

Investigations on reducing the failure-to-enroll rate for fingerprint scanners by means of user-centered interaction design

International Biometric Performance Conference
Gaithersburg, May 4, 2016



TECHNISCHE UNIVERSITÄT
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“A user interface is like a joke. If you have to explain it,
it’s not that good.”

Martin LeBlanc

Typical users of fingerprint scanners

Yesterday

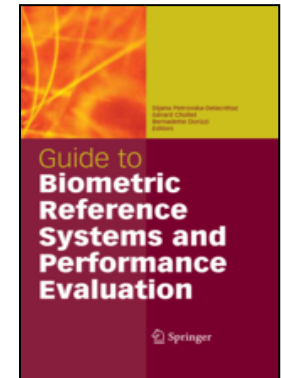
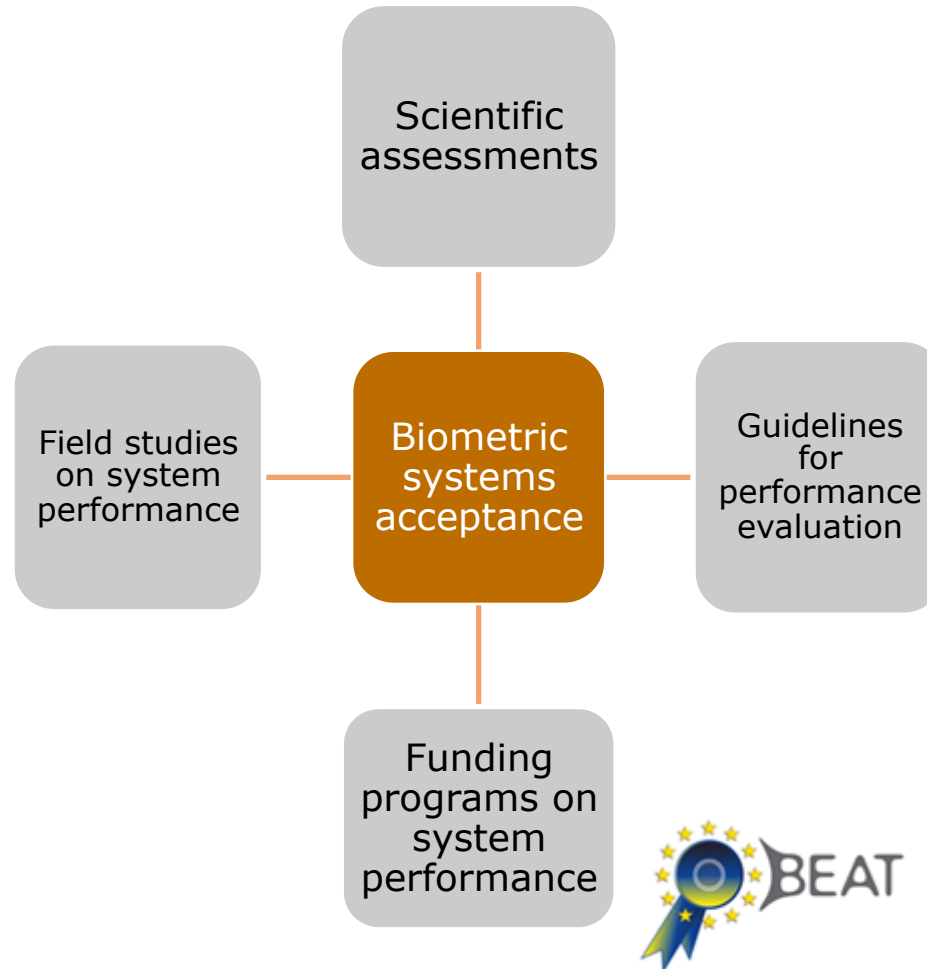
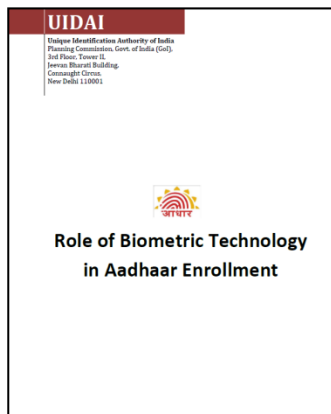


Today



Biometric system assessments

Large-Scale Eval. Multim. Biometric Authentication using state-of-the-art systems
Snelic et al.; IEEE Transactions on pattern analysis and machine intelligence, Vol 27, No 3, March 2005



Lesson learnt from public usability studies

Live image leads to pseudo quality assessment¹

Habituation only improves the usability if user feedback is provided¹

Poster does not work for user guidance, best are videos²

User feedback needs to be quality based³

User feedback needs to be in real-time⁴

1) Does habituation affect fingerprint quality?, Theofanos M et al.; CHI, April 22-27, 2006 Montreal, Canada

2) Usability testing of Ten-print fingerprint capture, Theofanos et al.; NISTIR 7403, March 2007

3) Interactive Quality driven Feedback for biometric systems, Wong et al.; IEEE BTAS, 2010

4) Real-time feedback for usable fingerprint systems, Guan H et al.; IEEE Fifth International Conference BTAS2012

Lesson learnt from testing for Air Entry/Exit Re-engineering

Usability issues identified

Presentation press	Which finger, where to place, how hard to press?
Stability Duration	How long to hold?
Movement	When to start, how fast to move?

Yevgeney Sirotin, Scitor corporation, connect:ID, March 14

Standard development for feedback and user guidance

ISO/IEC JTC 1/SC 37 N 5265

24779-1: Cross-jurisdictional and societal aspects of implementation of biometric technologies — Pictograms, Icons and Symbols for use with Biometric Systems

Part 1 General principles



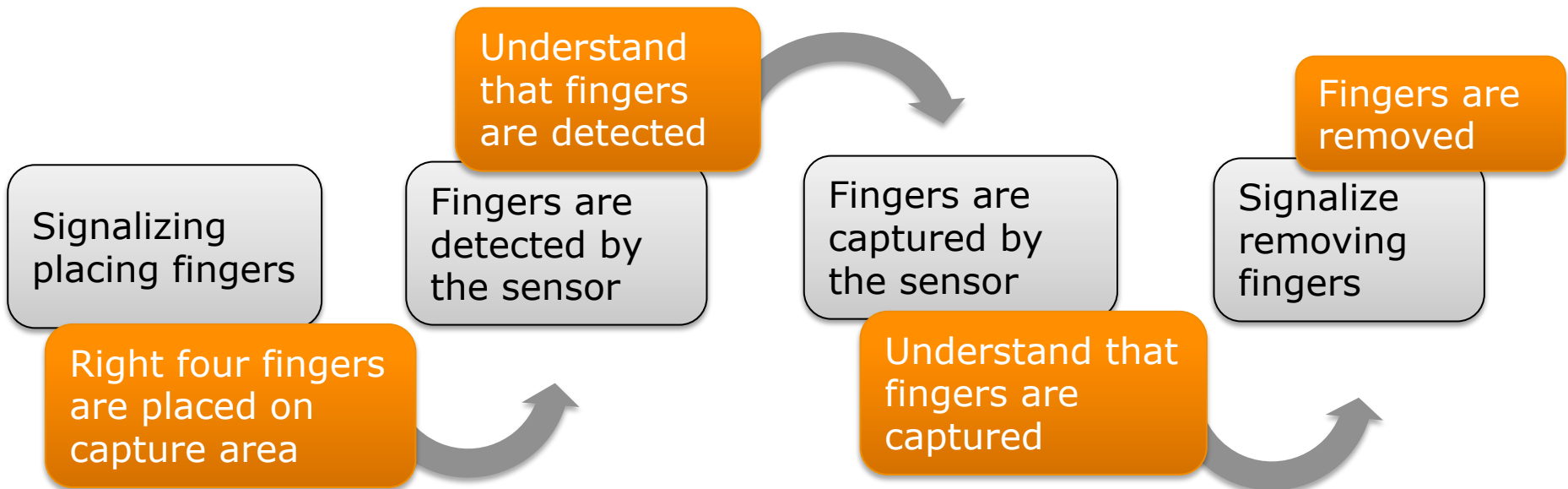
Part 4 Fingerprint applications



Human-Machine-Interaction

Interaction design = conversation between **user** and **device**
(WHAT and WHEN)

Example: Capture right four fingers



Interface design = HOW to communicate

Finger sequence error
for right middle finger.

Text messages



Audible or haptic



Live images



Guidance by
device design



Dynamic
feedback

ID Flats scanner



User interface studies

Usability Engineering

User-centered development of a fingerprint scanner

1. Understand Context of use

- Literature review
- Expert workshop

2. Specify User Requirements

- Standard review (i.e. ISO 9241-110, ISO 894-2)

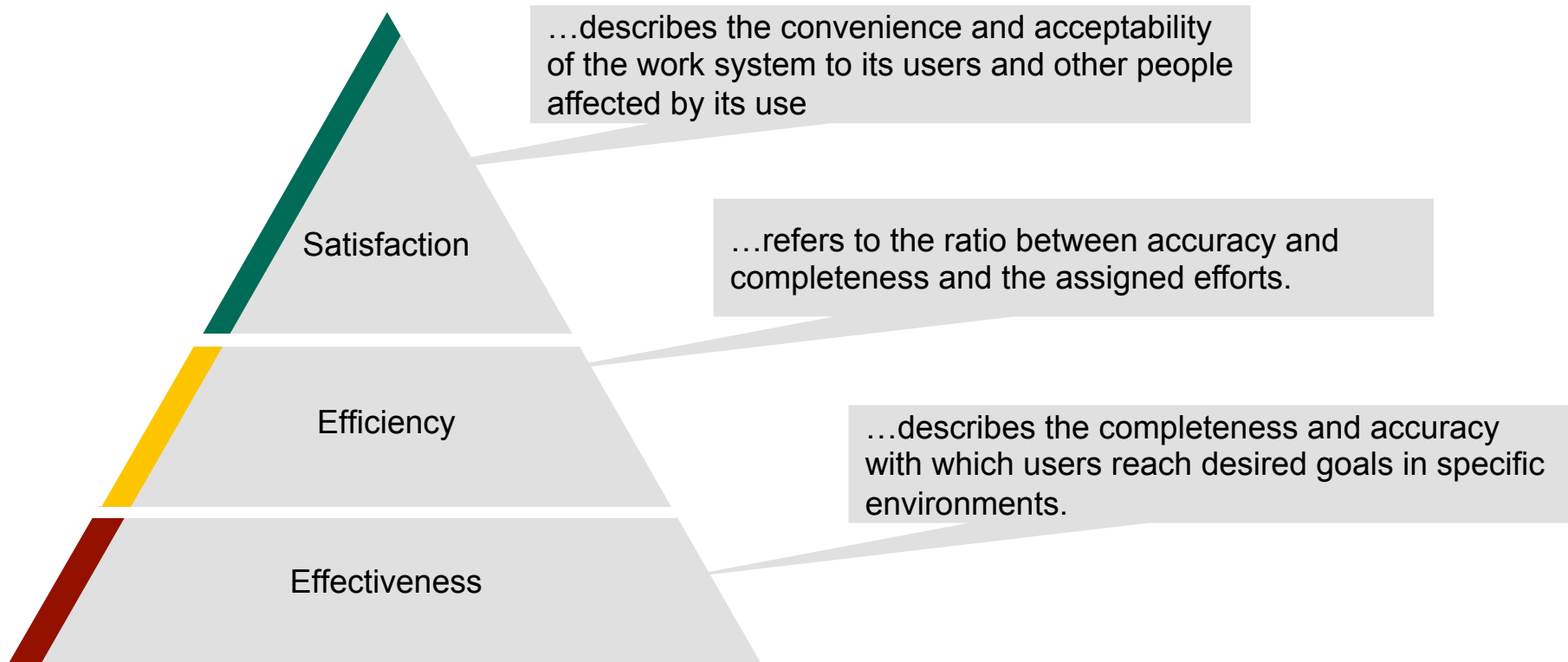
Requirement definition dependent of step 1 and 2

3. Design solutions

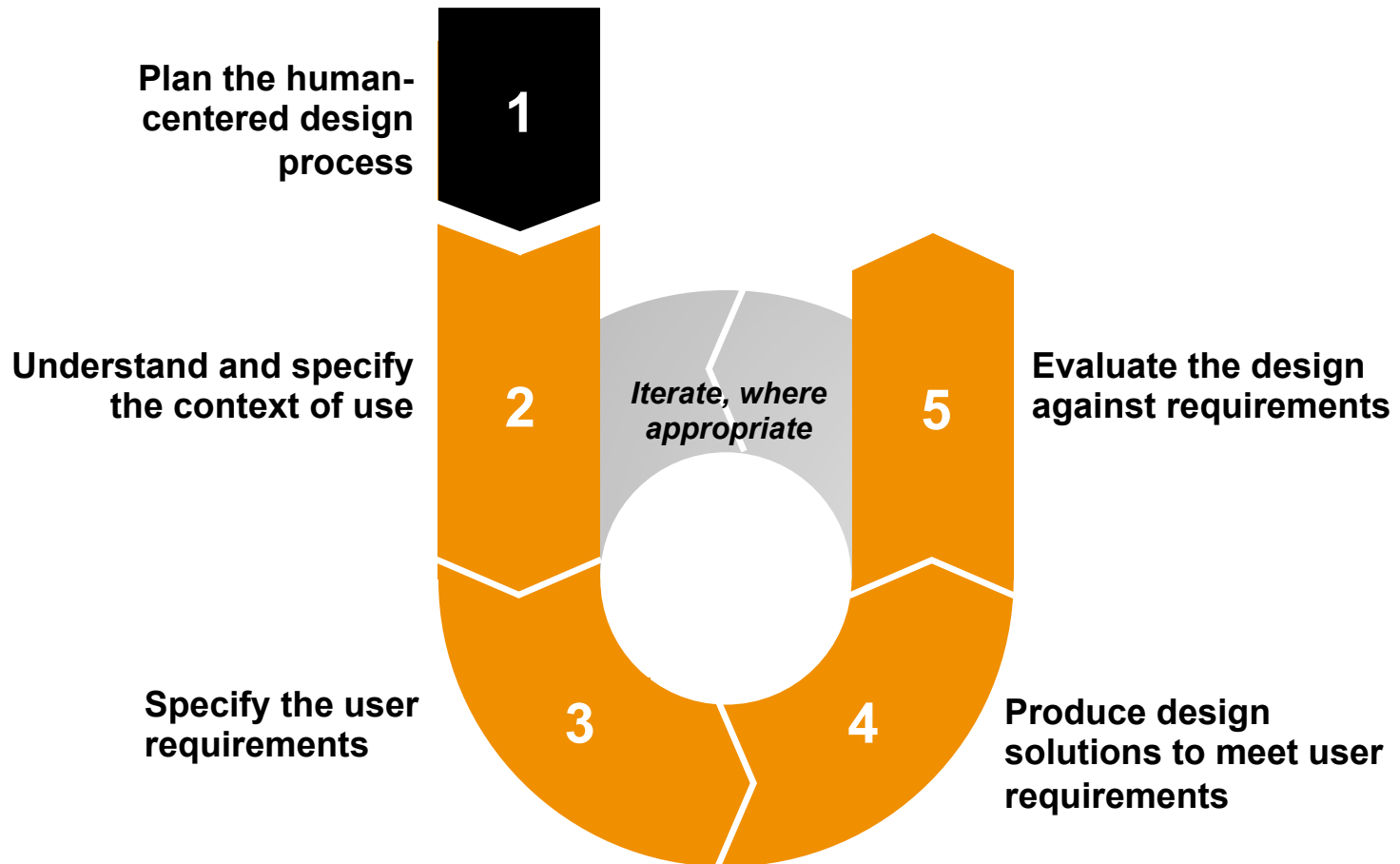
- Development of various design solutions base on requirements

Usability (ISO 9241-11)

"The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use."



Usability Engineering (ISO 9241-210)



Approach of the 1st and 2nd usability study

Objectives

Methodology

Results

1st Study

Which design solution is more understandable and cause fewer errors?

Test design:

- User Testing – Wizard of OZ
- Retrospective thinking aloud

Sample:

- 26 Participants
- European, Asian, Arab

- Identification and classification of errors (type)
- Preferred design solution

2nd Study

Causes the revised interaction design, fewer errors?

Test design:

- Same test design in order to ensure comparability of results

Sample:

- 21 Participants

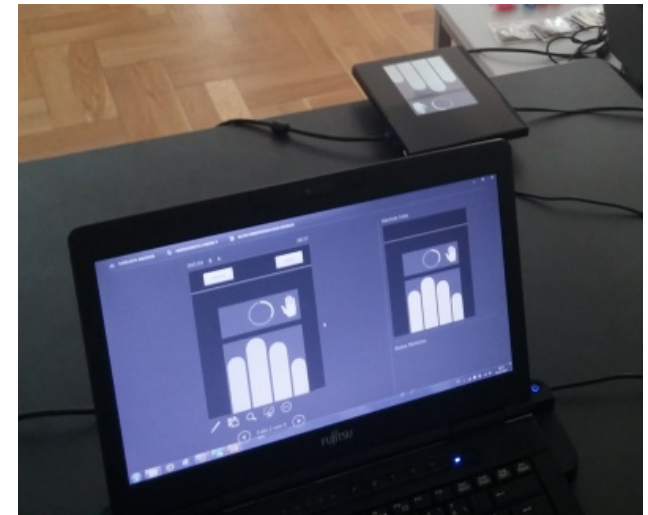
The revised interaction design causes fewer errors.

Approach of the 1st and 2nd usability study

Wizard of Oz – Method for usability testing in an early development stage

Definition: '[...] describe a testing or iterative design methodology wherein an experimenter (the "Wizard"), in a laboratory setting, simulates the behavior of a theoretical intelligent computer application [...].'¹

- Exploring requirements at an early stage of design process
 - Not necessary to create a functional prototype
- Cost effective and easy way to gain feedback from the user



¹ Kelley, J. F. (1984). An iterative design methodology for user-friendly natural-language office information applications. ACM Transaction on Office Information Systems, 2, 26-41.

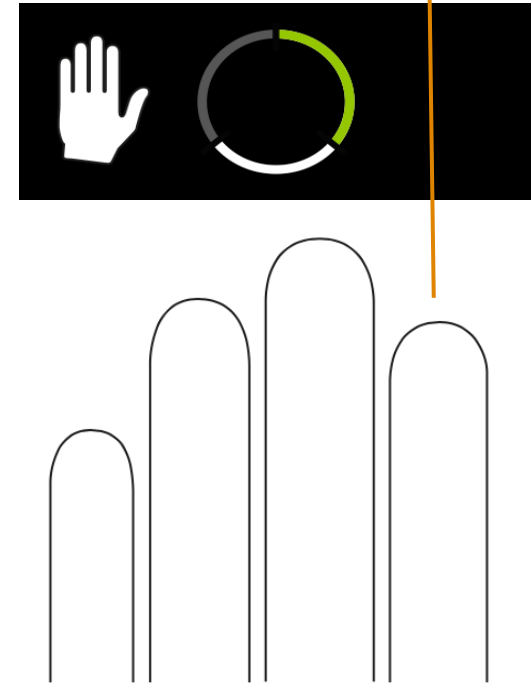
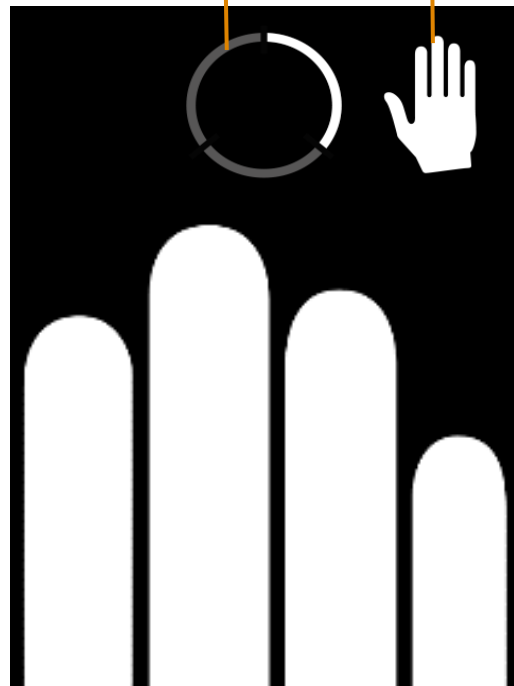
Visual and/or haptic feedback?

Circle for capture progress?

Flashing hand for prompting?

FP ridges or just blank?

White on black or vice versa?

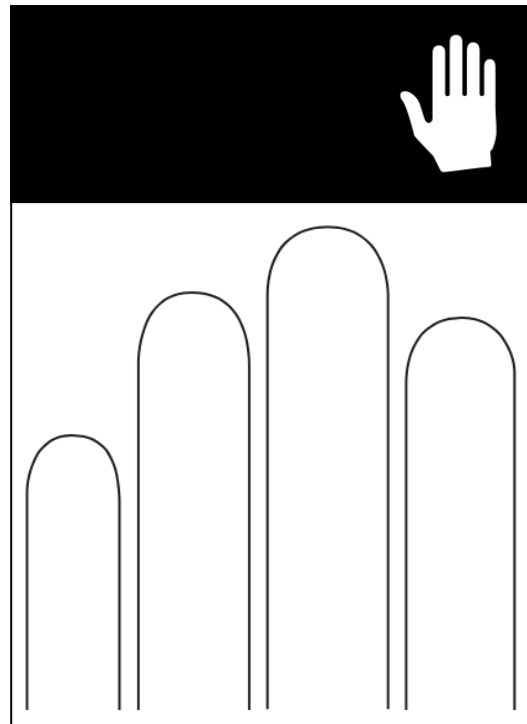


Finally selected design/approach

No progress of capture
workflow

Pulsing hand

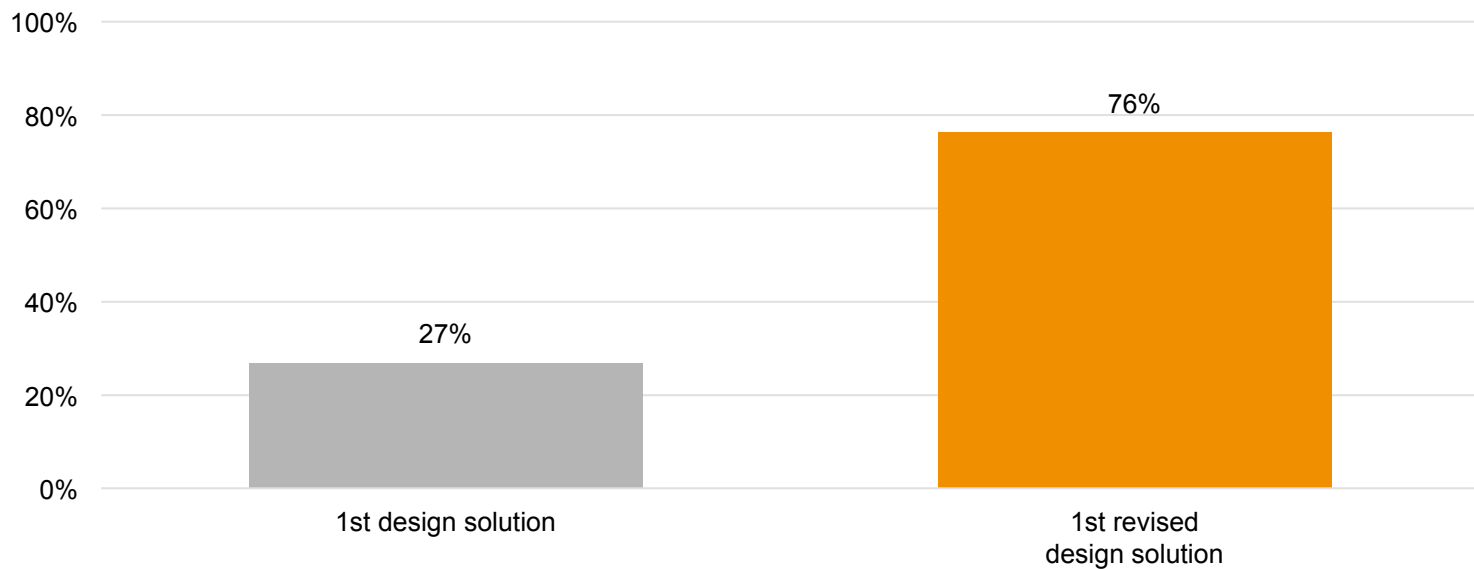
White light, black outlines



Results of the 1st and 2nd usability study (1st Iteration)

Error reduction in every process step

Interaction without any error



Approach of the 3rd usability study (now with a working scanner)

Objectives

Can users use the scanner without any help?

Do users understand the corrective actions, if they do an error?

Methodology

Test design:

- Usability-Test with error counting
- Retrospective thinking aloud

Sample:

- 54 Participants
- Age between 16 and 75 years
- European, Asian, Arab, American

Results

Users can use the device without guidance (i.e. guided by an officer)

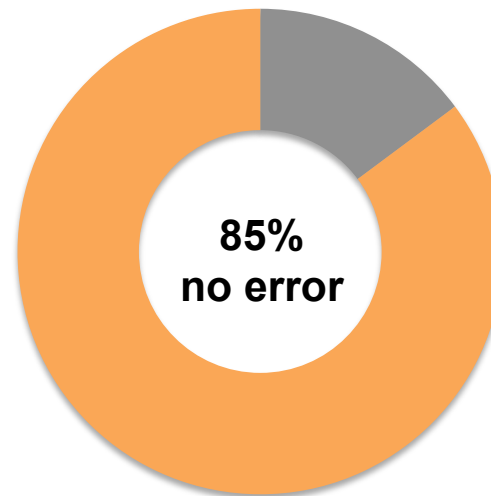
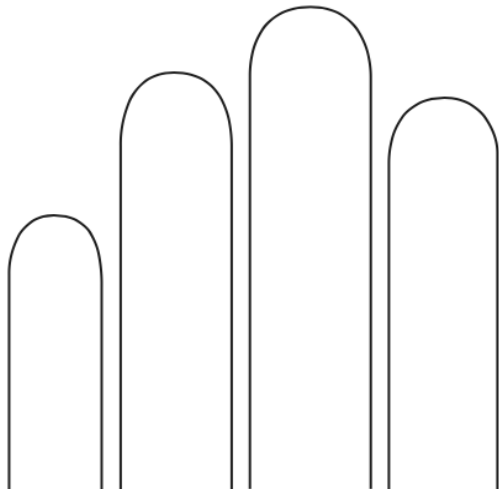
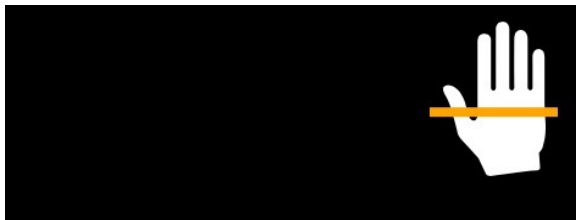
Users have problems to interpret some of the corrective actions*

3rd Study

*Interpretation of the corrective actions difficult, because the context for this actions is essential for intuitive understandability

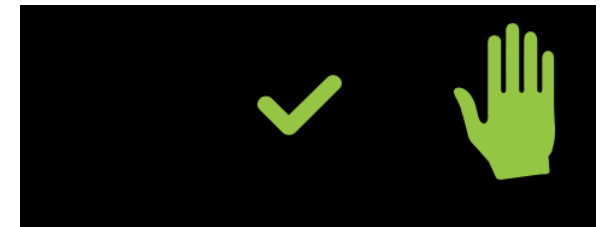
Standard 4-4-2 workflow

Start right hand

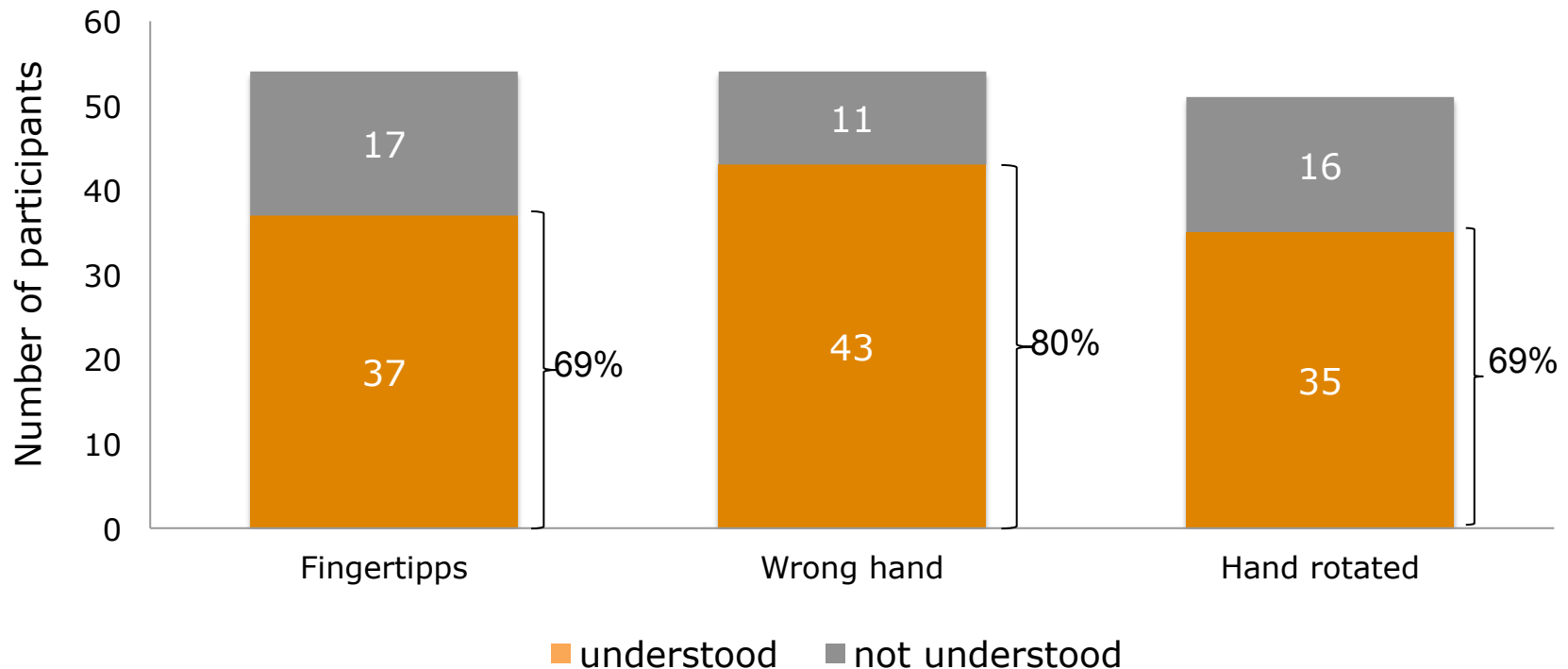
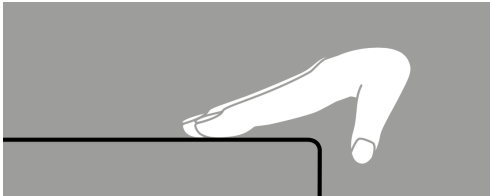


■ Error ■ No error

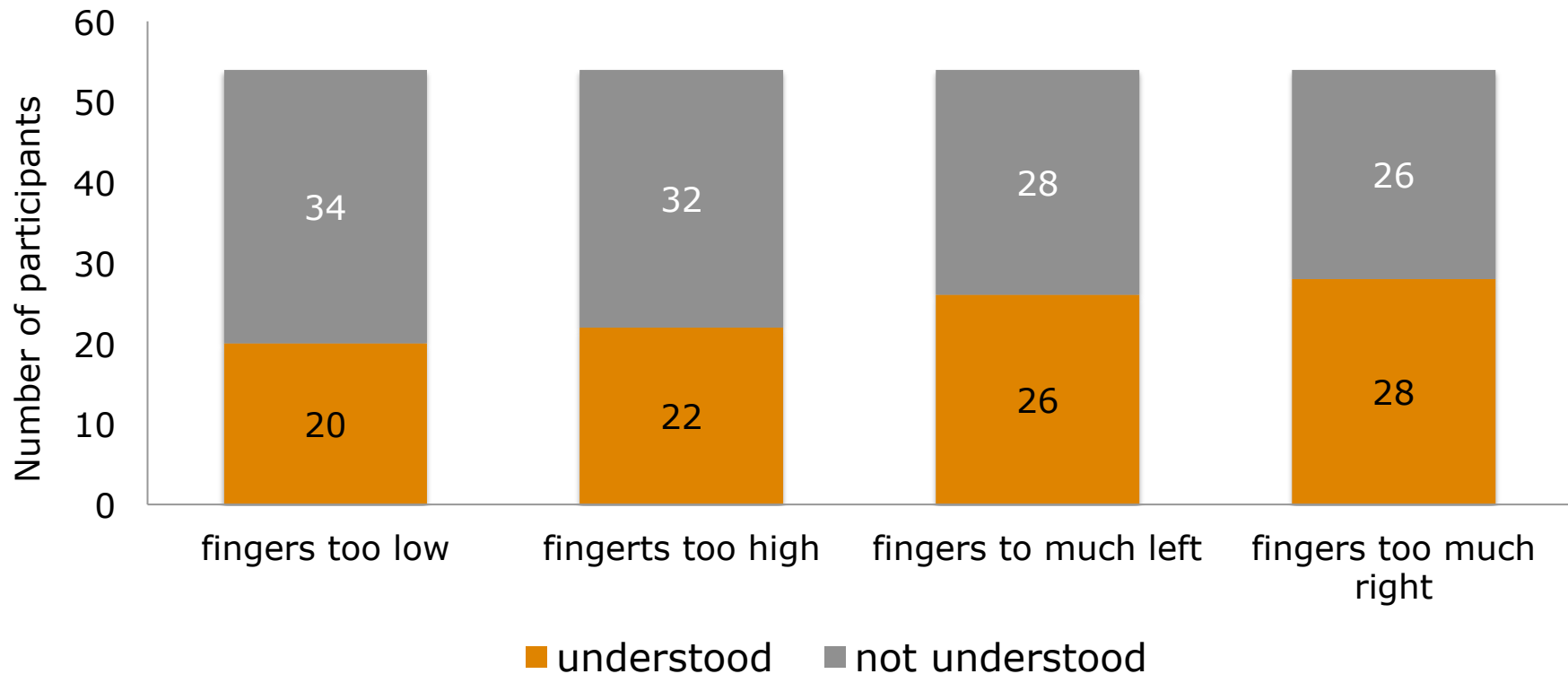
Complete right hand



Well understood corrective actions



Only partially understood corrective actions



Provide a target – not just the direction

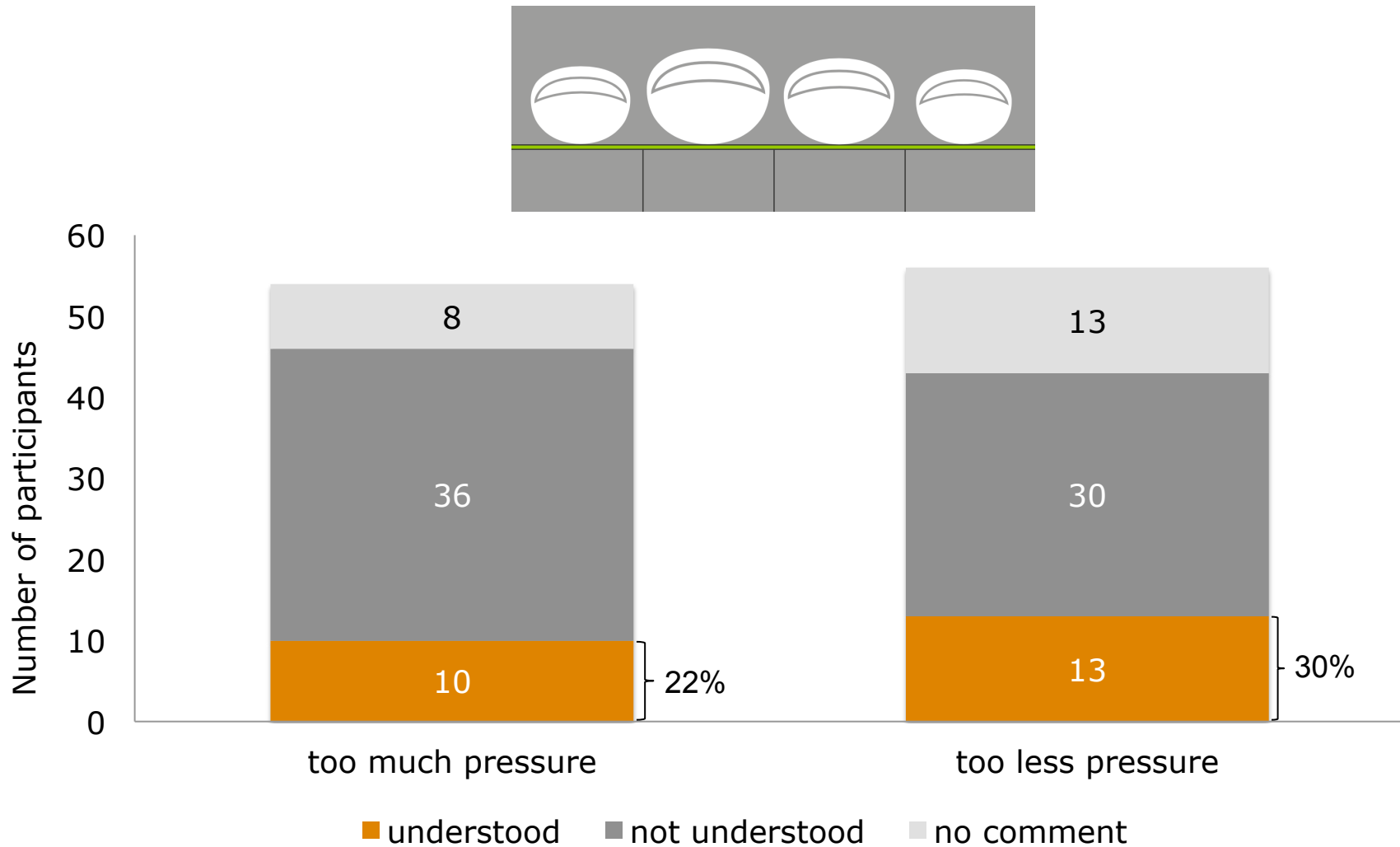
Fingers over the upper edge



Fingers over the right edge



Pressure: Not understood corrective actions



Summary

Don't let engineers (only) design the user interface.
Work with pros and real users.

Small details make big difference.

This is an never ending story.
Flexible user interface is essential.

Thank you for your attention!



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Daniel Schubert, Frank Dittrich, Thomas Seeling

Roberto Wolfer

