

Engineering Human Computer Interaction

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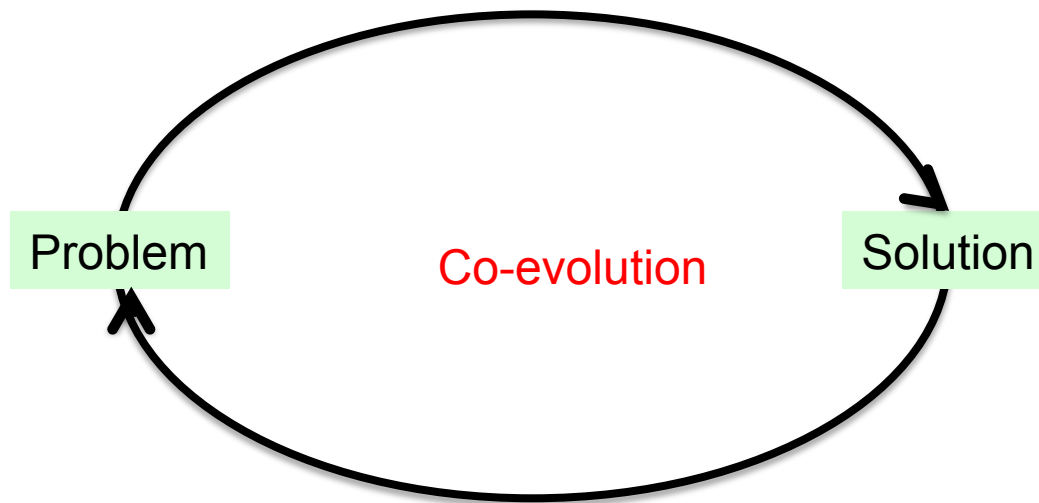
Institut polytechnique de Grenoble
Laboratoire d'Informatique de Grenoble

Core principles

Global picture

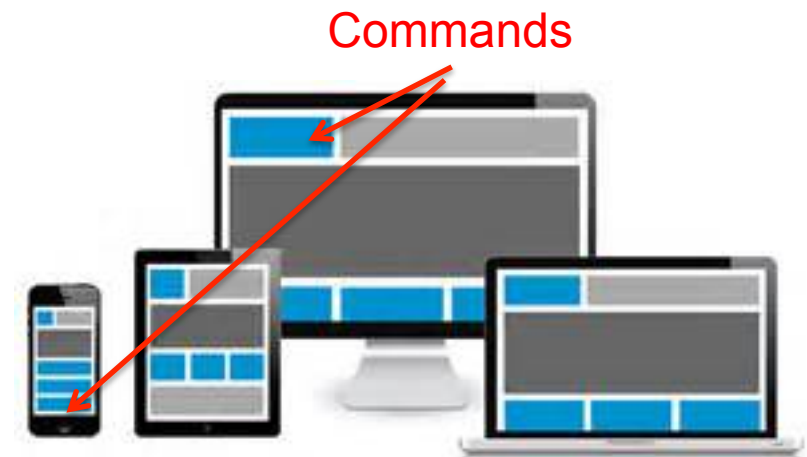
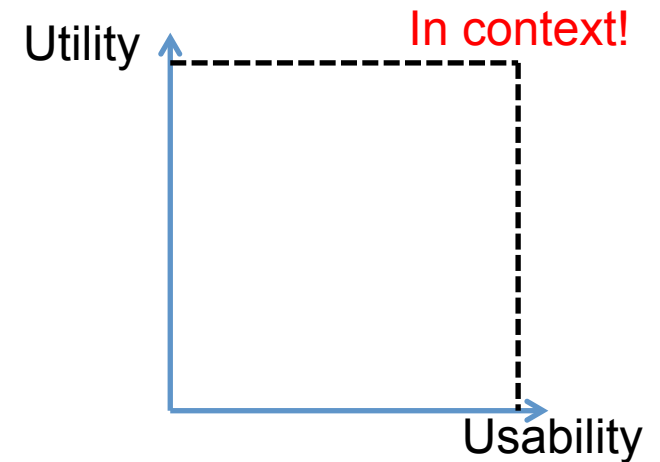
- Users' side

- Designers' side



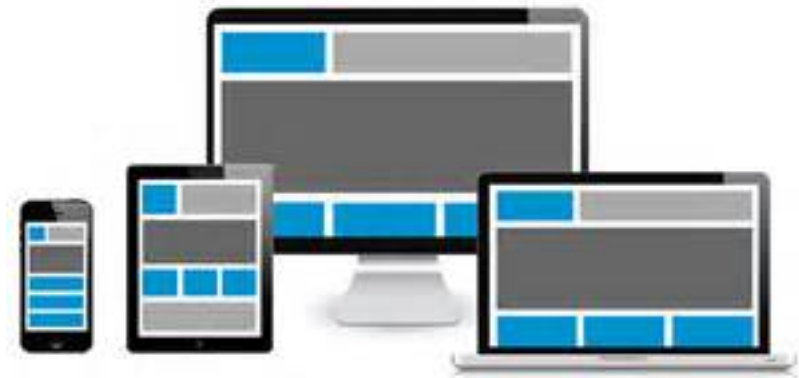
Quality

- Two dimensions
 - Functional quality: services (e.g., user tasks coverage) -> **Utility**
 - Non functional quality: quality of services (e.g., latency) -> **Usability**
- **In context!**
 - User
 - Platform
 - Environment

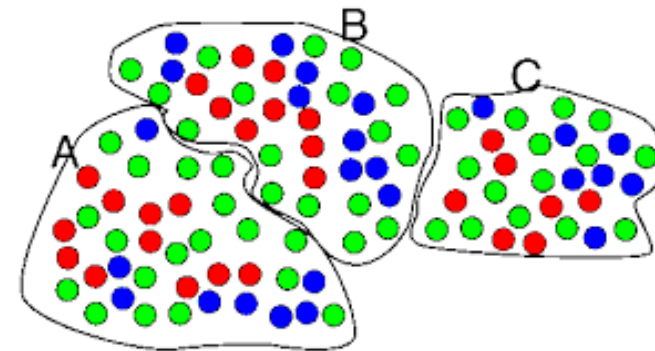


Scalability

- One does not fit all
- From one to many
 - Platform: responsive design -> consistency
 - User: Persona



PERSONA NAME, "Persona categorization"		« Short Persona Quotation »
Narrative Lorem ipsum dolor sit amet, consectetur adipiscing elit. Nam sodales luctus risus ut luctus. In at odio vel elit rhoncus pharetra a eget mi. Suspendisse quam odio, accumsan eget suscipit in, tincidunt vitae magna. Proin tristique nisl ac quam rutrum ut semper metus feugiat. Aenean lobortis, est in semper faucibus, leo arcu faucibus risus, ut dignissim nisi odio Lorem ipsum dolor sit amet, consectetur adipiscing elit. Nam sodales luctus risus ut luctus. In at odio vel elit rhoncus pharetra a eget mi. Suspendisse quam odio, accumsan eget suscipit in, tincidunt vitae magna. Proin tristique nisl ac quam rutrum ut semper metus feugiat. Aenean lobortis, est in semper faucibus, leo arcu faucibus risus, ut dignissim nisi odio Lorem ipsum dolor sit amet, consectetur adipiscing elit. Nam sodales luctus risus ut luctus. In at odio vel elit rhoncus pharetra a eget mi.	Personal Information Job: Lorem ipsum Location: Lorem ipsum Age: Lorem ipsum Status: Lorem ipsum Hobbies: Lorem ipsum	Domain Information Lorem ipsum: Lorem ipsum Service usage: Lorem ipsum Favorites: Lorem ipsum
User Goals Our persona wants to: <ul style="list-style-type: none">• Action 1• Action 2• Action 3• Action 4	Our Business Objectives We want our persona to: <ul style="list-style-type: none">• Action 1• Action 2• Action 3• Action 4	Internet /IT Experience: Lorem ipsum Service usage: Lorem ipsum Favorites: Lorem ipsum
		Delighters « Lorem ipsum »
		Frustrations & Pain Points « Lorem ipsum »



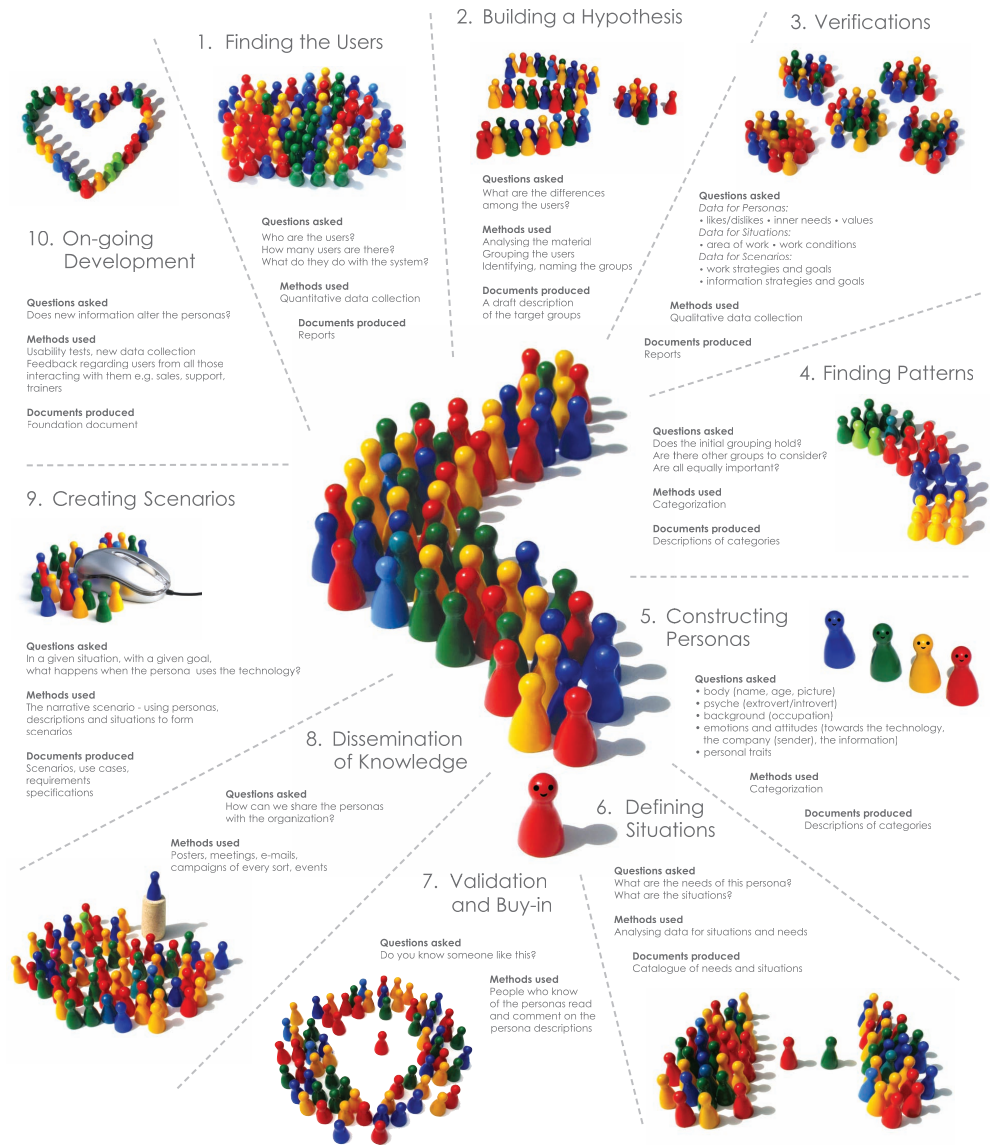
Scalability

- Method
- Cards



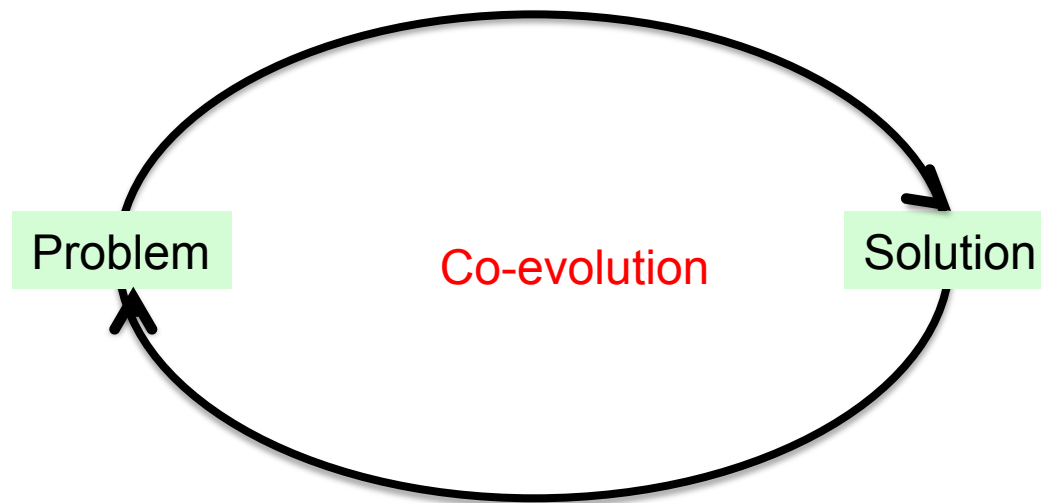
10 Steps to Personas

Based on the method "Engaging Personas and Narrative Scenarios" by Ph.D. Lene Nielsen



Scalability

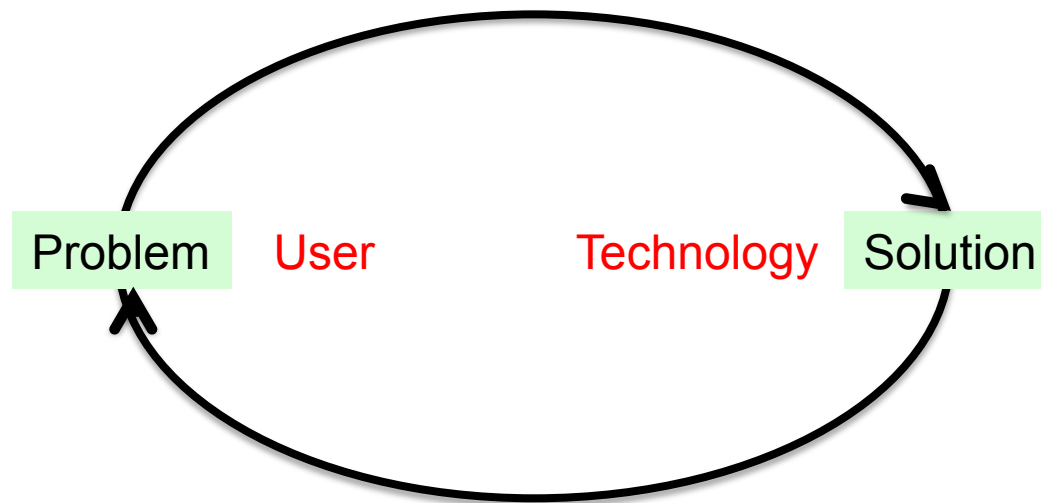
- Users' side: **persona**
- Designers' side: **responsive design**



Focus, foci

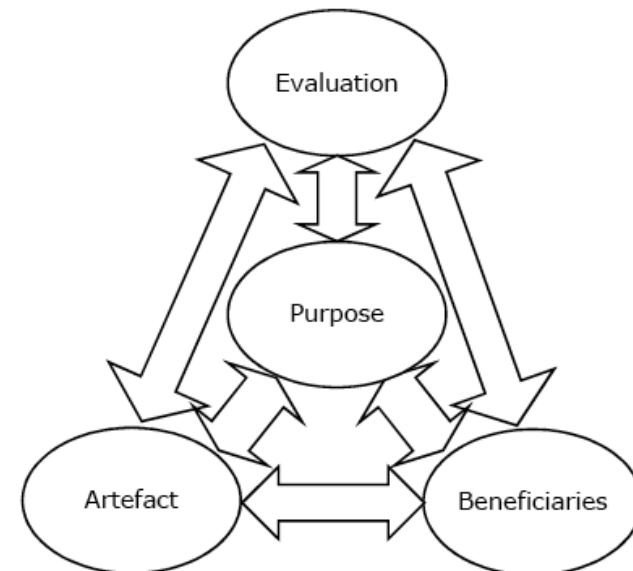
- Users' side

- Designers' side



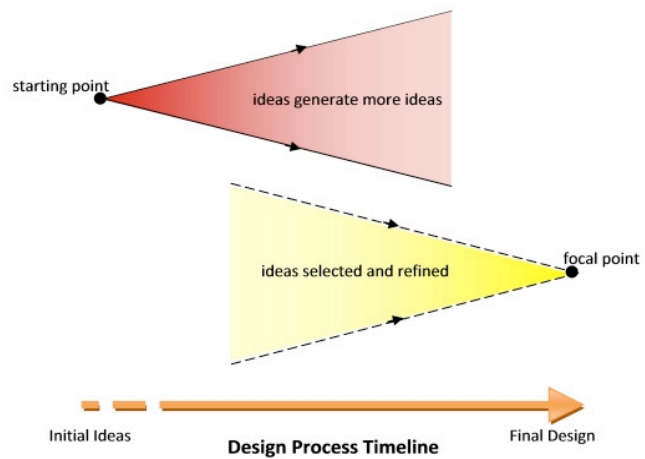
Focus, foci

- From user-centered design to BIG [Cockton 13]
 - **Balanced**
 - **Integrative**
 - **Generous**
- “Design isn't a Shape and it Hasn't Got a Centre: Thinking BIG about Post-Centric Interaction Design”



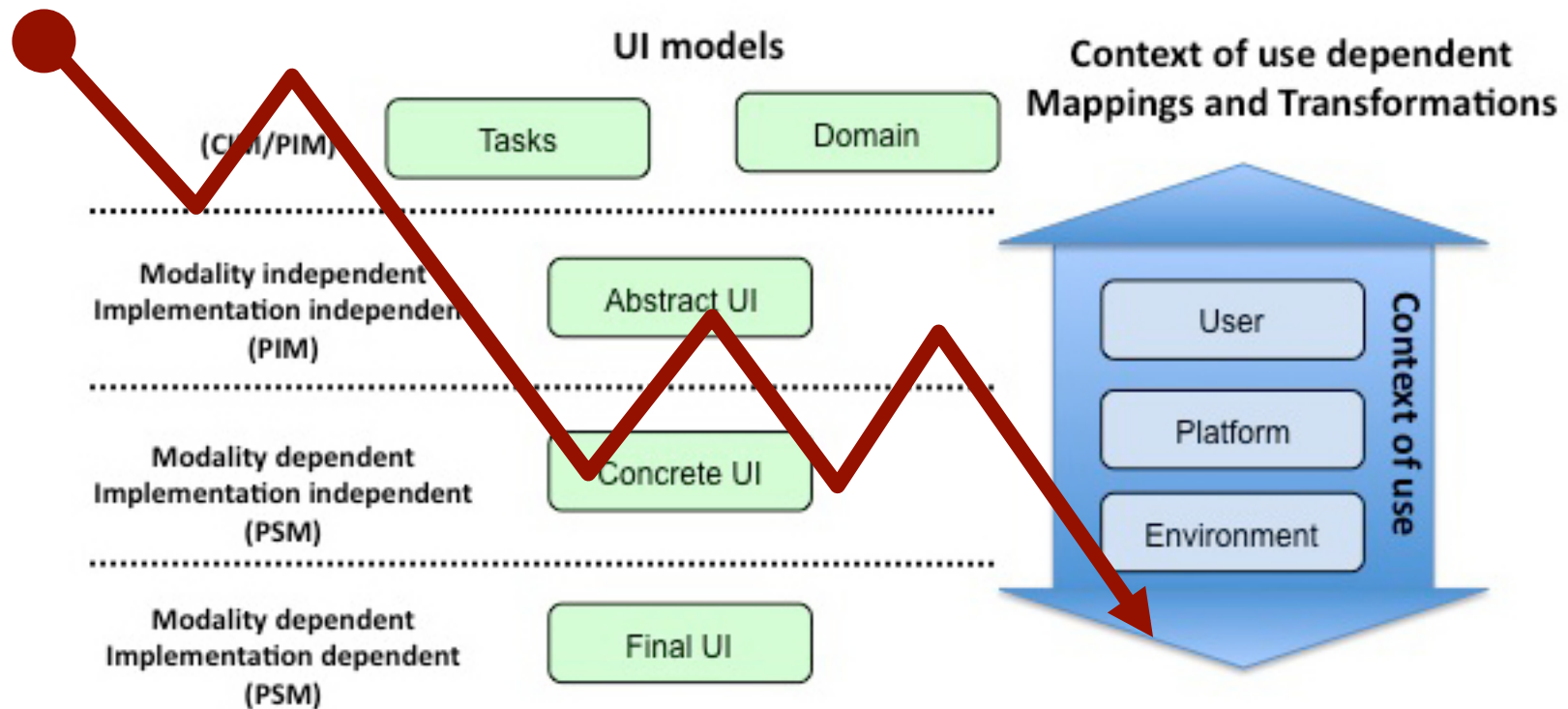
Co-design

- Time! -> best effort, best trade-off
- Design Scape
- Tools!



Generation

Abstraction (W3C)



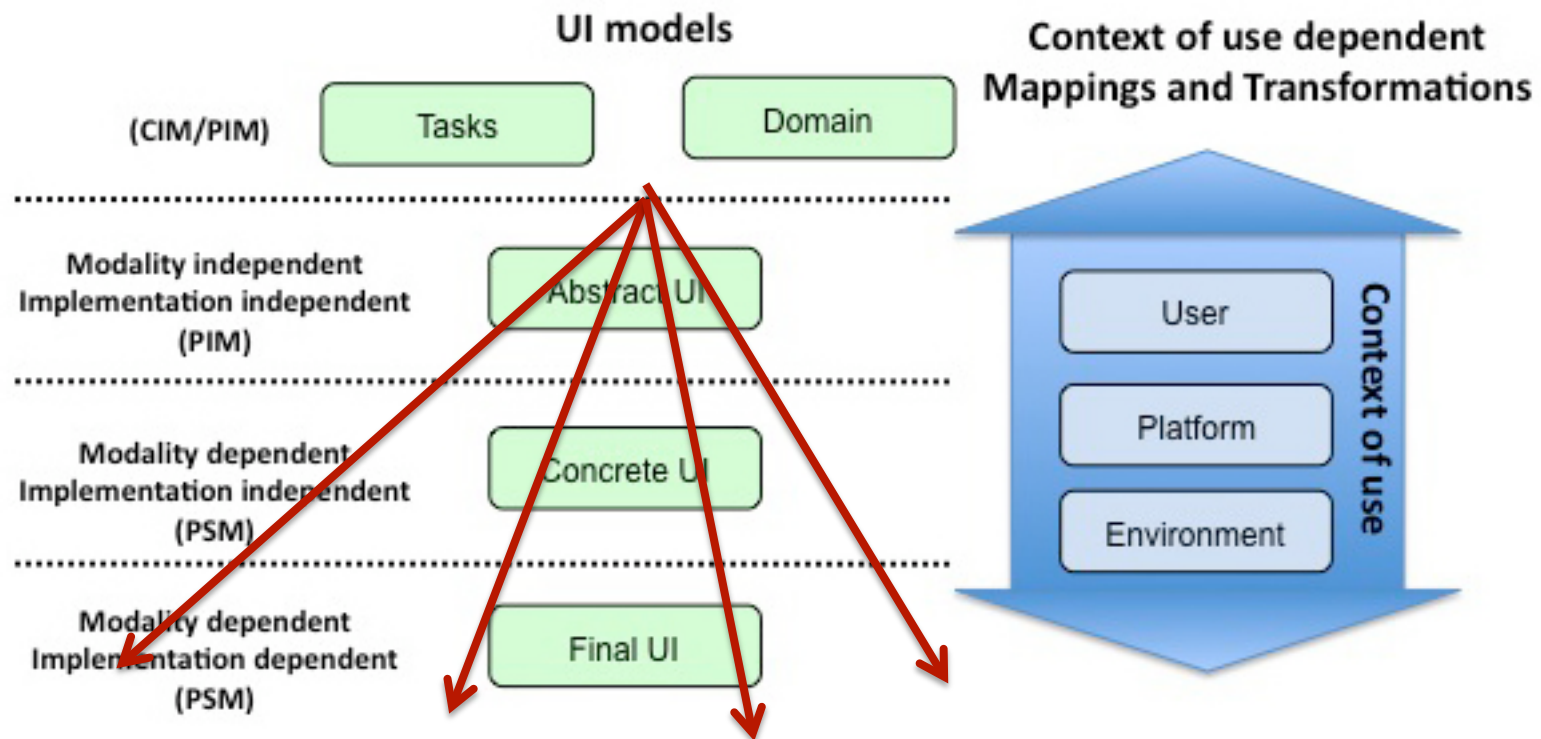
Practice

- Google example (session 1)
- TV example (session 2)

Adaptation, plasticity

- Users' side
 - «Cerebral plasticity is a **continuous** process allowing short-term, middle-term and long-term **remodelling** of neuron synaptic maps, to **optimize** the functioning of brain networks» [*Duffau 2006*]
- Designers' side
 - Capacity of the User Interface to **adapt** to the **context of use** (user, platform, environment) while preserving its **user's centered properties**
 - **Specify one, generate many ... with consistency by design!**

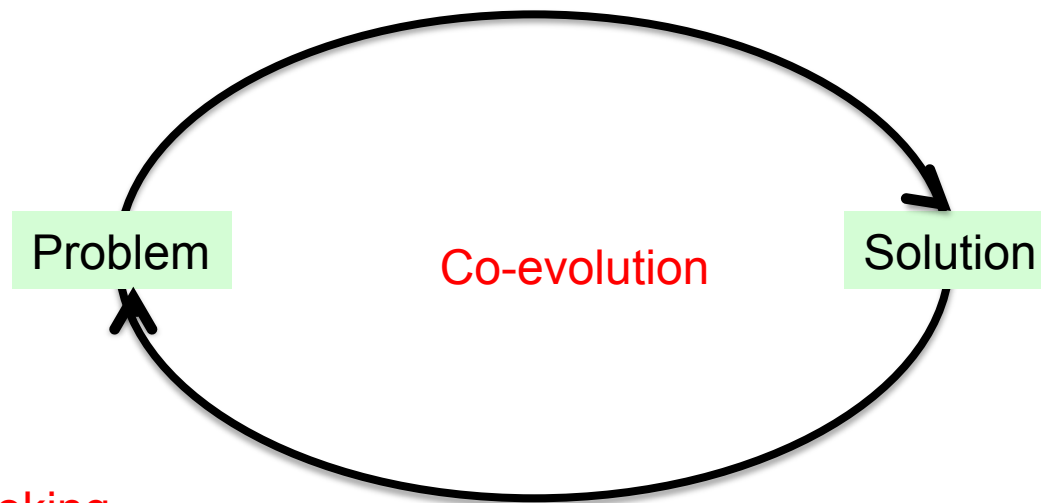
Adaptation, plasticity



Applicability

- Users' side

- Designers' side

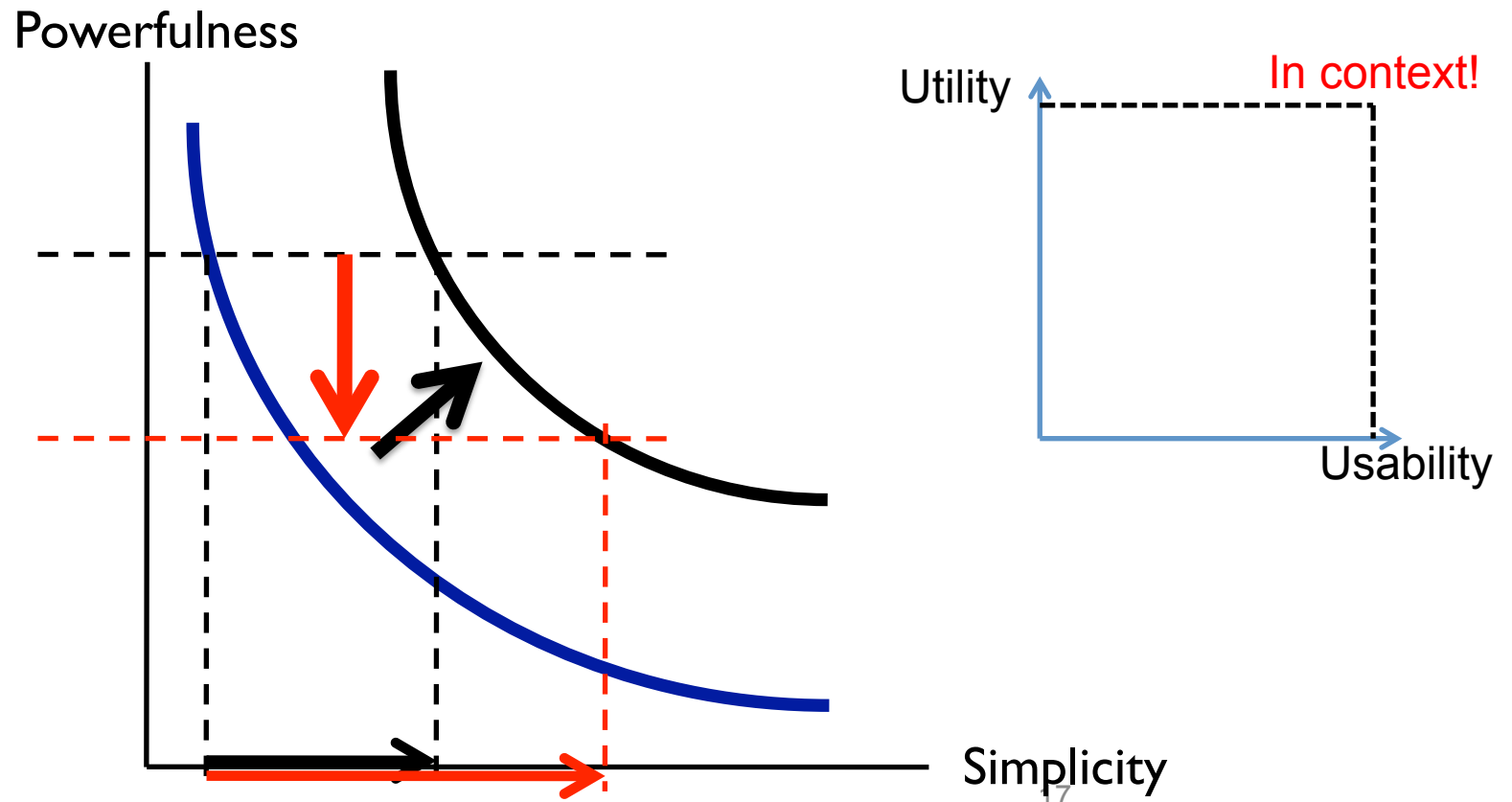


Stop smoking
Do more sport
Eat more vegetables
Do not waste water

...

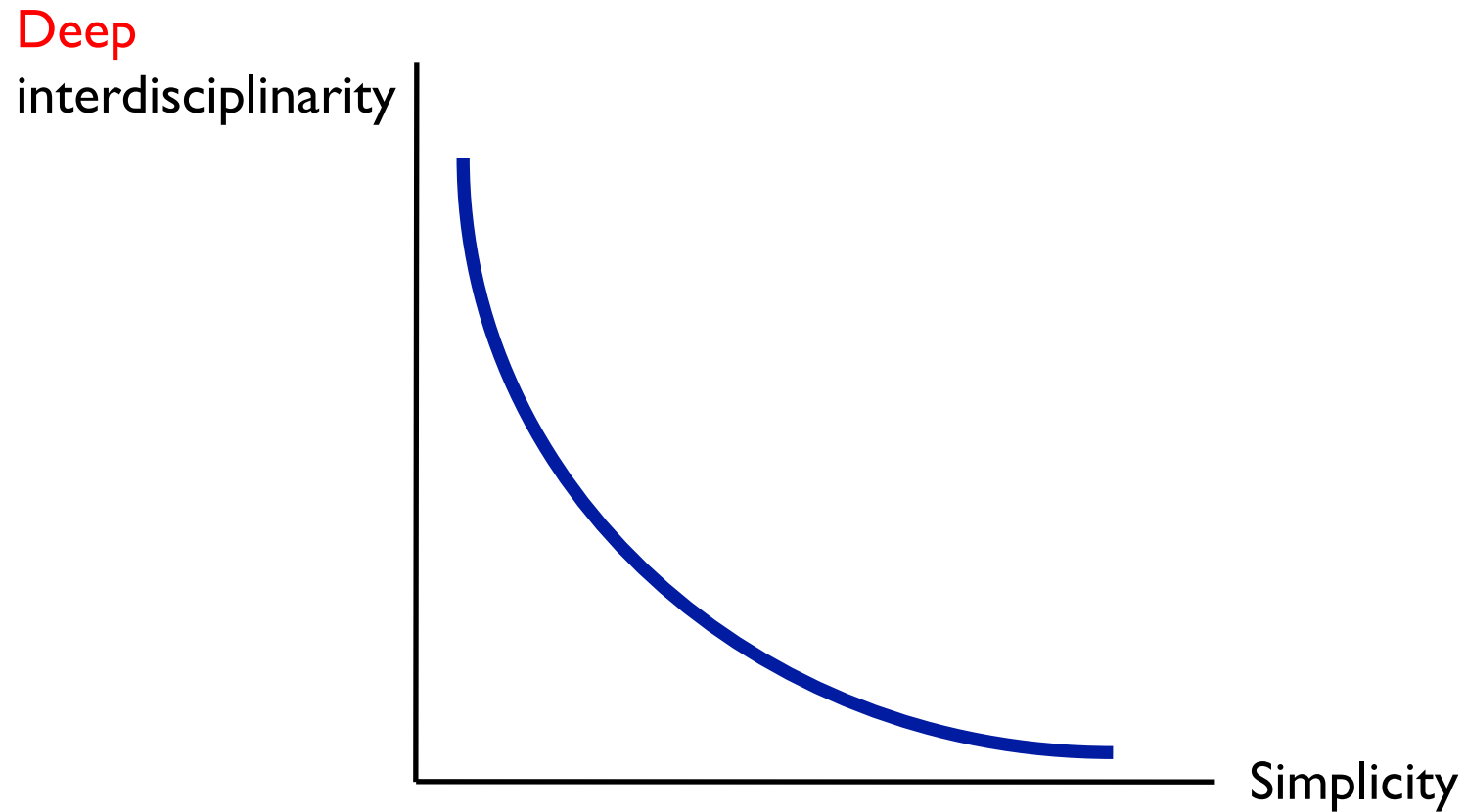
Applicability

- So far, focus on usability for a given task



Applicability

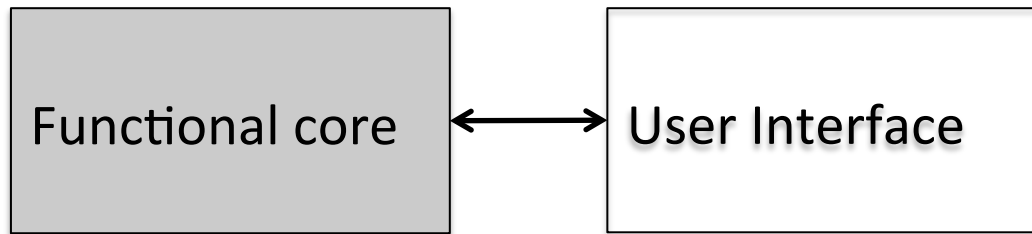
- But, what is the task in *future symbiotic* systems?



Applicability

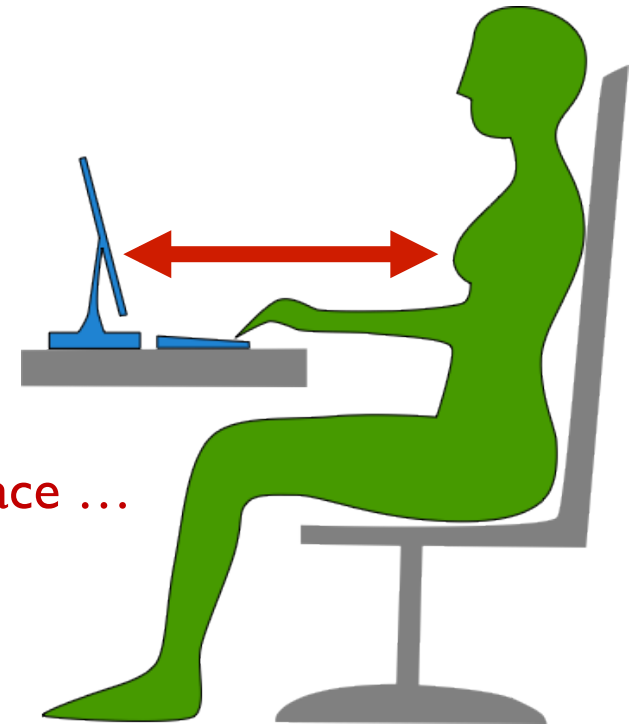
Challenge: getting the right design and the design right

The **right** information, function ...



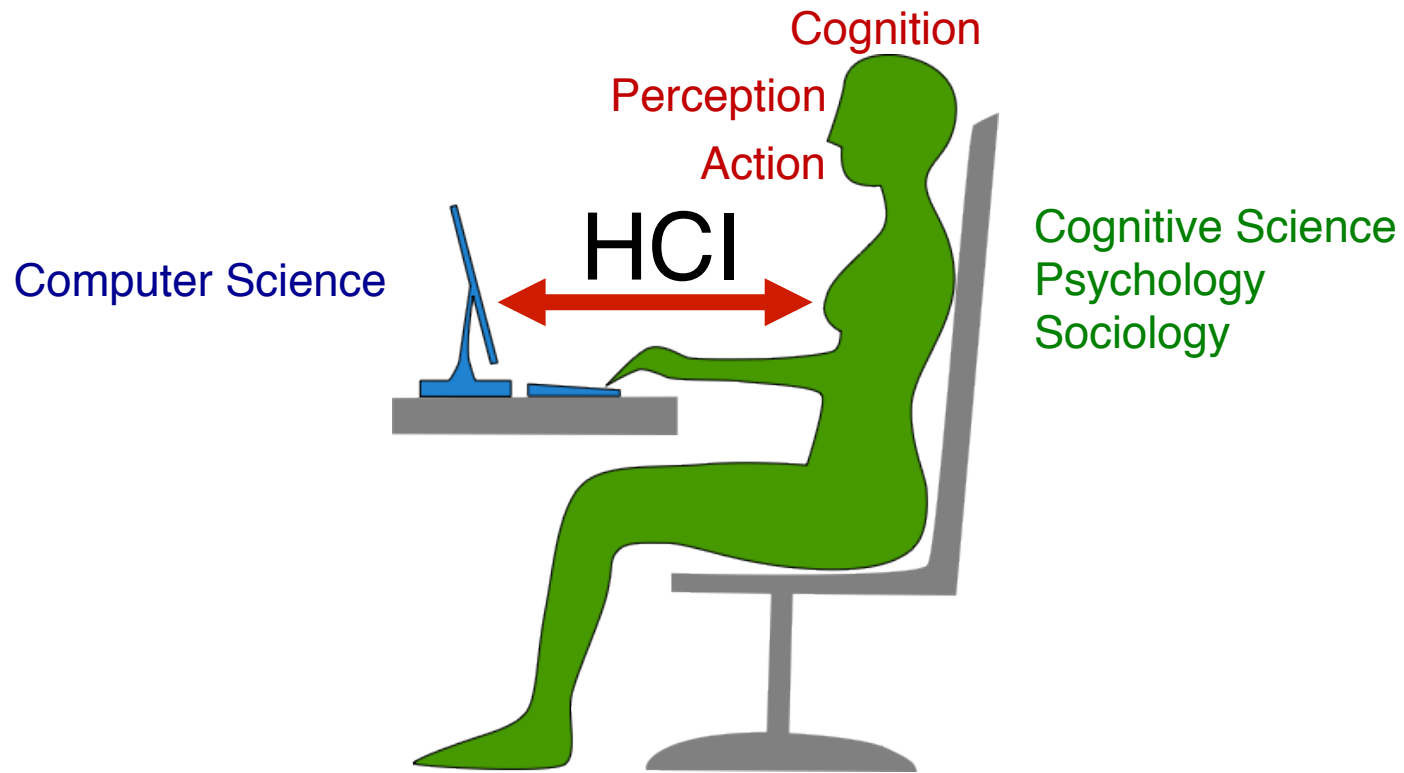
... at the **right** time, place ...

... with the **right** presentation ...



Applicability

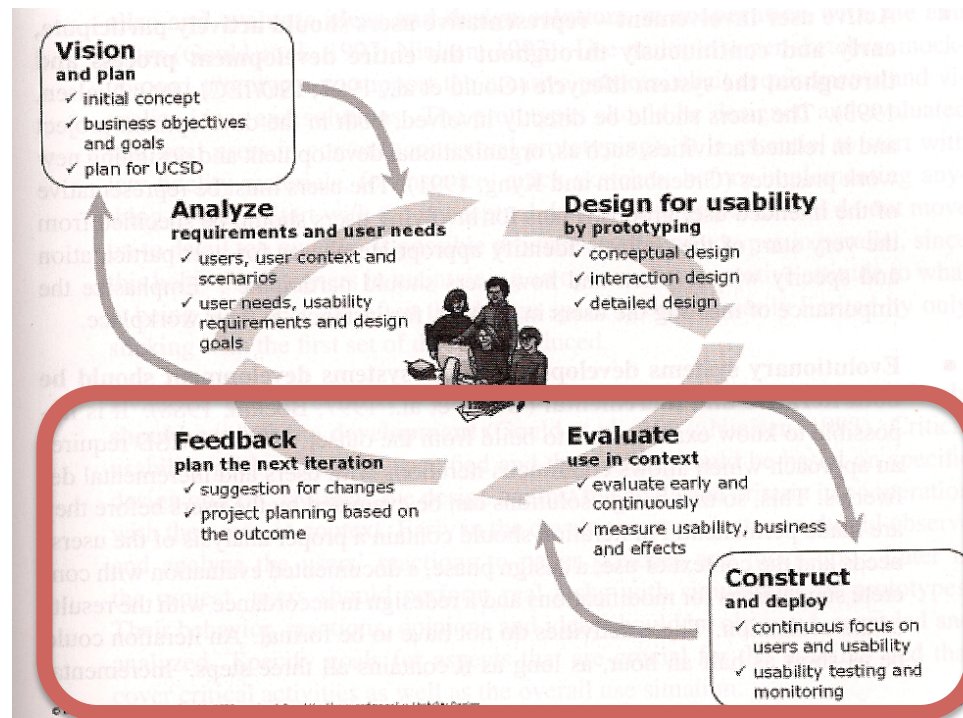
EHCI: holistic design!
At the cross-road of several disciplines



Selection

Principles

#1. Evaluation is key! Prototypes are a means for supporting evaluation!

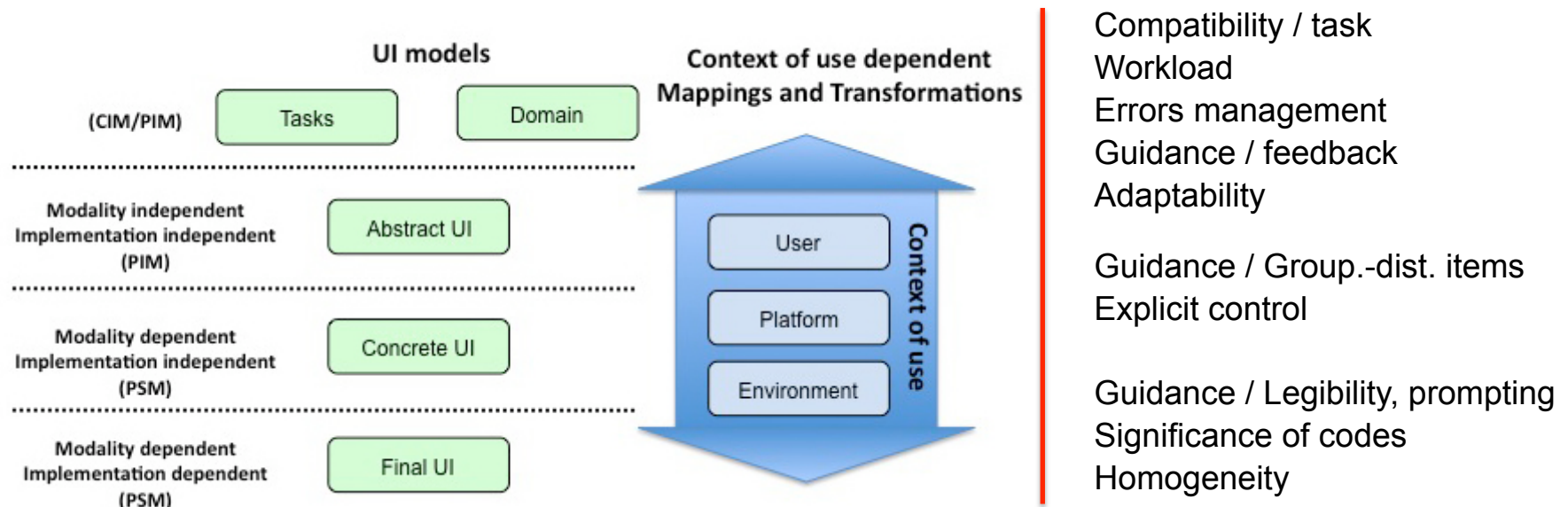


Principles

#1. Evaluation is key! Prototypes are a means for supporting evaluation!

#2. A large set of approaches and tools. Two main classes:

- predictive: without users
- experimental: with users



Principles

#1. Evaluation is key! Prototypes are a means for supporting evaluation!

#2. A large set of approaches and tools. Two main classes:

- predictive: without users
- experimental: with users

#3. Evaluate as soon as possible! Two ultimate goals:

- evaluation: formative
- validation: sommative

Principles

#1. Evaluation is key! Prototypes are a means for supporting evaluation!

#2. A large set of approaches and tools

#3. Evaluate as soon as possible!

#4. Know what you are looking for!

« Don't waste users on the small stuff. Critique can identify minor issues that can be resolved before testing, allowing users to focus on the big issues » (S. Klemmer)

Principles

#1. Evaluation is key! Prototypes are a means for supporting evaluation!

#2. A large set of approaches and tools

#3. Evaluate as soon as possible!

#4. Know what you are looking for!

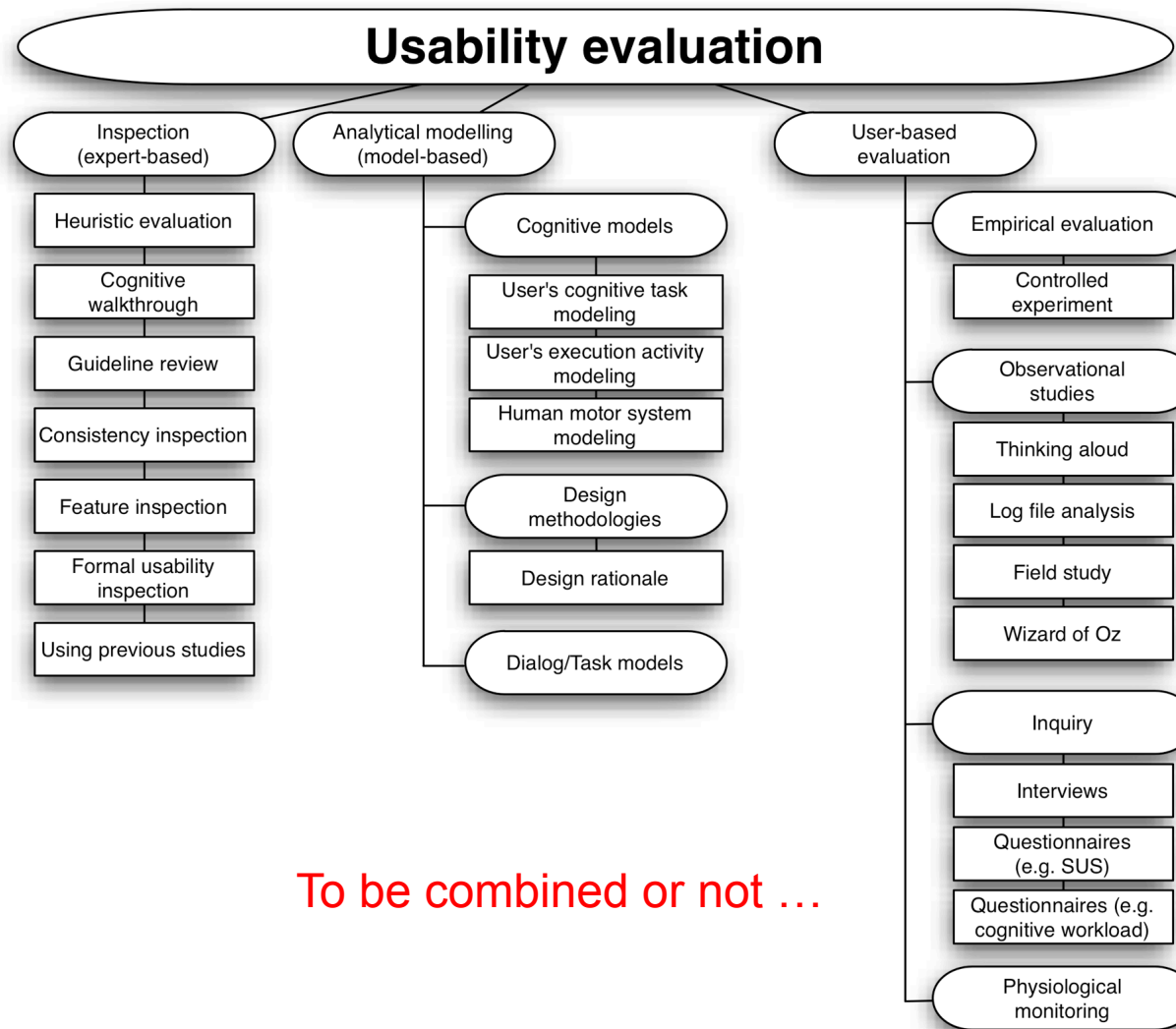
#5. Design your evaluation! Evaluation needs to be carefully thought, anticipated, and prepared. **Evaluation costs; non evaluation costs more!**

Principles

- #1. Evaluation is key! Prototypes are a means for supporting evaluation!
- #2. A large set of approaches and tools
- #3. Evaluate as soon as possible!
- #4. Know what you are looking for!
- #5. Design your evaluation! Evaluation needs to be carefully thought, anticipated, and prepared. Evaluation costs; non evaluation costs more!
- #6. A bad evaluation is better than nothing. ... but better it is, better your product is

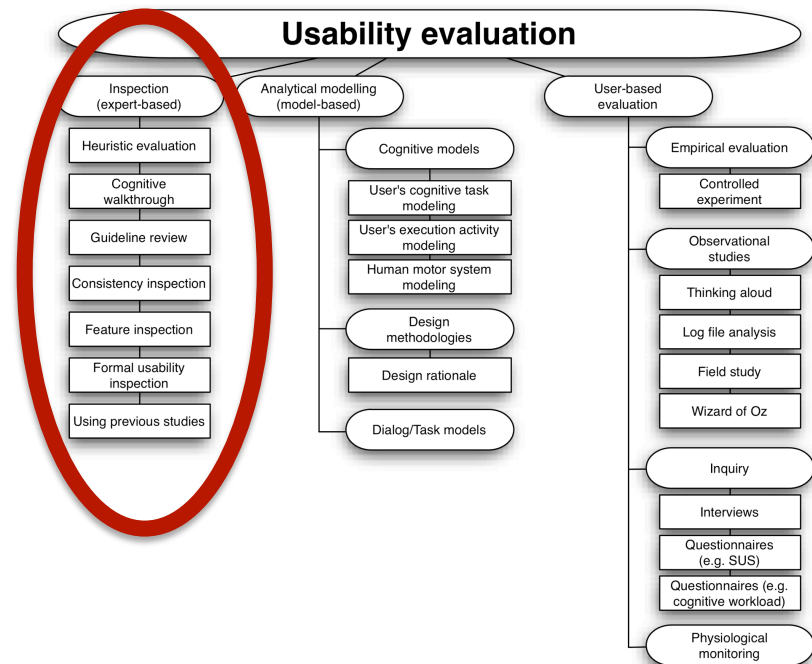
Overview of approaches

Classification



To be combined or not ...

Inspection



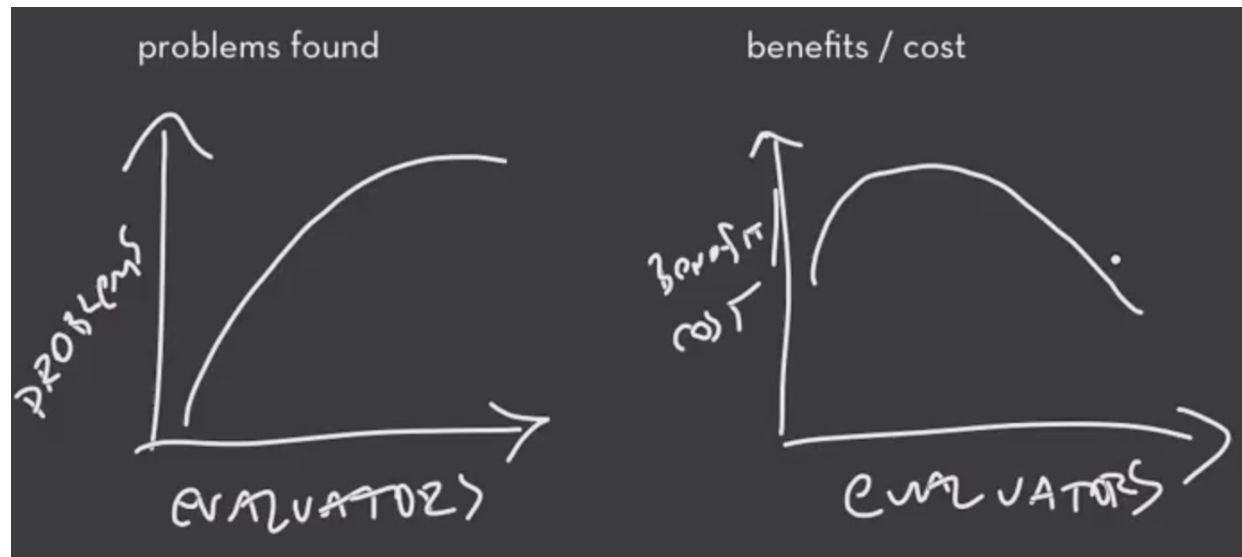
Heuristic evaluation

- Usability criteria
- Several frameworks: Jakob Nielsen, Ben Schneidermann, ..., D. Scapin & C. Bastien
- Useful both at design time and evaluation time
- In practice:
 - 3 to 5 experts: inspection, discussion
 - At any level of fidelity

Heuristic evaluation

- D. Scapin et C. Bastien
 - Compatibilité
 - Guidage
 - Charge de travail
 - Homogénéité-Cohérence
 - Gestion des erreurs
 - Contrôle explicite
 - Adaptabilité
 - Signifiante des codes et dénominations
- J. Nielsen
 - Visibility of System Status
 - Match between System & World
 - User Control & Freedom
 - Consistency & Standards
 - Error Prevention
 - Recognition Rather than Recall
 - Flexibility & Efficiency of Use
 - Aesthetic & Minimalist Design
 - Help Users Recognize, Diagnose & Recover from Errors
 - Help & Documentation

Heuristic evaluation: several experts



One expert: 35% of usability problems in 1-2 hours ; 5 experts 75%

Heuristic evaluation: several steps

1- Discovery

2- Individual evaluation

3- Agregation

4- Classification of problems

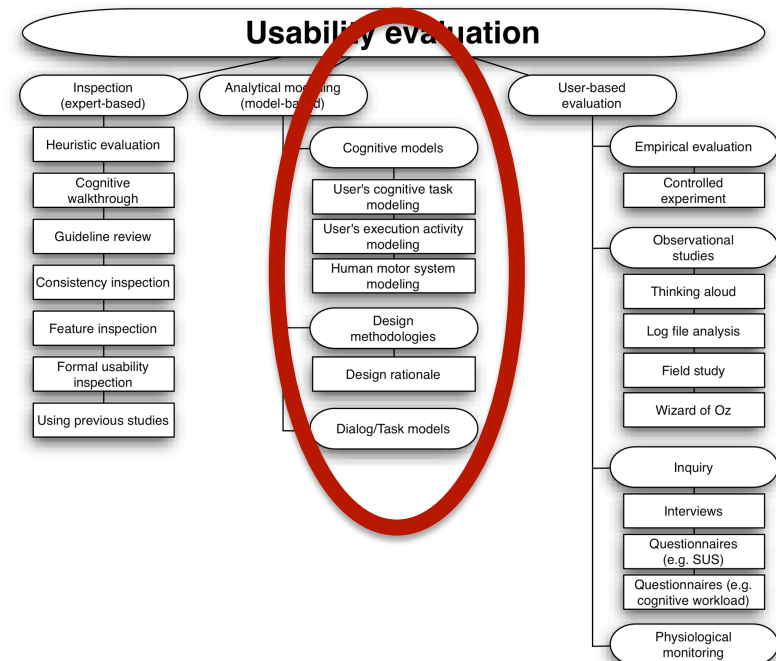
5- Discussion based on criticity

[Bowman, 2002]

Cognitive walkthrough

- Principle: expert as a user, based on a generic description of the users activity
- A a result
 - Focuses on the learning effect
 - Does not cover domain-related problems

Cognitive models



Cognitive models

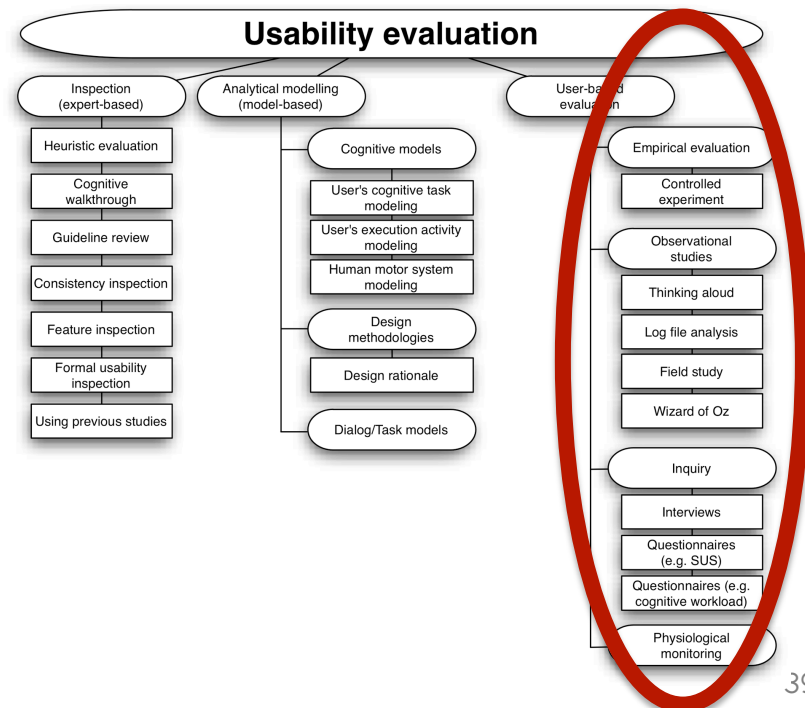
- Principle (Freiberg, 2008)

“As their name suggests, model-based evaluation techniques **use models of interfaces as the basis for the evaluation**. The goal is, to **predict** mostly **quantitative measures** of an interface for example, task duration by **simulating the users' behaviour**. The basic technique consists of 4 steps: describe the interface design in detail, create a model of representative users and their task performance, predict chosen measures by simulating the model, and initially revise or choose the design depending on the prediction. Such a simulation can take place at **early stages** in the development process and thus valuable usability results can be collected **without even implementing a prototype**. However, it can be challenging to correctly set up and fine-tune such a model and, even when done, it still might not be a complete or perfected mapping of the actual interface.”

Cognitive models

- Three classes of models (Dix, 2004)
 - Cognitive models to predict user's performance (e.g., GOMS (goals, operators, methods and selection), KLM (keystroke-level model))
 - Design methodologies (e.g., design rationale)
 - Dialog models (e.g., state transition networks for unreachable states, circular dialogs and complexity)

Experimental evaluation



Controlled experiment

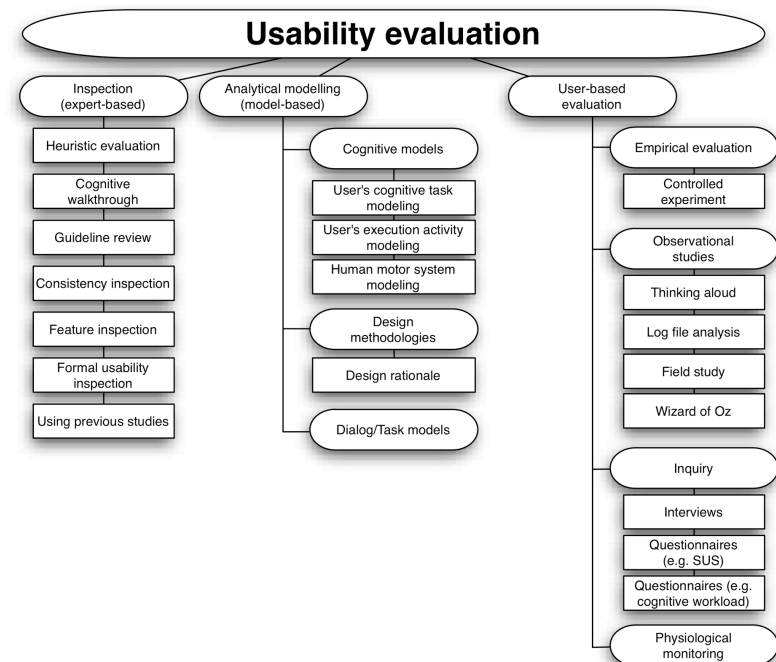
- Principle
 - Questions (doubts)
 - Running system(s), conditions, (in)dependent variables
 - Observers & Participants & Tasks
 - Records

- Scope
 - Utility
 - Usability

- Analysis
 - Qualitative, quantitative
 - Significant variations?

- **Validity, reproduceability**

Which one? How to select



Selection criteria

- Eight criteria (Dix, 2004)
 - Design vs. implementation
 - Laboratory vs. field study: laboratory studies allow controlled experimentation and observation while losing something of the naturalness of the user's environment. Field studies retain the latter but do not allow control over user activity.
 - Subjective vs. objective: Evaluation techniques also vary according to their objectivity – some techniques rely heavily on the interpretation of the evaluator, others would provide similar information for anyone correctly carrying out the procedure. The more subjective techniques, such as cognitive walkthrough or think aloud, rely to a large extent on the knowledge and expertise of the evaluator, who must recognize problems and understand what the user is doing. Ideally, both objective and subjective approaches should be used.

Selection criteria

- Eight criteria (Dix, 2004)
 - Design vs. implementation
 - Laboratory vs. field study
 - Subjective vs. objective
 - Qualitative vs. quantitative measures: the former is usually numeric and can be easily analyzed using statistical techniques. The latter is non-numeric and is therefore more difficult to analyze, but can provide important detail that cannot be determined from numbers. The type of measure is related to the subjectivity or objectivity of the technique, with subjective techniques tending to provide qualitative measures and objective techniques, quantitative measures.
 - Information provided: the information required by an evaluator at any stage of the design process may range from low-level information to enable a design decision to be made (for example, which font is most readable) to higher-level information, such as 'Is the system usable?'

Selection criteria

- Eight criteria (Dix, 2004)
 - Design vs. implementation
 - Laboratory vs. field study
 - Subjective vs. objective
 - Qualitative vs. quantitative measures
 - Information provided
 - Immediacy of the response: some methods record the user's behavior at the time of the interaction itself, others rely on the users recollection of events, which may be incomplete or biased. However, immediate techniques can also be problematic, since the process of measurement can actually alter the way the user works.

Selection criteria

- Eight criteria (Dix, 2004)
 - Design vs. implementation
 - Laboratory vs. field study
 - Subjective vs. objective
 - Qualitative vs. quantitative measures
 - Information provided
 - Immediacy of the response
 - Intrusiveness: certain techniques, particularly those that produce immediate measurements, are obvious to the user during the interaction and therefore run the risk of influencing the way the user behaves. Sensitive activity on the part of the evaluator can help to reduce this but cannot remove it altogether. Most immediate evaluation techniques are intrusive, with the exception of automatic system logging. Unfortunately, this is limited in the information that it can provide and is difficult to interpret

Selection criteria

- Eight criteria (Dix, 2004)
 - Design vs. implementation
 - Laboratory vs. field study
 - Subjective vs. objective
 - Qualitative vs. quantitative measures
 - Information provided
 - Immediacy of the response
 - Intrusiveness
 - Resources required: the final consideration when selecting an evaluation technique is the availability of resources. Resources to consider include equipment, time, money, participants, expertise of evaluator and context. Some decisions are forced by resource limitations: it is not possible to produce a video protocol without access to a video camera (and probably editing facilities as well). However, other decisions are not so clear cut.”

Selection criteria

- Eight criteria (Dix, 2004)
 - Design vs. implementation
 - Laboratory vs. field study
 - Subjective vs. objective
 - Qualitative vs. quantitative measures
 - Information provided
 - Immediacy of the response
 - Intrusiveness
 - Resources required

Selection criteria

- Characterization (Dix, 2004)

	Cognitive walkthrough	Heuristic evaluation	Review based	Model based
Stage	Throughout	Throughout	Design	Design
Style	Laboratory	Laboratory	Laboratory	Laboratory
Objective?	No	No	As source	No
Measure	Qualitative	Qualitative	As source	Qualitative
Information	Low level	High level	As source	Low level
Immediacy	N/A	N/A	As source	N/A
Intrusive?	No	No	No	No
Time	Medium	Low	Low-medium	Medium
Equipment	Low	Low	Low	Low
Expertise	High	Medium	Low	High

Selection criteria

- Characterization (Dix, 2004)

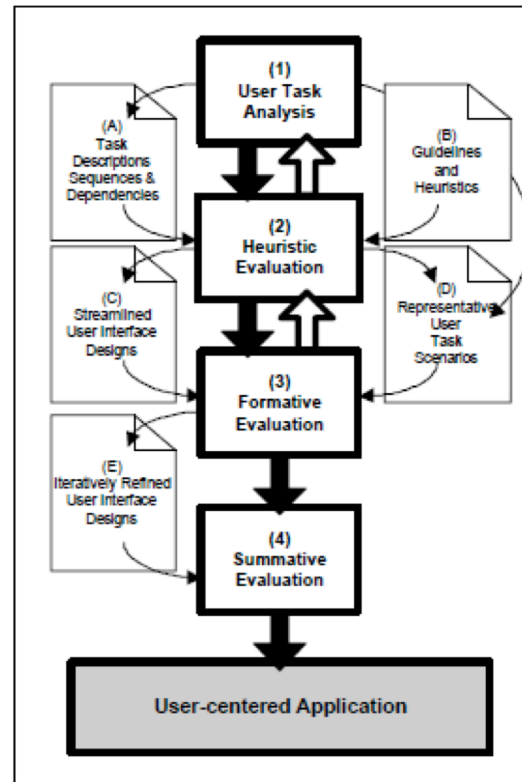
	Cognitive walkthrough	Heuristic evaluation	Review based	Model based
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Immediacy	N/A	N/A	As source	N/A
Intrusive?	No	No	No	No
Time	Medium	Low	Low-medium	Medium
Equipment	Low	Low	Low	Low
Expertise	High	Medium	Low	High

	Experiment	Interviews	Questionnaire
Stage	Throughout	Throughout	Throughout
Style	Laboratory	Lab/field	Lab/field
Objective?	Yes	No	No
Measure	Quantitative	Qualitative/ quantitative	Qualitative/ quantitative
Information	Low/high level	High level	High level
Immediacy	Yes	No	No
Intrusive?	Yes	No	No
Time	High	Low	Low
Equipment	Medium	Low	Low
Expertise	Medium	Low	Low

	Think aloud ¹	Protocol analysis ²	Post-task walkthrough
Stage	Implementation	Implementation	Implementation
Style	Lab/field	Lab/field	Lab/field
Objective?	No	No	No
Measure	Qualitative	Qualitative	Qualitative
Information	High/low level	High/low level	High/low level
Immediacy	Yes	Yes	No
Intrusive?	Yes	Yes ³	No
Time	High	High	Medium
Equipment	Low	High	Low
Expertise	Medium	High	Medium

	Eye tracking	Physiological measurement
Stage	Implementation	Implementation
Style	Lab	Lab
Objective?	Yes	Yes
Measure	Quantitative	Quantitative
Information	Low level	Low level
Immediacy	Yes	Yes
Intrusive?	No ¹	Yes
Time	Medium/high	Medium/high
Equipment	High	High
Expertise	High	High

Sequential evaluation

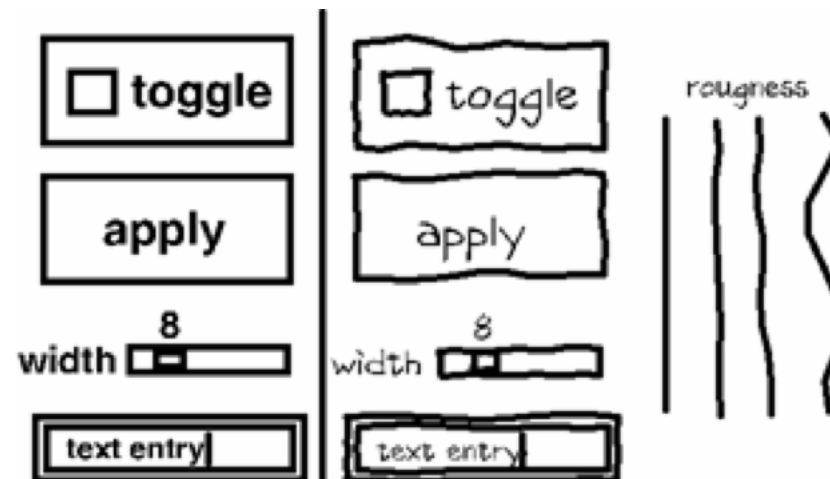


In practice

Best practices

#1. Heuristic first

#2. Low fidelity first [Meyer 1996] [Meyer 2005]



Best practices

#1. Heuristic first

#2. Low fidelity first [Meyer 1996] [Meyer 2005]

#3. Comparative evaluation [Tohidi 2006]

Best practices

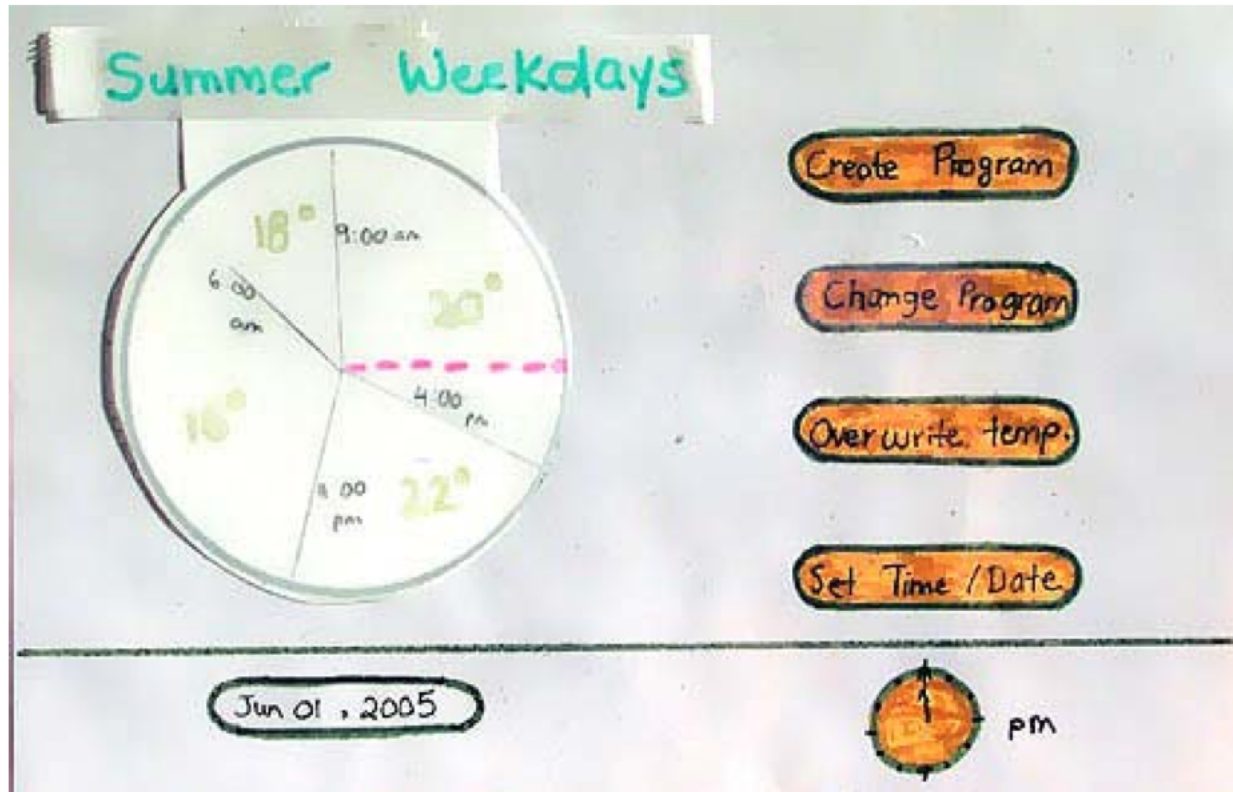


Figure 1. The “Circular” paper prototype

Best practices

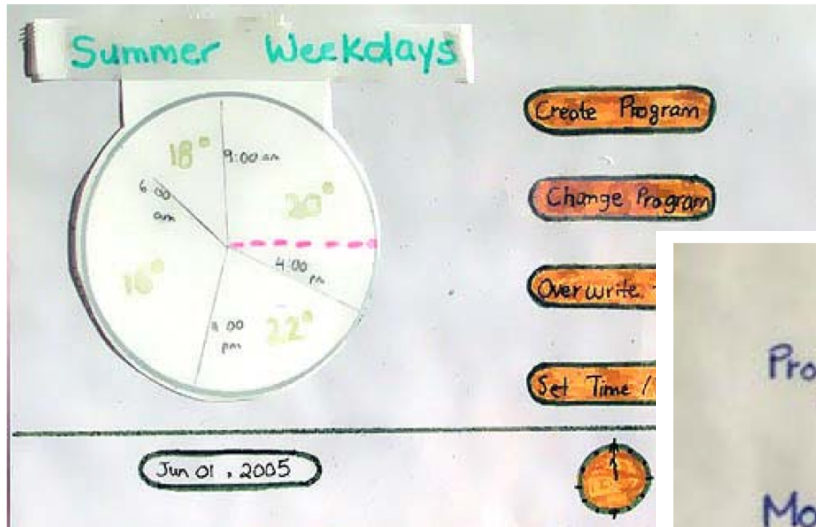


Figure 1. The “Circular” paper prototype

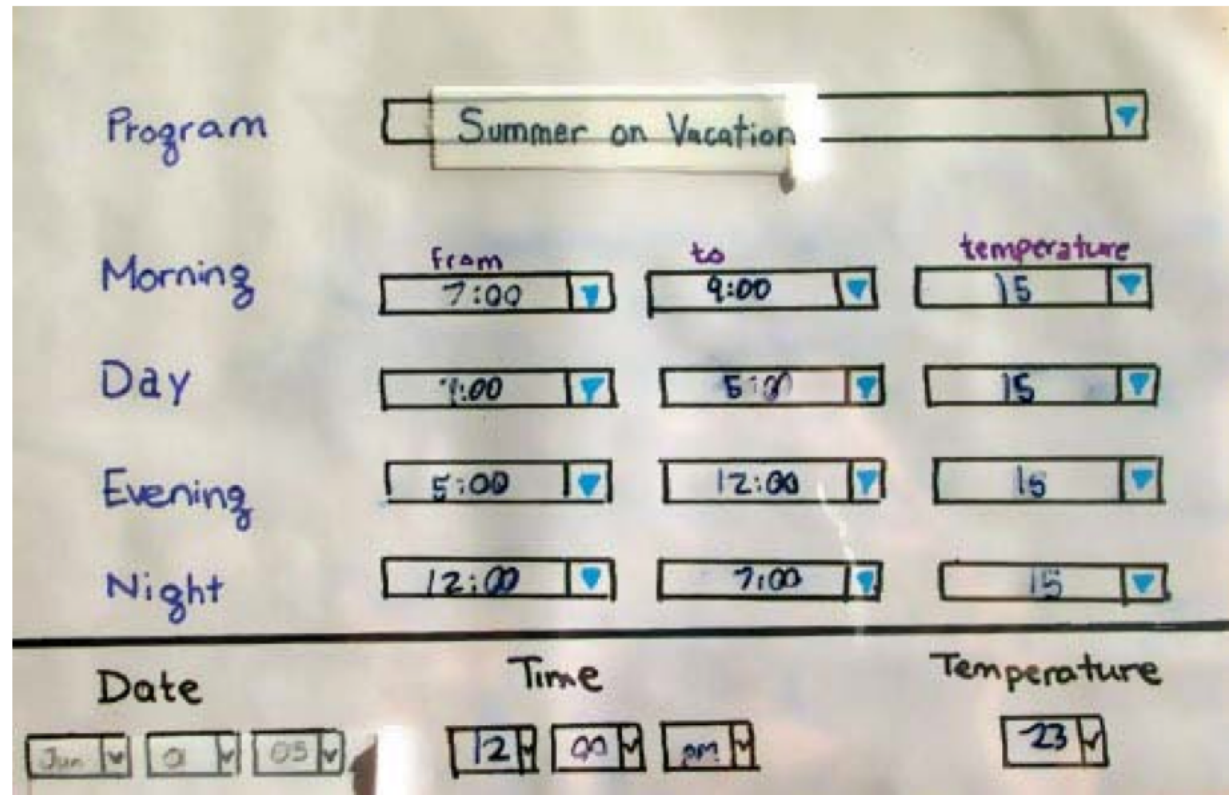


Figure 2. The “Tabular” paper prototype

Best practices

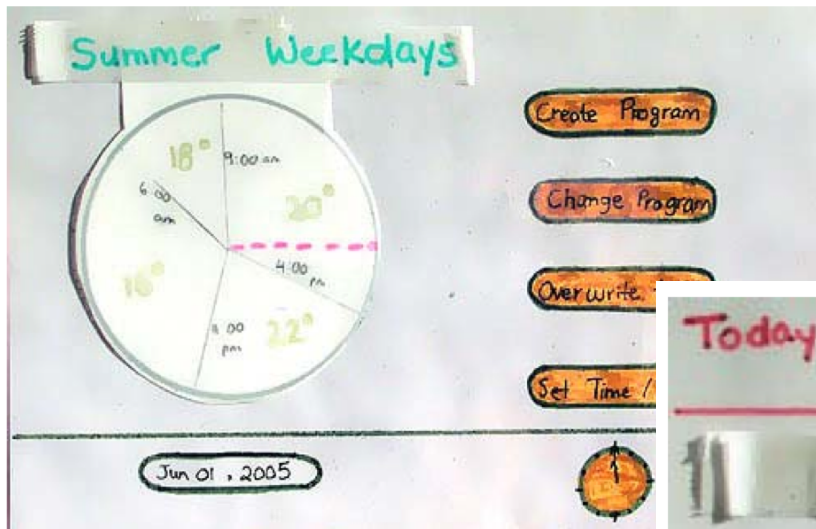


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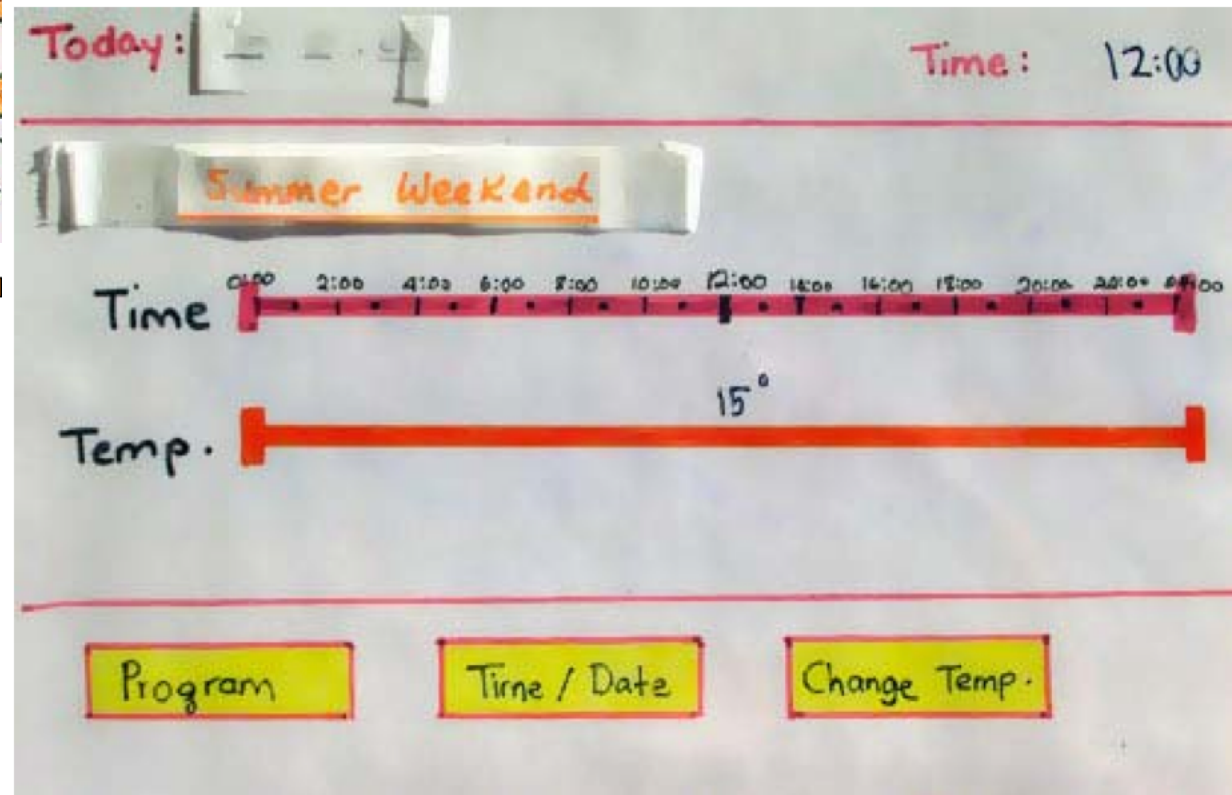
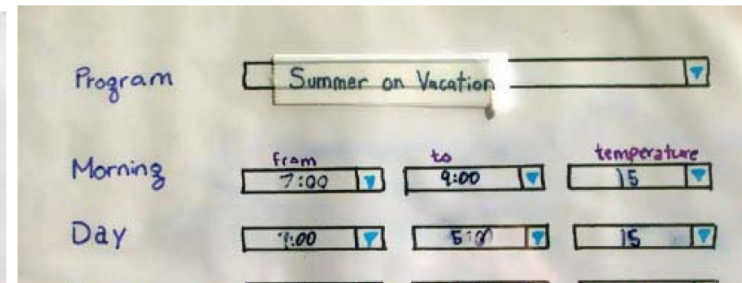


Figure 3. The "Linear" paper prototype
[Tohidi 2006]

Best practices

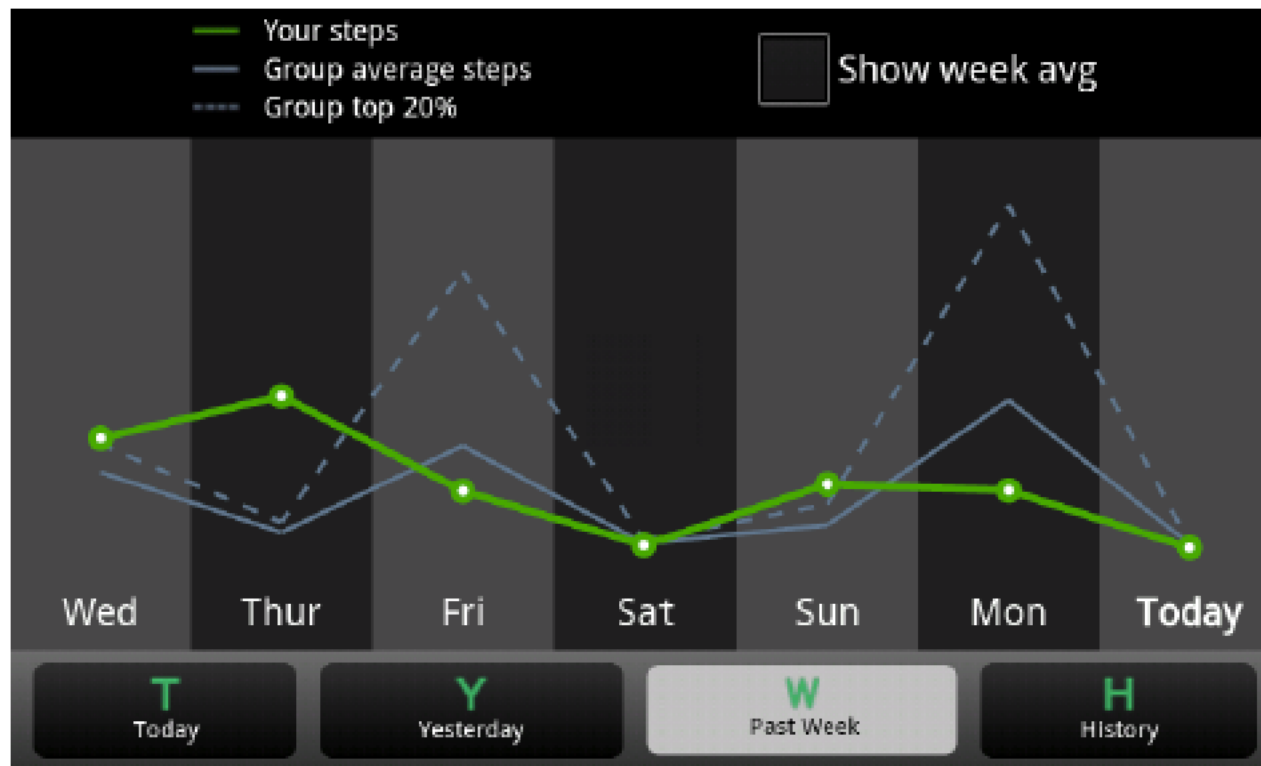
- #1. Heuristic first
- #2. Low fidelity first [Meyer 1996] [Meyer 2005]
- #3. Comparative evaluation [Tohidi 2006]
- #4. Control and bias (ex: learning effect, S1-S2/S2-S1)
- #5. Longitudinal evaluation

Best practices

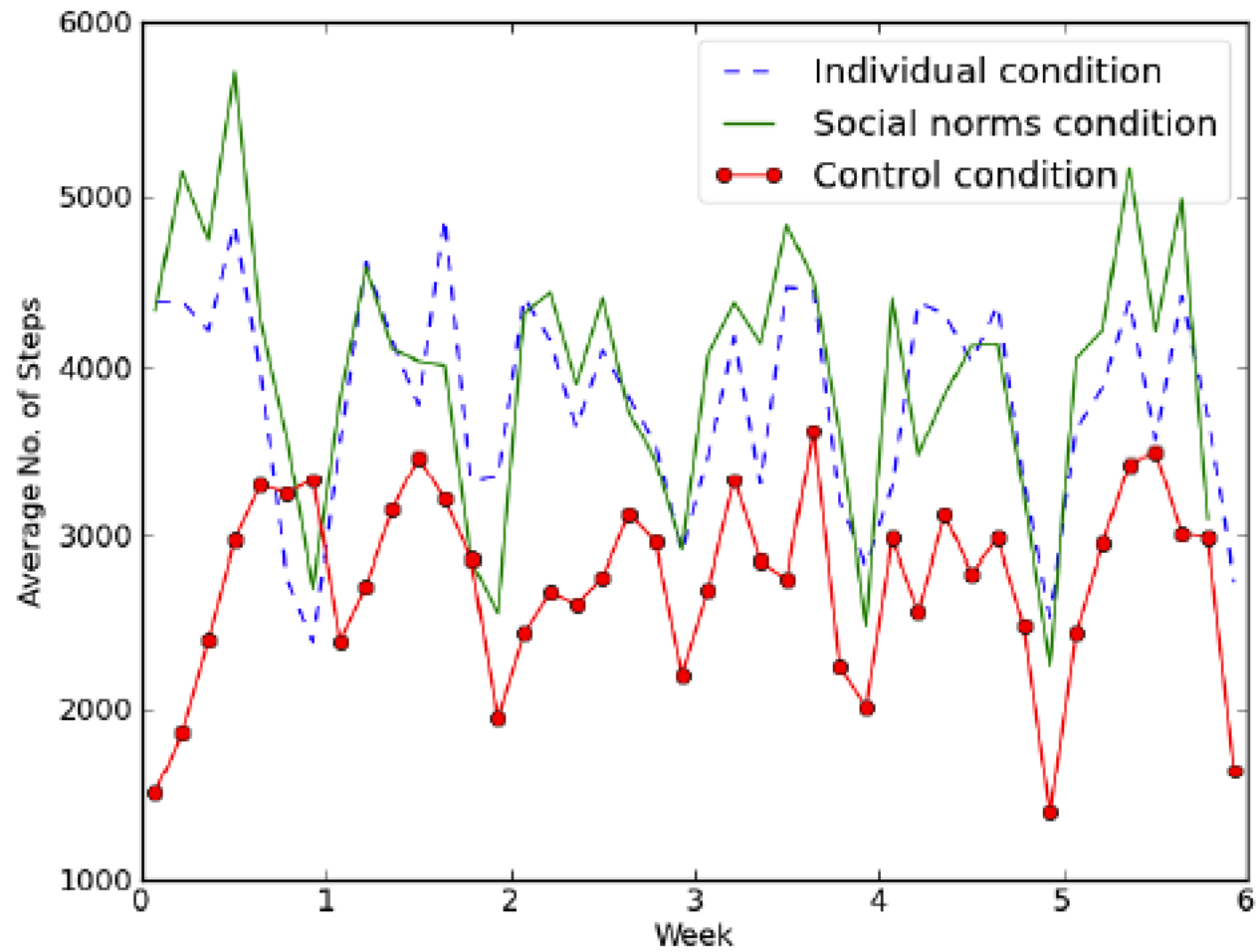
- Case study [Harries 2013]
 - Persuasive technology for health
 - Walk
 - « Walking in the Wild – Using an Always-on Smartphone Application to Increase Physical Activity »

Best practices

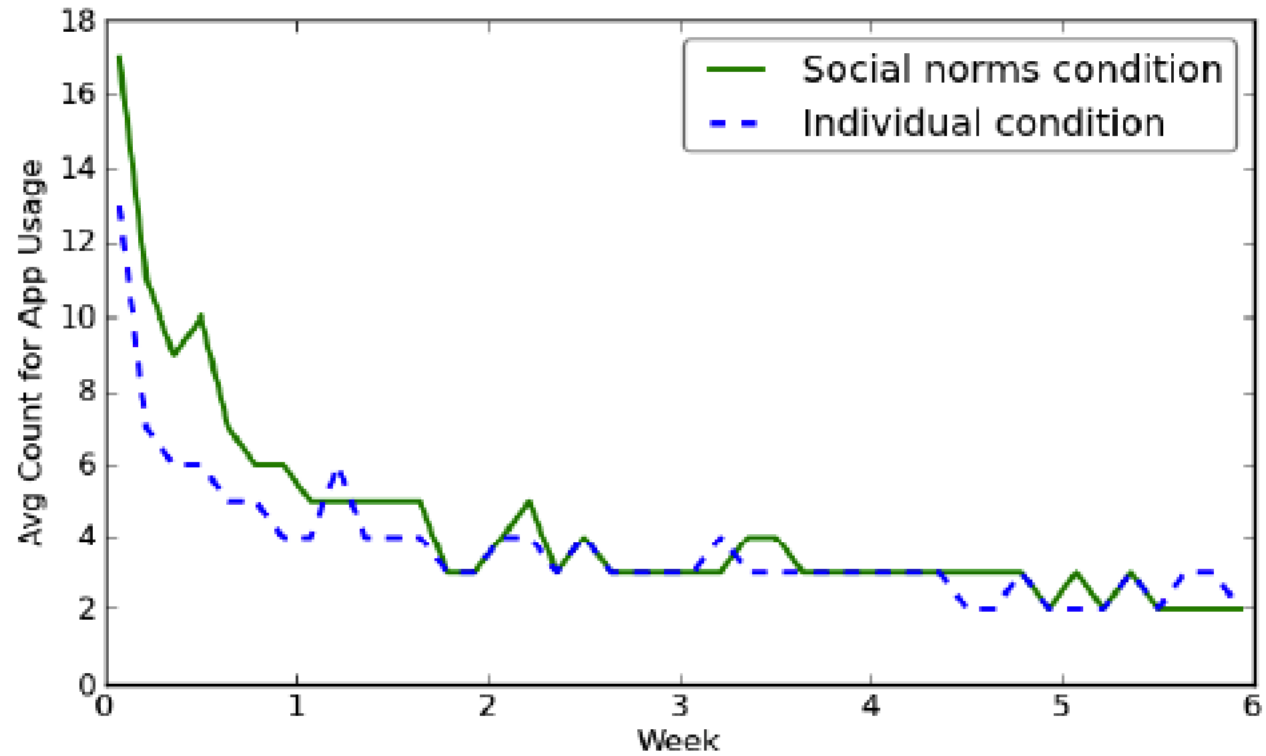
- History



Best practices



Best practices



Best practices

- #1. Heuristic first
- #2. Low fidelity first [Meyer 1996] [Meyer 2005]
- #3. Comparative evaluation [Tohidi 2006]
- #4. Control and bias (ex: learning effect, S1-S2/S2-S1)
- #5. Longitudinal evaluation
- #6. First person experience ...