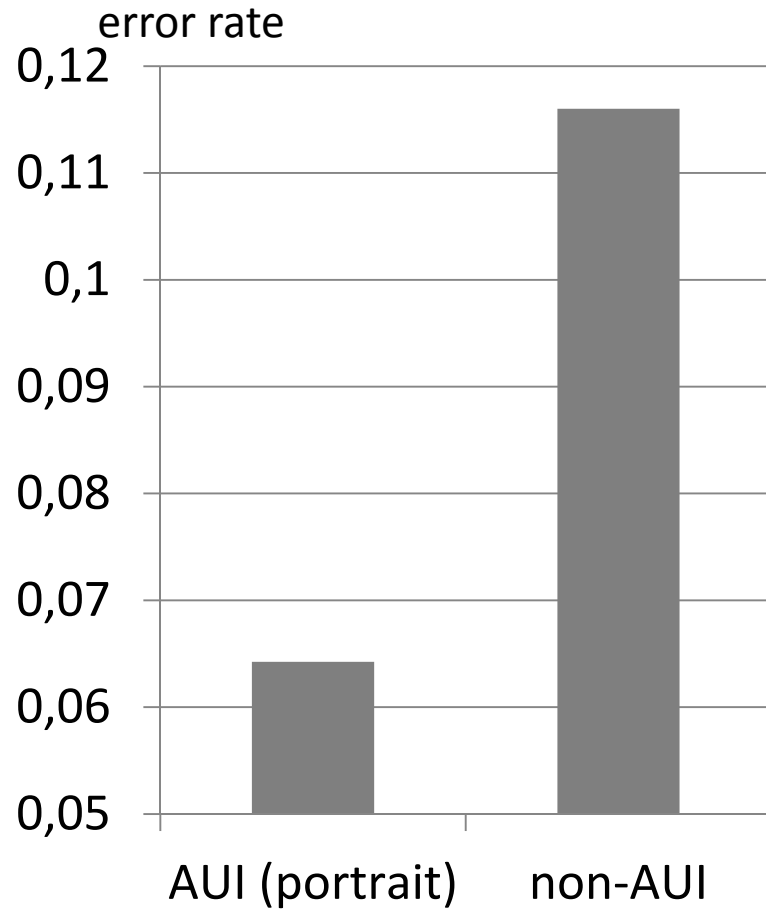
total # button presses

AUI:

On 1000 button presses: **69 x clear**

non-AUI:

On 1000 button presses: **62 x clear**



error rate =

 presses

total # button presses

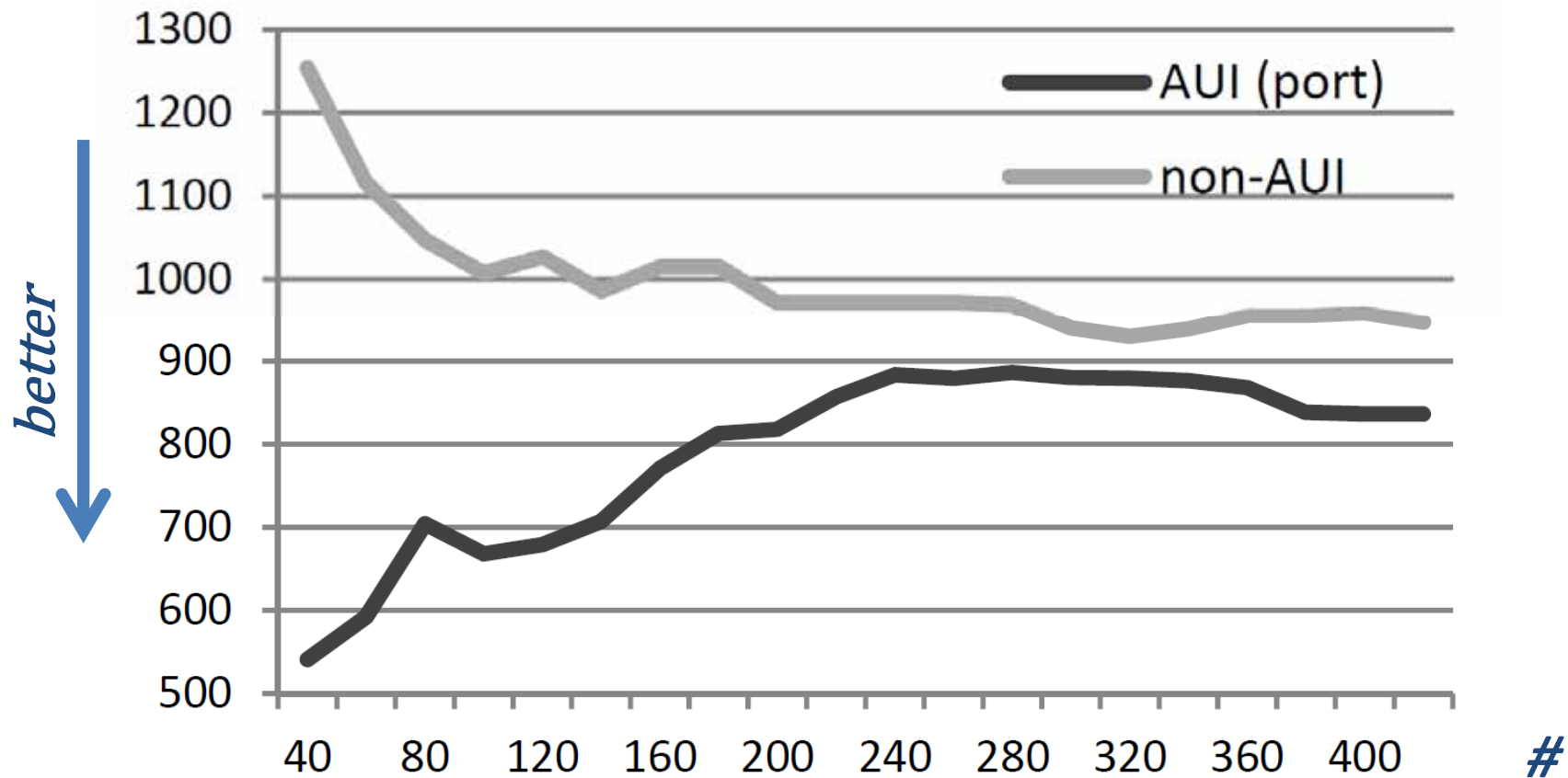
AUI:

On 1000 button presses: **64 x clear**

non-AUI:

On 1000 button presses: **116 x clear**

Average of the medians of the TBBPs



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- Acceptance of the AUI was higher
- Users using the AUI are performing better
- Smart adaption has high potential

- Problems:
 - Investigation of other factors potentially influencing the results is necessary.
 - Possible correlation between the higher typing speed and error rate?

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- Usability considerations are essential in SE
- UIs must
 - tolerate and correct users' errors
 - provide better navigation
 - adapt to the users' needs and context
- **AUIs can improve performance of end-users**
- Make use of all device's and system's capabilities (e.g. sensors) to support the user wherever possible – but enable to switch it off 😊

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7. Future Work

- Research on **more sophisticated adaptations**
- How can **contextual information** be used for more accurate adaptations?
- How can UIs be **kept simple** given the **increasing complexity** of information spaces and contexts?
- Identification of **design guidelines** and adaptation mechanisms for AUIs



Thank you!

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