an evaluation of the influence of external factors on authentication performance and memorability
External Factors

ATM:

- Position of the ATM
- Audio / visual signals
- Haptic feedback
- Color coding
- Input device
- Arrangement of the controls

Fig. 1

Fig. 2

Fig. 3

Fig. 4
PinPad - Designs

Phone-Layout  Fig. 4

Calculator-Layout  Fig. 5

Line-Layout  Fig. 6
How to memorize numbers

Different strategies:

- Learn by heart
- Learn visual patterns
- Learn motoric patterns
- Association to given knowledge

**Visual memory [1]:**
- our mind's eye
- Used in the T-Com spot „11833“

**Motor memory [2]:**
- repeatedly trained movement
- Used in touch typing
User Study

Goal:

- Performance-Test of motorically and visually trained users on different numpad layouts.

Method:

- 66 participants in 2 groups
- Long-term study (2 months)
- 2 phases:
  - Training (group 1)
  - Test (group 1 + 2)
- Test runs at 2-3 Days a week

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ATM performance
User Study II

Testcases:

• Phone-Layout
• Calculator-Layout
• Random-Layout
• Line-Layout

Hypotheses:

• Users are motorically and visually trained to the phone layout:
  ➢ Best performance for phone layout
  ➢ Worst performance for random layout
  ➢ Line and calculator layout in between

Fig. 11

Fig. 13
First Results - Survey

How do you memorize your pin?

- 30%: „Numpads and pinpads look the same“
- 9%: „789 in the first row“

- 64%: By heart
- 19%: Visual pattern
- 17%: Motoric pattern
First Results - Training

Training affects waiting time
First Results - Performance

![Graph showing ATM performance](Image)

- **phone (trained)**
- **phone (untrained)**
- **calc (trained)**
- **calc (untrained)**

- **time (sec)**
  - run
  - wait
  - input

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ATM performance
any questions?
Sources: Figures

Fig. 1:  http://hackedgadgets.com/2006/12/01/atm-pin-numbers-hacked/
Fig. 2:  http://commons.wikimedia.org/wiki/File:Japanese_ATM_Palm_Scanner.jpg
Fig. 3:  http://www.electronicsweekly.com/blogs/engineering-design-problems/2008/08/an-extremely-inconvenient-atm.html
Fig. 4:  http://commons.wikimedia.org/wiki/File:ATM_pinpad_in_german.jpg
Fig. 5:  http://www.co-opcreditunion.com/pix/atm_keypad.jpg
Fig. 6:  http://www.flickr.com/photos/chocogato/3850825632/
Fig. 7:  http://commons.wikimedia.org/wiki/File:Telefon_t-sinus-700.jpg
Fig. 8:  http://www.edelweissair.ch/d/shop/smstool/
Background / related work


First Results – Backup

![Bar chart showing ATM performance](chart.png)

- **Phone (trained)**
- **Phone (untrained)**
- **Rand (trained)**
- **Rand (untrained)**

**Axes:**
- X-axis: Phone (trained), Phone (untrained), Rand (trained), Rand (untrained)
- Y-axis: Time (sec)

**Legend:**
- Blue: Run
- Red: Wait
- Green: Input
First Results – Backup

ATM performance