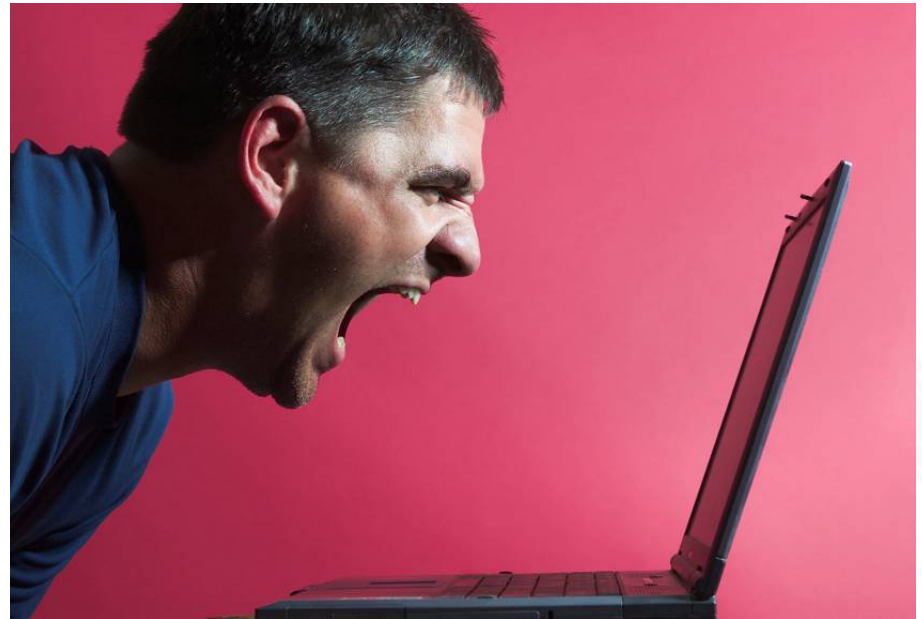


## *Lecture 10*

# Design of Mobile Applications & Services: HCI Issues



Mobile Business II (SS 2017)

Prof. Dr. Kai Rannenberg

Deutsche Telekom Chair of Mobile Business & Multilateral Security  
Goethe University Frankfurt a. M.

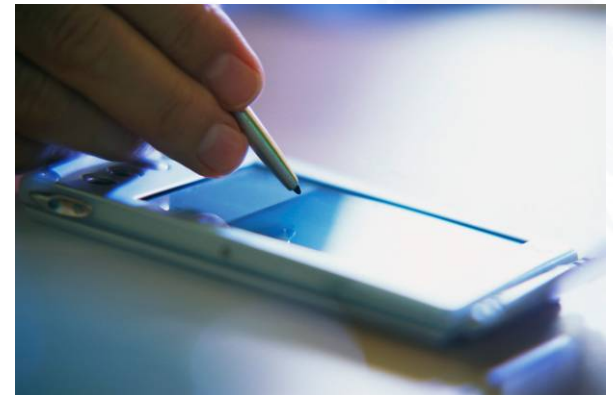
- Introduction to HCI
- Mobile Interaction Styles
- Mobile Interaction Design
  - Understanding Users
  - Developing Prototype Designs
  - Evaluation
- Example of Enhanced App Store

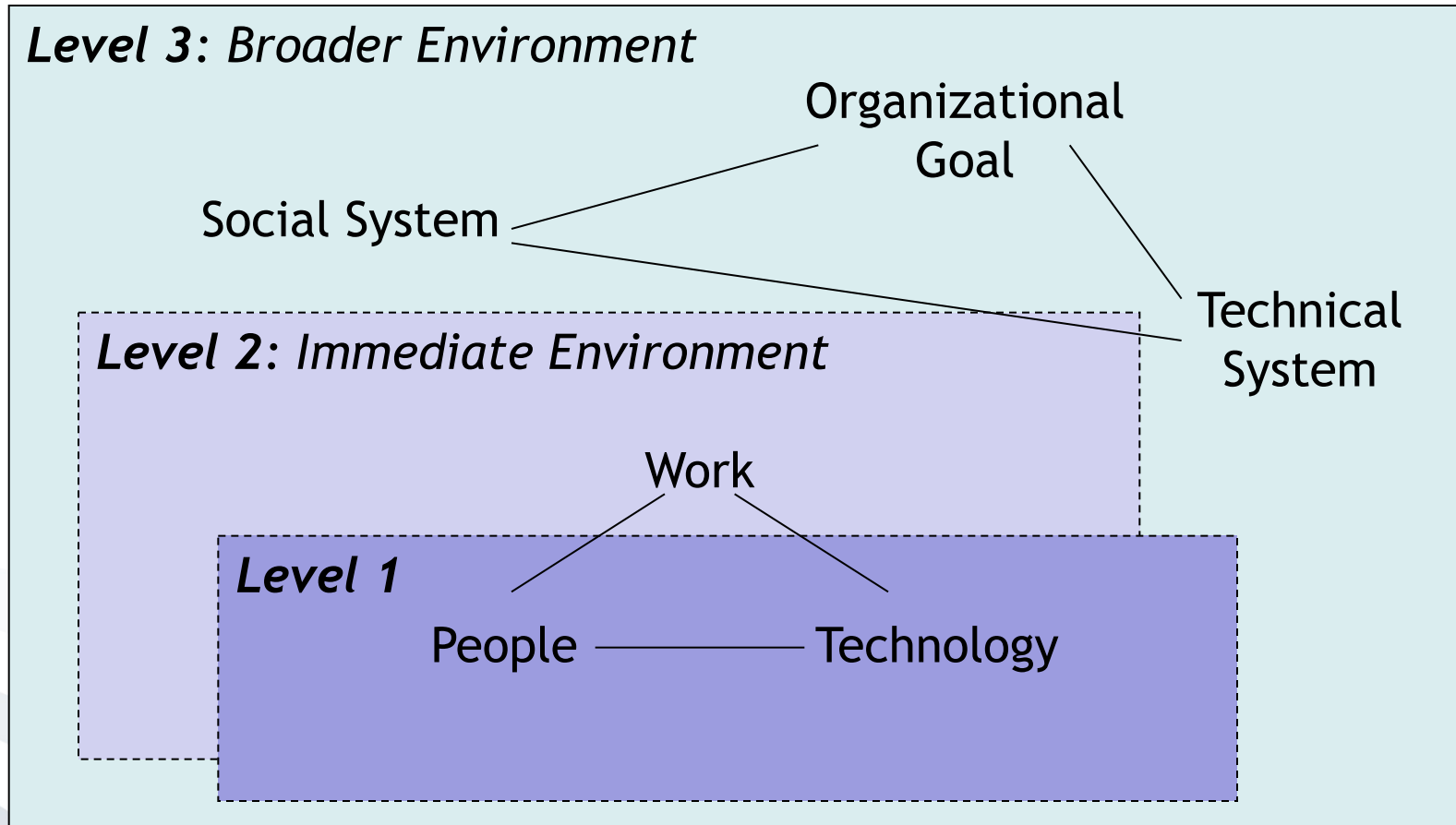
“Human-computer interaction is a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them.”

[Hewett et al. 1992]

“Human-computer interaction is the scientific study of the interaction between people, computers, and the work environment.”

[BeardPeterson1988]





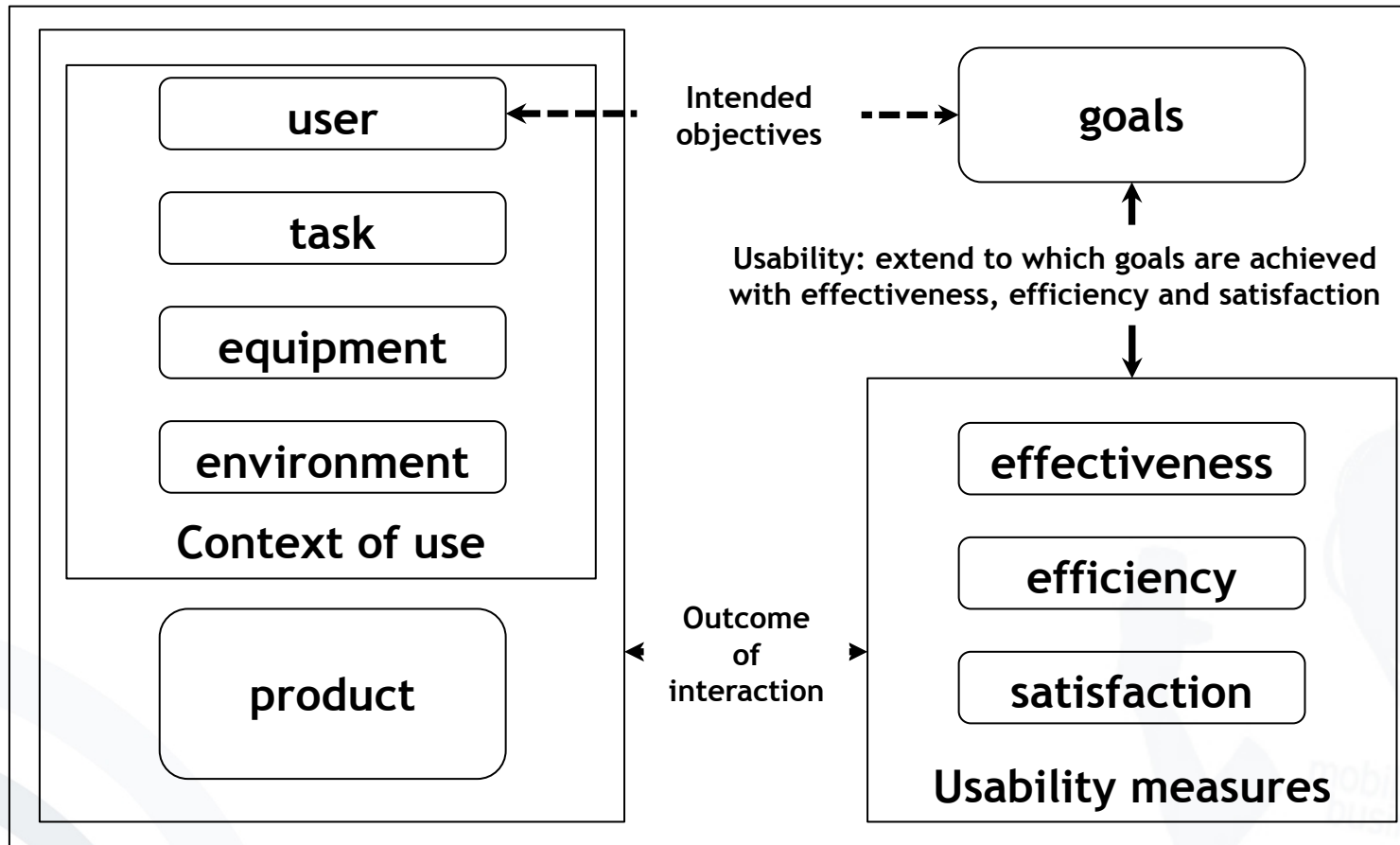
# Definition of Usability

*Usability is 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.”*

# Elements of Usability Definition

- **effectiveness:** Accuracy and completeness with which users achieve specified goals.
- **efficiency:** Resources expended in relation to the accuracy and completeness with which users achieve goals.
- **satisfaction:** Freedom from discomfort, and positive attitudes towards the use of the product.
- **context of use:** Users, tasks, equipment (hardware, software and materials), and the physical and social environments in which a product is used.
- **user:** Person who interacts with the product.
- **goal:** Intended outcome.
- **task:** Activities required to achieve a goal.
- **product:** Part of the equipment (hardware, software and materials) for which usability is to be specified or evaluated.

# Usability Framework

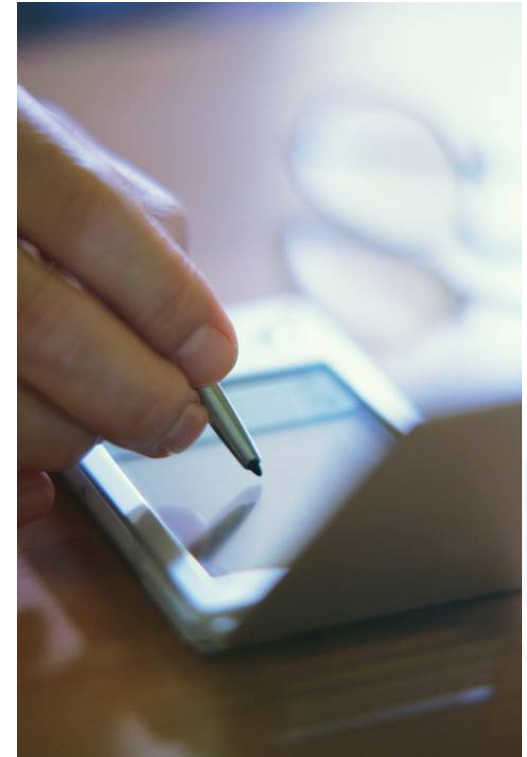


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The interaction between users and mobile devices is multidimensional.

- Text entry
- Speech input
- Menu navigation
- MultiTouch
- Earcons
- Metaphors



Possible interaction via text entry:

- Keyboard entry
- Touch screen
  - Recognition of handwriting
  - Palm-Graffiti
  - Virtual keyboard
  - Swype
- Tegic T9
- Octave
- ...

- Text entry via classic keyboard solution.
- For higher mobility, keyboards become foldable and virtual.



Source: [www.palm.com](http://www.palm.com)



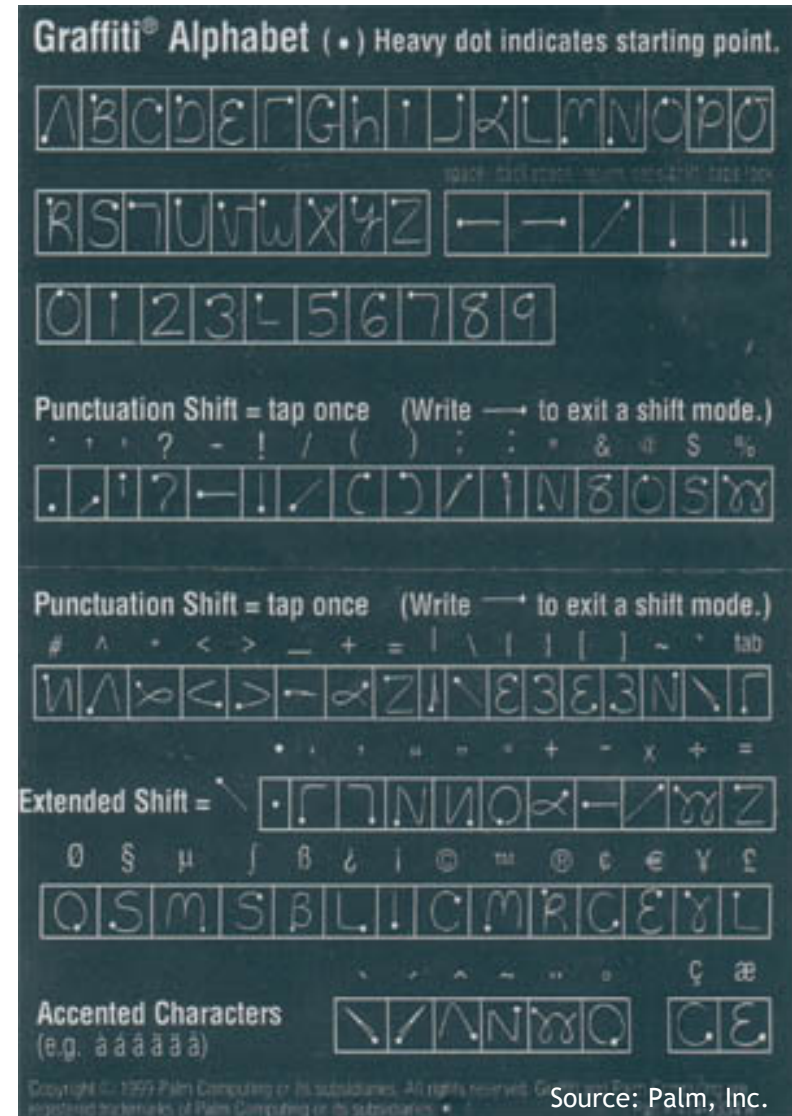
Source: iBIZ Technology Corp

➡ Adaptation of a traditional text entry concept

# Mobile Interaction Styles

## Text Entry - Touch Screen

- Handwriting recognition software
- Artificial script, based on upper-case characters
- Can be drawn blindly with a stylus on a touch-sensitive panel



- Virtual keyboard on the screen
- Can be used with a stylus or with fingers



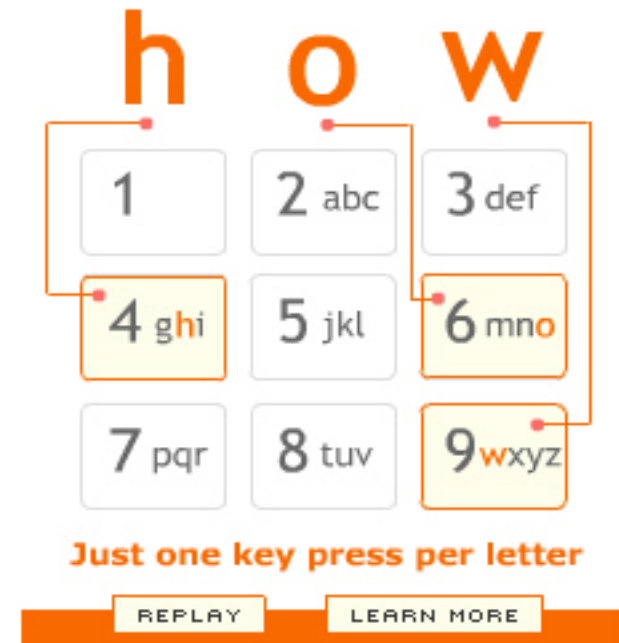
Source: HTC, Inc.

- Swype is an input method for touch screens developed by Swype Inc.
- Available on Samsung, HTC, and also on Android and Symbian.
- Three major components: An input path analyzer, word search engine with corresponding database, and a manufacturer customizable interface.
- Available on >40 languages.



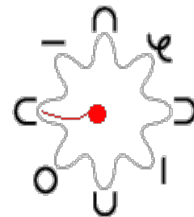
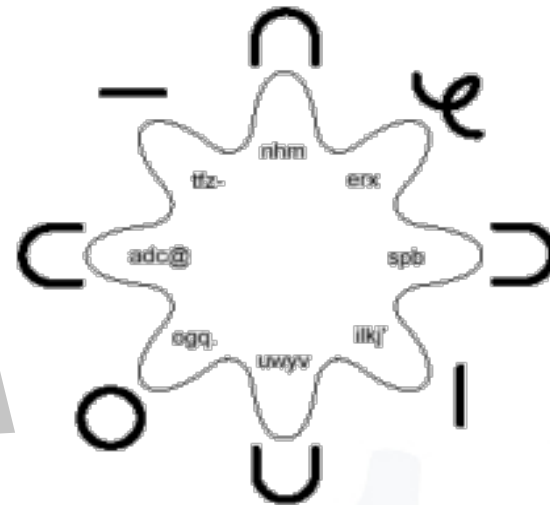


- T9 (*Text on 9 keys*) is a predictive text technology developed by Tegic Communications.
- Widely used by: LG, Samsung, Nokia, Siemens, Sony Ericsson, Sanyo
- Uses a dictionary of words, which is used to look up all the possible words, corresponding to the sequence of keys pressed.
- Available in 27 languages



Source: [www.t9.com](http://www.t9.com)

- 



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# Mobile Interaction Styles

## Speech Input

- Speech input relies on speech recognition technologies used by the mobile application.
  - *Speaker-dependent*  
Recognition technologies “learns” from a set of sample words spoken by the user (system training).
  - *Speaker-independent*  
Pre-defined vocabulary that has been set up by a large number of speech samples.





- Mobile phone applications usually have a hierarchically structured navigation menu providing a list of menu choices.
- Menu hierarchies are often not self-explanatory (switching costs for users).
- Long menu lists can overload the users' short-term memory.

### connect your memory card to a computer

You can use a cable connection to access your phone's memory card with a PC.

**Note:** When your phone is connected to a computer, you can only access the memory card through the computer.

On your phone:

**Disconnect the cable** from your phone, if it is connected, then press  >  **Settings**  
> Connection > USB Settings > Default Connection  
> Memory Card.

This directs the USB connection to your memory card.

Source: Motorola



# Mobile Interaction Styles

## Touch Screen - Multi-touch

- Input by using gestures
- Up to three (or more) fingers simultaneously



Source: Wikipedia

- Earcons are abstract musical tones that produce sound messages to represent parts of an interface.
- Event-driven:
  - Incoming text messages
  - Alarm clock
  - ...
- Menus augmented with earcons can support user navigation.



- Interface metaphors work by applying prior knowledge from a familiar to a new domain.
- Goal: Reducing people's perception of the complexity of the device used.

[Love2005]



Source: Nokia



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## Main activities of effective interaction design

### Understanding users

(Capabilities and limitations)

### Developing prototype designs

(Demonstration of proposed interaction design)

### Evaluation

(Identification of strengths and weaknesses of a design)

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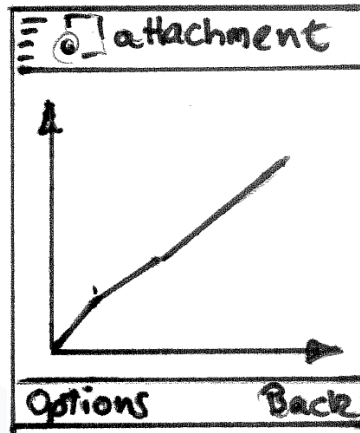


- For an effective interaction design, it is necessary to understand potential users of a system.
- Possible methodologies
  - Field studies (observe and probe a particular group in situations of interest)
  - Laboratory experiments (observe and probe a particular group within a controlled environment)
  - Direct questionnaire (e.g. to validate impressions and interpretations from the field)

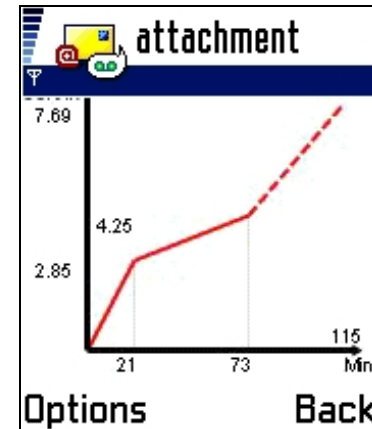
- The user group needs to have a significant impact on the design process.
- User-centered service design can significantly affect the user's perception of mobile devices and services.
- Examples of user characteristics:
  - **Spatial ability:**  
dealing with spatial relations and visualization of spatial tasks
  - **Verbal ability:**  
comprehend spoken or written words
  - **Working memory:**  
limited capacity of short-term memory
  - **Previous experience:**  
user's experience with an actual interface used

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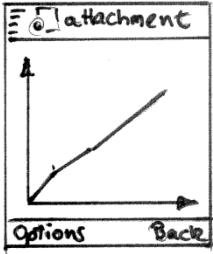
- HCI-Prototypes are built in order to express a design idea as quickly as possible.
- One can differentiate how closely a prototype resembles the appearance of the final product.



Low-fidelity



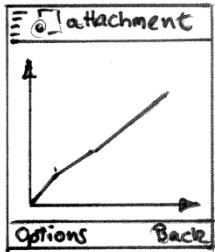
High-fidelity



### Low-fidelity

The prototype uses materials different to those in the final incarnation.

- Check for inconsistency
- Give a common specification for the design team
- Afford reflection
- Check interaction scenarios



### Basic Layouts

Display Defaults

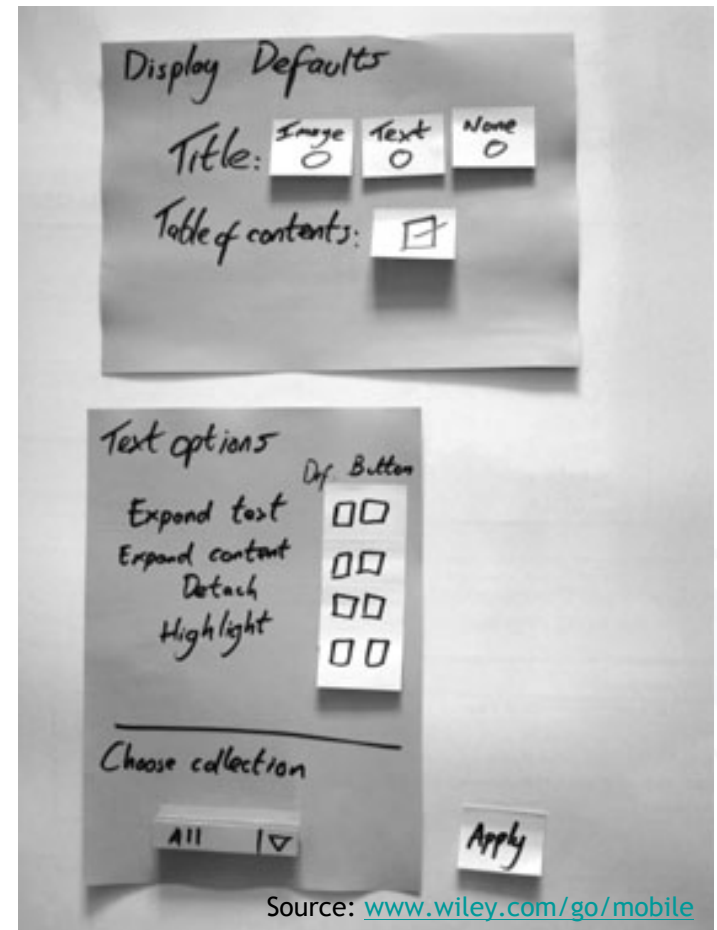
Title: ☒ Image ☐ Text ☐ None

Table of contents ☒

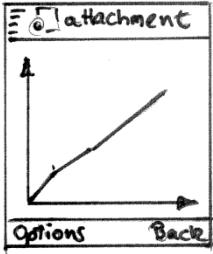
Text Options

	Default Button	
Expand Text	<input type="checkbox"/>	<input type="checkbox"/>
Expand Content	<input type="checkbox"/>	<input type="checkbox"/>
Detach	<input type="checkbox"/>	<input type="checkbox"/>
Highlight	<input type="checkbox"/>	<input type="checkbox"/>

Choose collection



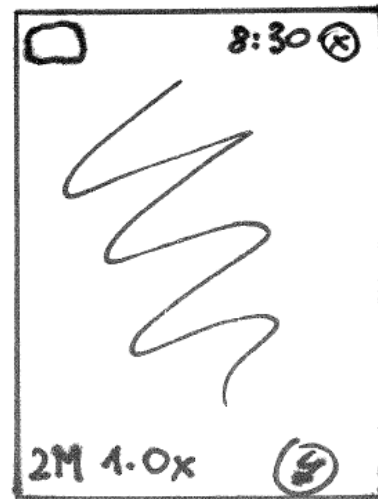
Source: [www.wiley.com/go/mobile](http://www.wiley.com/go/mobile)



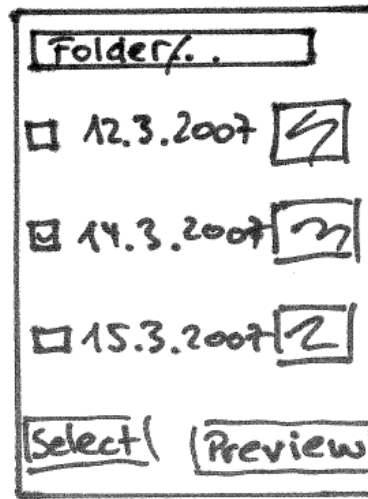
### Self-Checking

Building a low-fidelity prototype for testing the feasibility of ideas

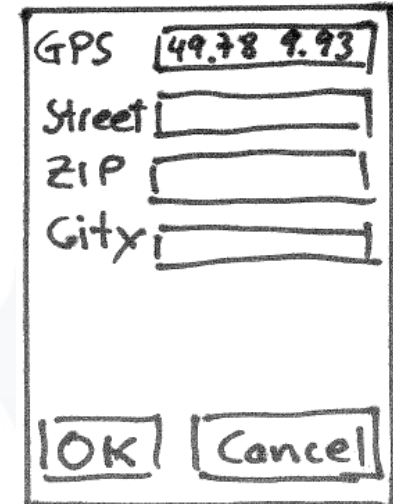
Example:



Take pictures

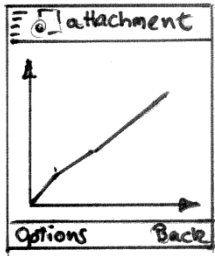


Choose a picture



Get location via  
GPS or manual input

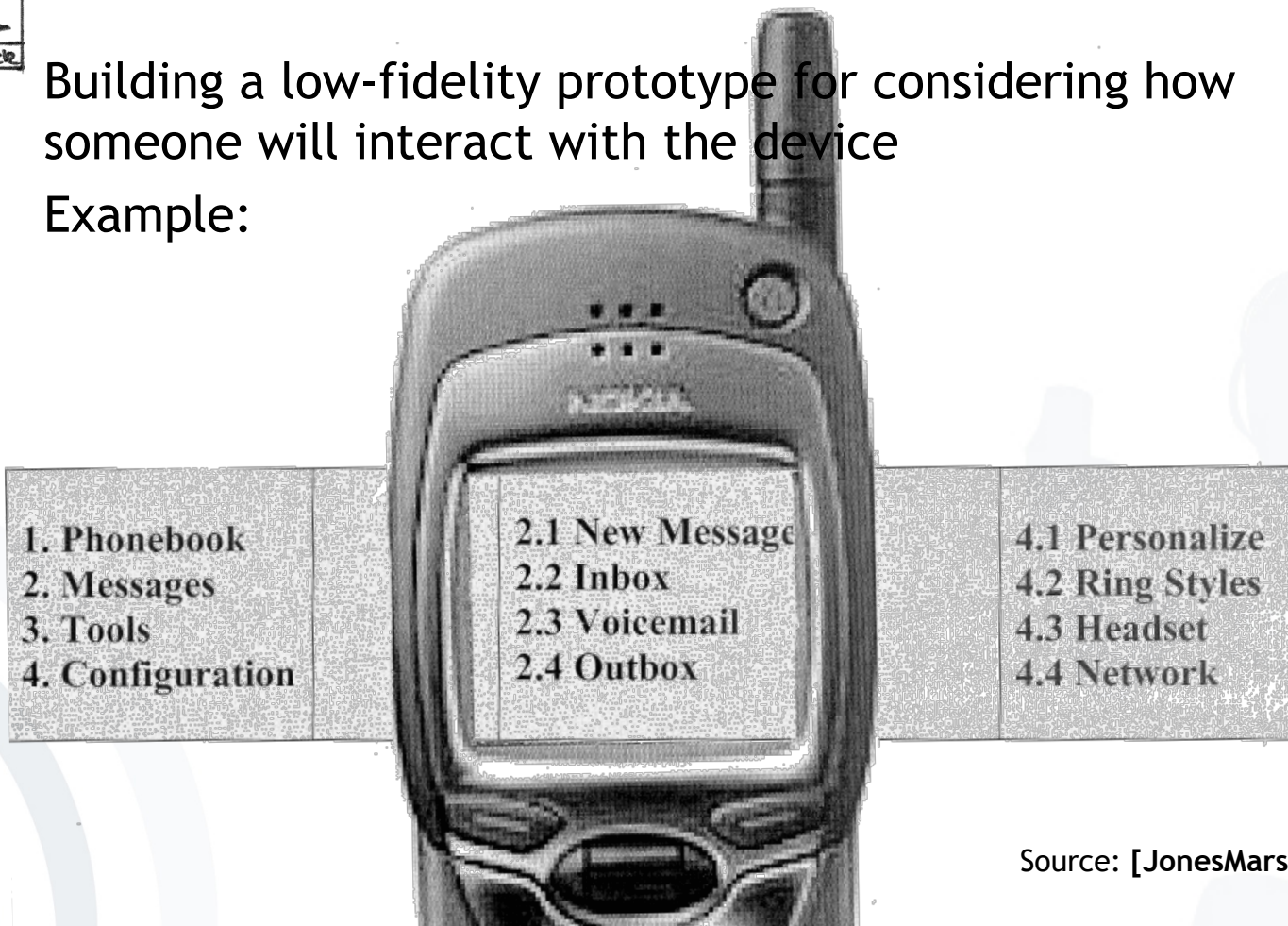




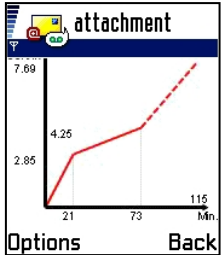
### Interaction prototyping

Building a low-fidelity prototype for considering how someone will interact with the device

Example:

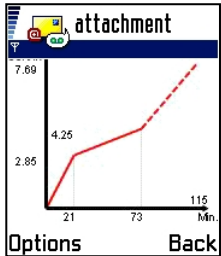






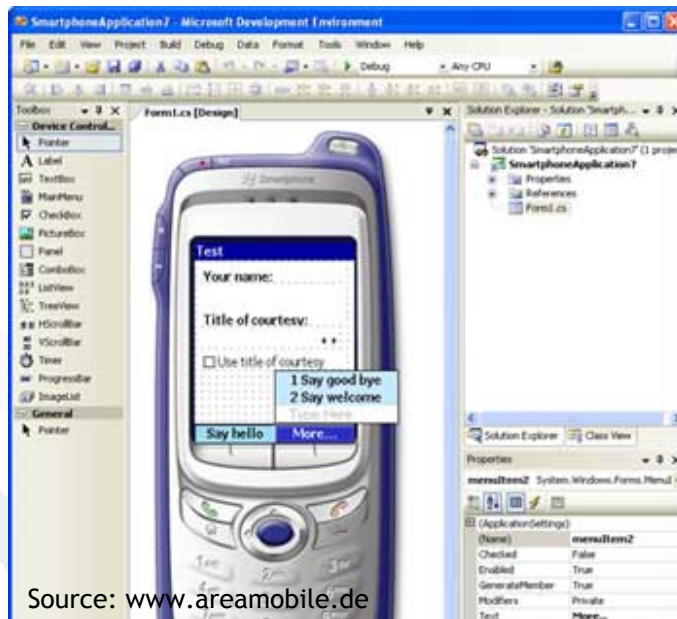
### High-fidelity

- The results of a low-fidelity prototyping process comprise a list of features that should be tested with representatives of the target group.
- High-fidelity prototype designs provide the functionality to evaluate critical tasks and functionalities that should be supported by the final product.
- Therefore, most critical features must be identified to be included in the prototype design.



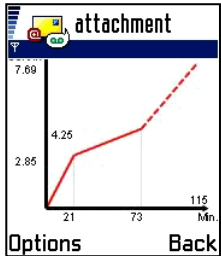
## PC-based prototype designs...

... can be developed by using standard programming environments (e.g. Visual Studio) and software emulators



Source: [www.areamobile.de](http://www.areamobile.de)



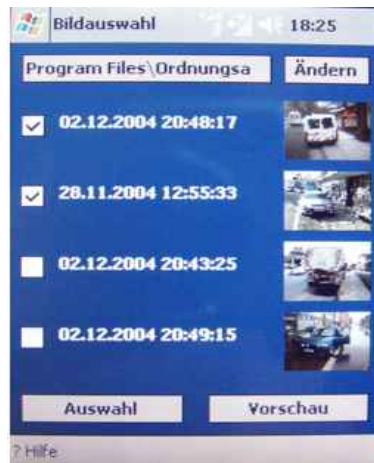


### Platform-specific prototype designs

... can provide a proof-of-concept and can be used for evaluations



Take pictures



Choose a picture



Get location via GPS or manual input



# Mobile Interaction Design

## Key Issues in HCI Prototyping

Type	Advantages	Disadvantages
Low-fidelity	<ul style="list-style-type: none"> <li>▪ Less time</li> <li>▪ Lower costs</li> <li>▪ Evaluate multiple concepts</li> <li>▪ Useful for communication</li> <li>▪ Address screen layout issues</li> </ul>	<ul style="list-style-type: none"> <li>▪ Little use for usability test</li> <li>▪ Navigation and flow limitation</li> <li>▪ Facilitator driven</li> <li>▪ Poor detail in specification</li> </ul>
High-fidelity	<ul style="list-style-type: none"> <li>▪ Partial functionality</li> <li>▪ Interactive</li> <li>▪ User-driven</li> <li>▪ Clearly defined navigation scheme</li> <li>▪ Use for exploration and test</li> <li>▪ Marketing tool</li> </ul>	<ul style="list-style-type: none"> <li>▪ Creation time-consuming</li> <li>▪ Inefficient for proof-of-concept</li> <li>▪ Blinds users for major representational flaws</li> <li>▪ Users may think prototype is 'real'</li> </ul>

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### Why evaluation?

- Understanding how users will use the design in the real world,
- Comparing different prototype designs,
- Assessing whether the product to be developed meets usability requirements, and
- Ensuring that the product conforms to industry standards.

- The evaluation of HCI prototype designs can be based on different methodologies addressing different aspects, e.g.:
  - Direct observation
  - Interviews
  - Questionnaires
  - Experiments
  - ...

### Direct observation

Observe or video users how they use the HCI design in order to check, for e.g.:

- the intuitive and correct usage of design by the users,
- ability of users to manage pre-defined tasks.

- **Conducted by:** End-Users
- **Equipment:** Interactive prototype
- **Results:** Qualitative
- **Where:** Controlled setting



## Interviews

- Often made in conjunction with observations
- Provision of direct feedback from the users
- Observed problems can be addressed

- **Conducted by:** End-Users
- **Equipment:** Interactive prototype
- **Results:** Qualitative
- **Where:** Controlled setting

## Questionnaires

- Tool for gathering users' opinions
- Tool for comparing different designs by using quality scales
- Example: *I was able to enter text easily*

Disagree [1] [2] [3] [4] [5] Agree

- **Conducted by:** End-Users
- **Equipment:** Interactive prototype & Questionnaire
- **Results:** Qualitative & Quantitative
- **Where:** Controlled setting

## Experiments

- Usually hypothesis-based  
(e.g. *Navigation within application A is quicker than within application B.*)
- Results provide insight on how much 'better' a certain design is

- **Conducted by:** End-Users
- **Equipment:** Interactive prototype
- **Results:** Qualitative
- **Where:** Controlled setting

- Design shortcomings of products can have different reasons, such as:
  - A lack of user-based evaluation during the design process,
  - Perceived financial costs of better design,
  - An overemphasis on technology over purpose.

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- ✓ Enhance **privacy transparency** and **privacy awareness** in app markets.
- ✓ Foster **informed choice** of apps.
- ✓ Integrate more effective **privacy risk indicators** into app markets.
- ✓ **Develop and evaluate** proof of concept for Google's Play Store.

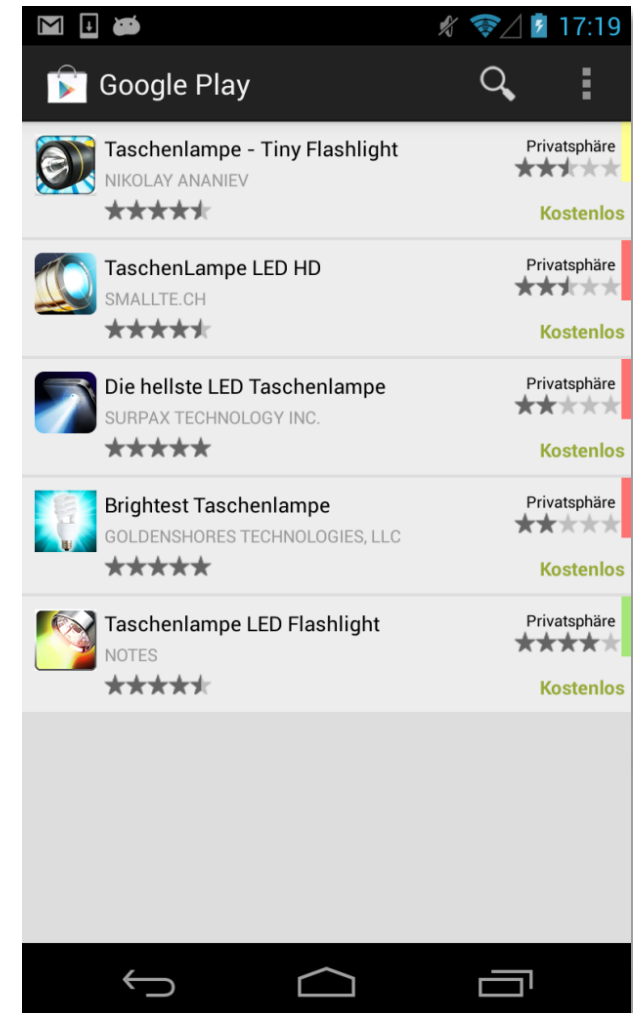
[BalRannenbergl 2014, Bal et al. 2015]



1. Search results enhanced with privacy score.

2. App description enhanced with visual privacy information.

3. App description enhanced with textual privacy information.





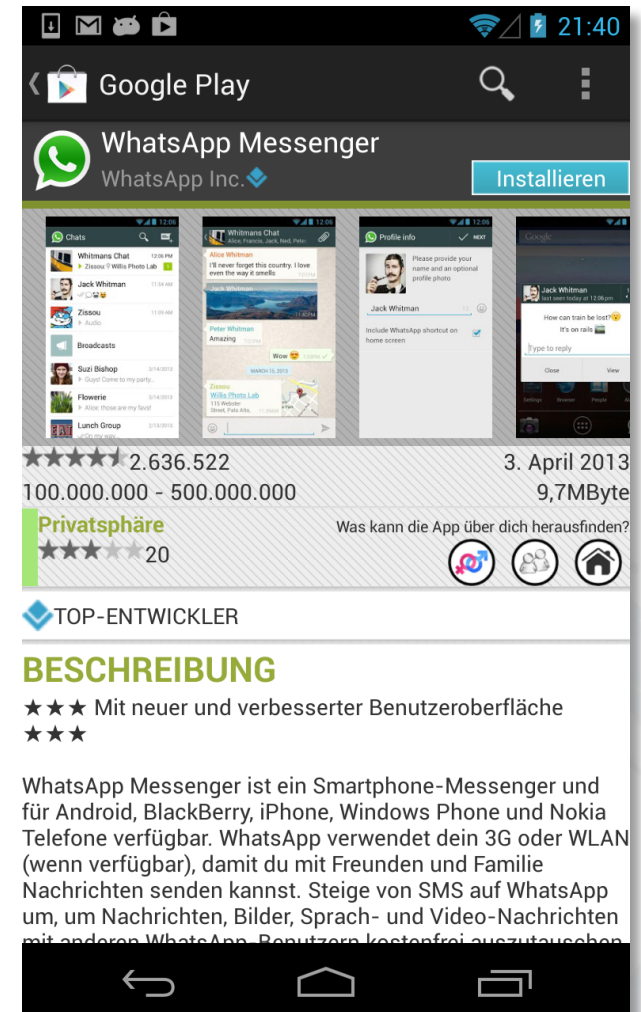
# Privacy Enhanced App Store

## Privacy Indicators

1. Search results enhanced with privacy score.

2. App description enhanced with visual privacy information.

3. App description enhanced with textual privacy information.



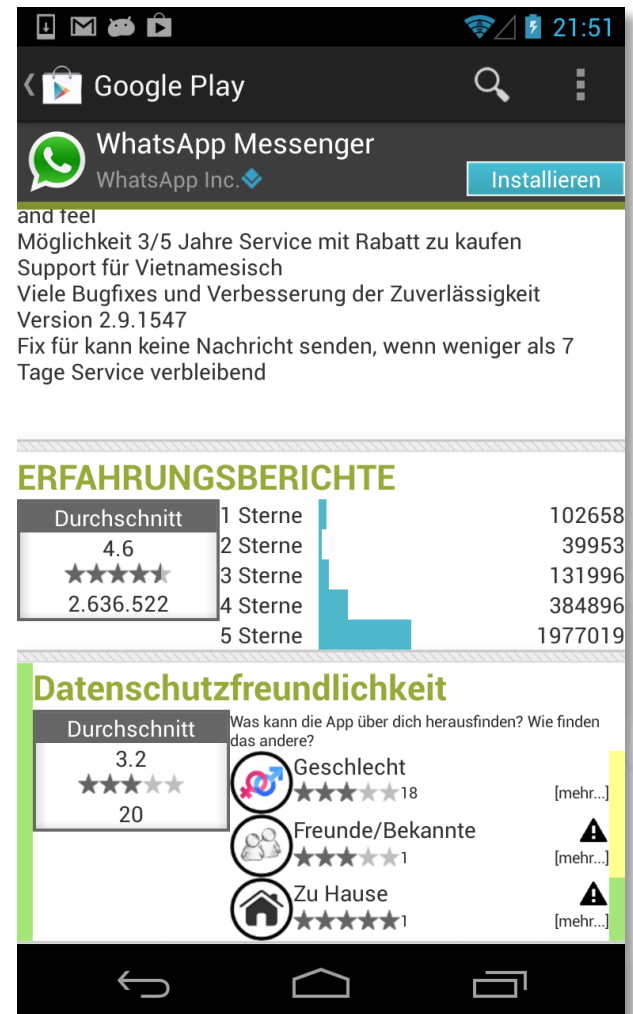
# Privacy Enhanced App Store

## Privacy Indicators

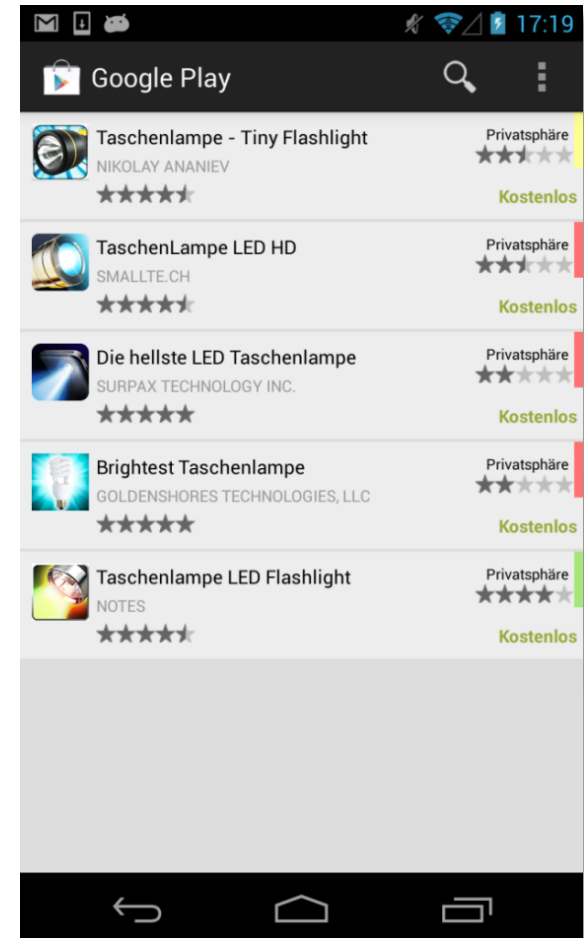
1. Search results enhanced with privacy score.

2. App description enhanced with privacy information.

3. App description enhanced with textual privacy information.



- Result of an experimental user study:  
better privacy risk communication  
leads to:
  - increased privacy and risk awareness,
  - better comprehension of risks,
  - better comparison of apps,
  - privacy as a stronger decision factor,
  - safer app choices.



- [Bal et al. 2015] Gökhan Bal, Kai Rannenberg, Jason Hong: Styx: Privacy risk communication for the Android smartphone platform based on apps' data-access behavior patterns; Pp. 187-202 in Computers and Security, Volume 53, September 2015, doi:10.1016/j.cose.2015.04.004
- [BalRannenberg 2014] Gökhan Bal, Kai Rannenberg: User Control Mechanisms for Privacy Protection Should Go Hand in Hand with Privacy-Consequence Information: The Case of Smartphone Apps", W3C Workshop on Privacy and User-Centric Controls, Berlin, 2014-11-20/21, [https://m-chair.de/images/documents/publications/Position\\_Paper\\_W3C\\_WPUCC\\_Bal\\_\\_Rannenberg.pdf](https://m-chair.de/images/documents/publications/Position_Paper_W3C_WPUCC_Bal__Rannenberg.pdf)
- [BeardPeterson1988] Beard, J.W. and Peterson, T.O. A *Taxonomy for the Study of Human Factors in Management Information Systems*. Human Factors in Management Information Systems, Greenwich, CT, Ablex Publ., pp. 7-26, 1988.
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