Users

Human-Computer Interaction Lecture

Slides adapted from hci-lecture.org (A. Schmidt, N. Henze, K. Wolf, V. Schwind), Image from: Robert Couse Baker/pxhere.com

Prof. Dr. Valentin Schwind

Learning Goals

- Understand …
  - › how users see a user interface and the user's illusion
  - › why it is hard for developers to spot usability issues
  - › mental models of the users, designers and developers
  - › the Human-Centered Design Process
  - › patterns of users and tasks
- Be able to explain …
  - › to use describe the concept of a user and to improve a user interface or interaction
  - › the principle of mental models

We see what we want to see (1)

Images from https://commons.wikimedia.org/wiki/File:My_Wife_and_My_Mother-in-Law.jpg
and https://commons.wikimedia.org/wiki/File:German_postcard_from_1888.png

We see what we want to see (2)
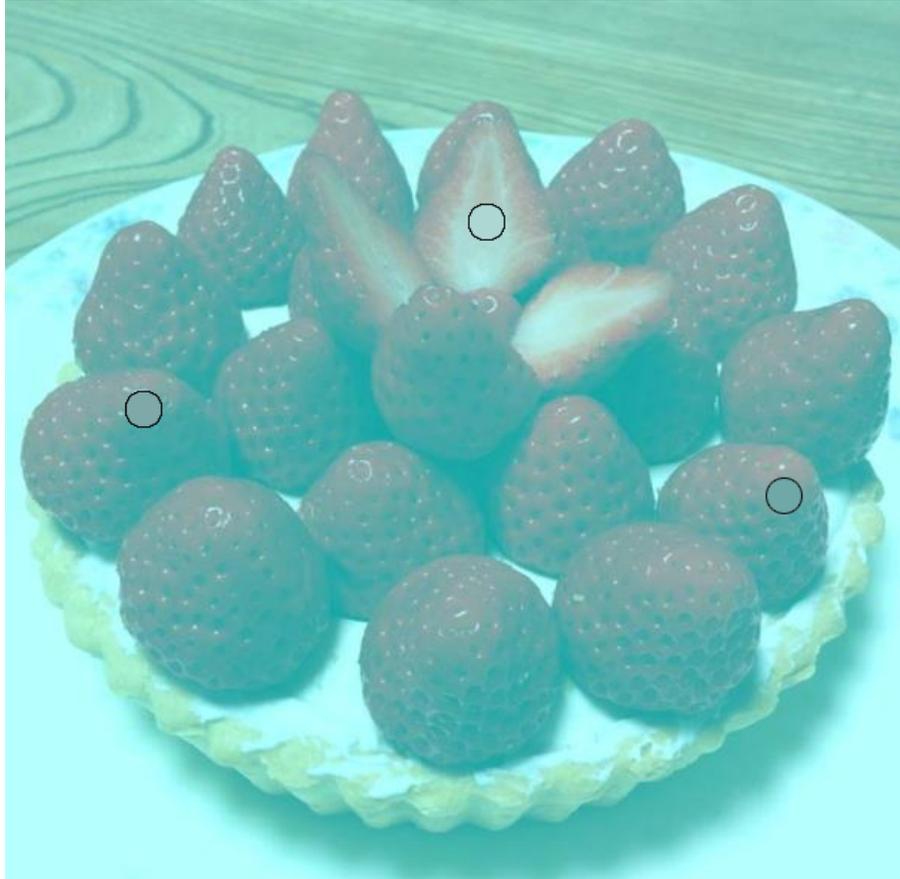
http://www.michaelbach.de/ot/col-strawbsNotRed/index.html
Images from Kitaoka A (2015) Apparent reddish strawberries. ECVP contribution Hansen T, Okkonen M, Gegenfurtner K (2006) Memory modulates color appearance
https://michaelbach.de/ot/col-strawbsNotRed/index.html and https://www.thesun.co.uk/living/3496637/optical-illusion-dresses-colour-change/

We see what we want to see (3)

Image posted by user earendilll 10 Apr 22 at 9gag.com
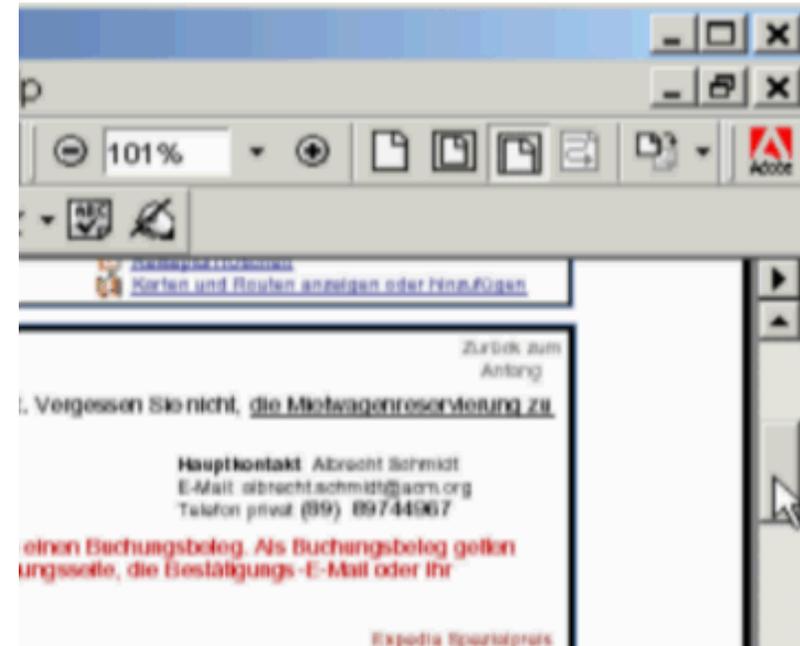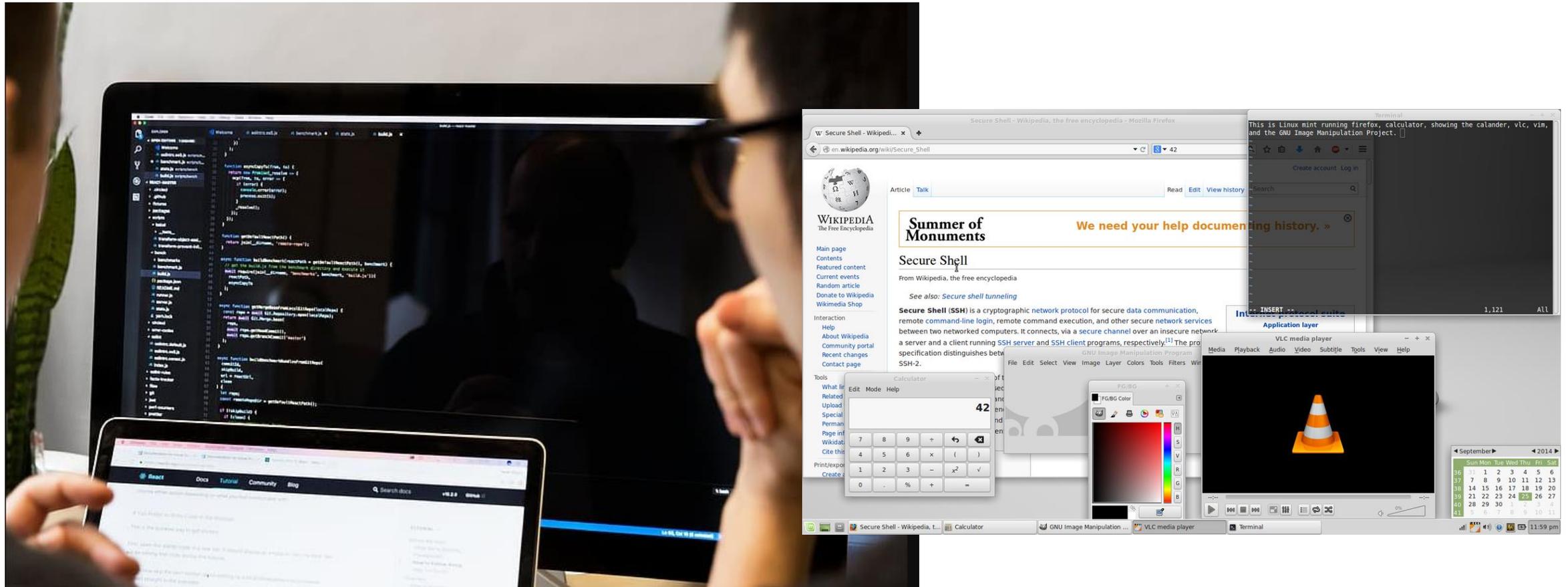
We see what we want to see (4)
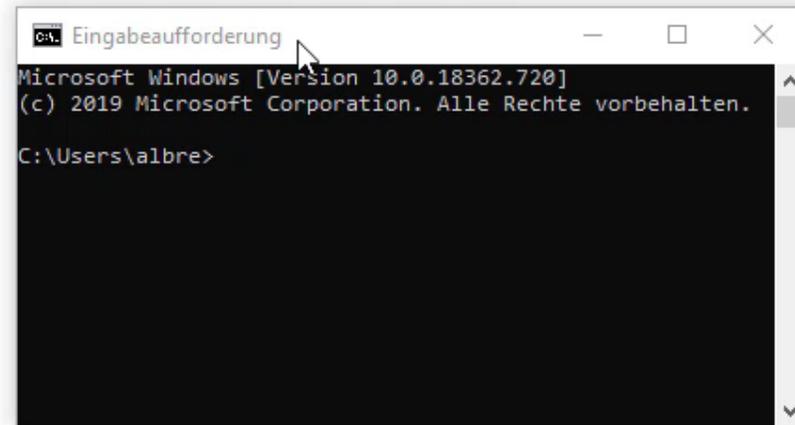
Video by Albrecht Schmidt

We see what we want to see (5)

Videos by Albrecht Schmidt

Why do developers have no usability issues?

Images from https://www.piqsels.com/en/public-domain-photo-zbszp and https://en.wikipedia.org/wiki/Free_and_open-source_software

End Users vs. Developers

- **Developers** know almost everything about their development
- **End users** have little idea about
  - › system and software architecture
  - › remote database connections
  - › state transitions and dependencies
  - › internal query syntax
  - › application context
  - › system restrictions
  - › …
- **… and the do not care about it − and they should not need to care about it!**

Why are users not supposed to care about software issues?

Discussion

Why do we always skip the tutorial?

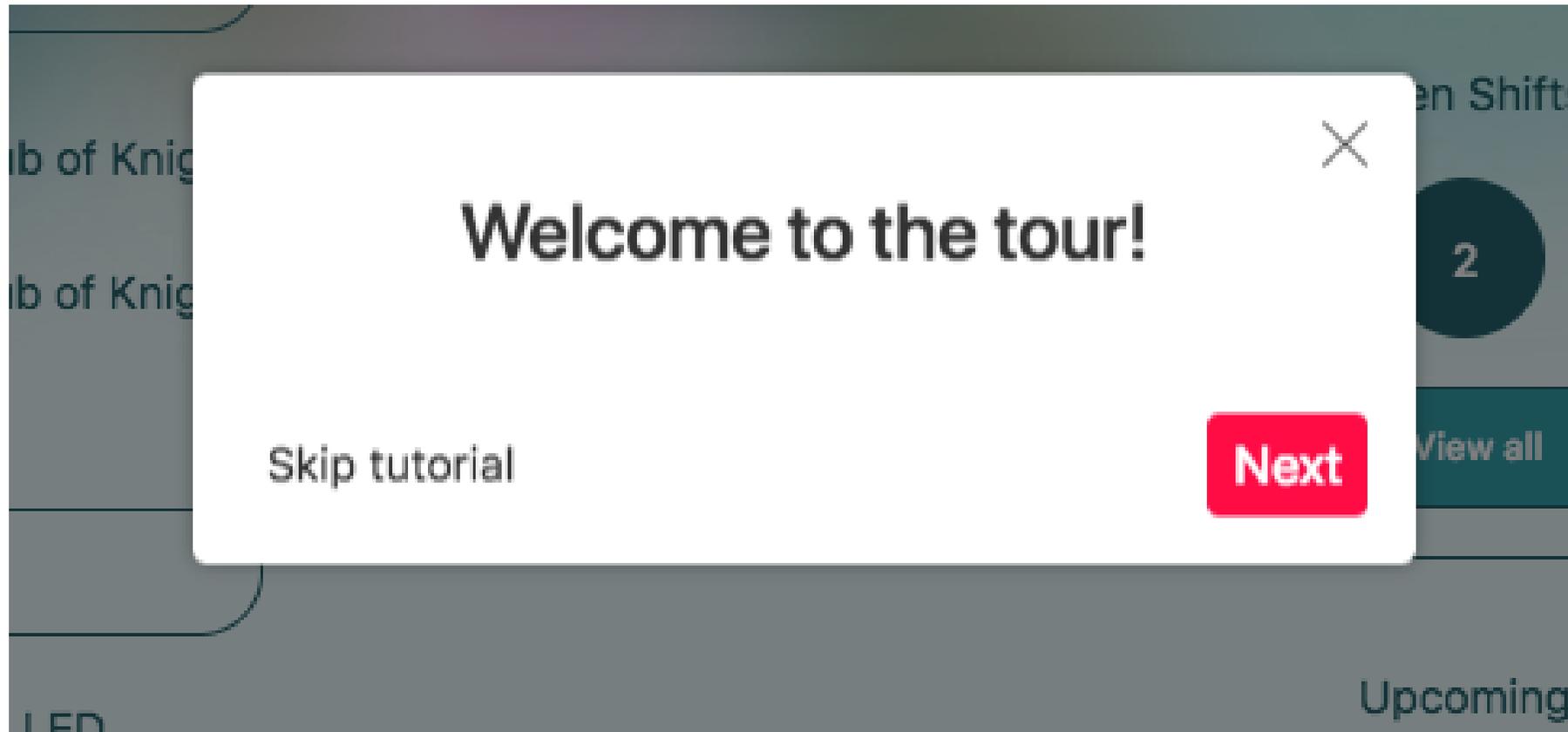Image from: https://github.com/JobCore/employer-web-client/issues/20

The Difference between Developers and Users

- **Developers want to complete the system**

- **Users want to complete tasks with your system**
  - › Once caught in a task, **users will try to keep the „flow"** until their task is completed

Images from Albrecht Schmidt and https://pixabay.com/de/photos/schnitzen-holz-mantel-h%C3%A4nde-96088/
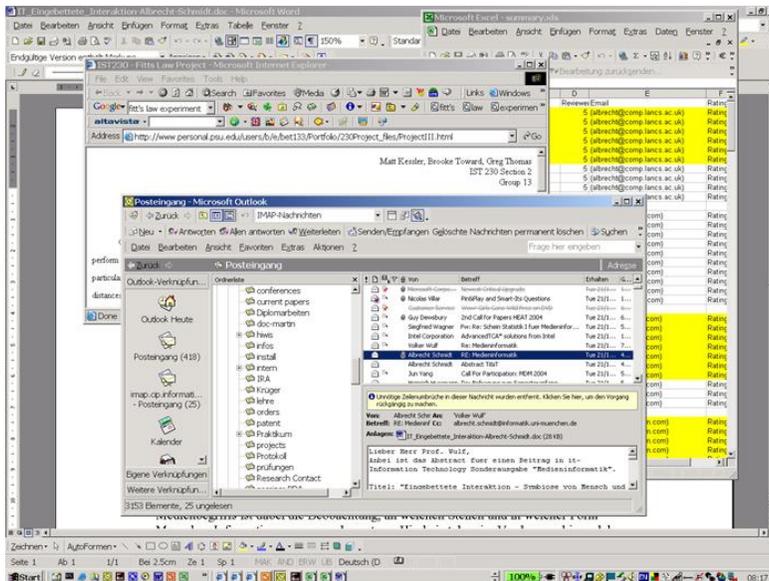
The Corridor of Options and the Users' Flow

Corridor of options

Less options increase the flow

The User

The problem

Many options slow down the task flow

The solution
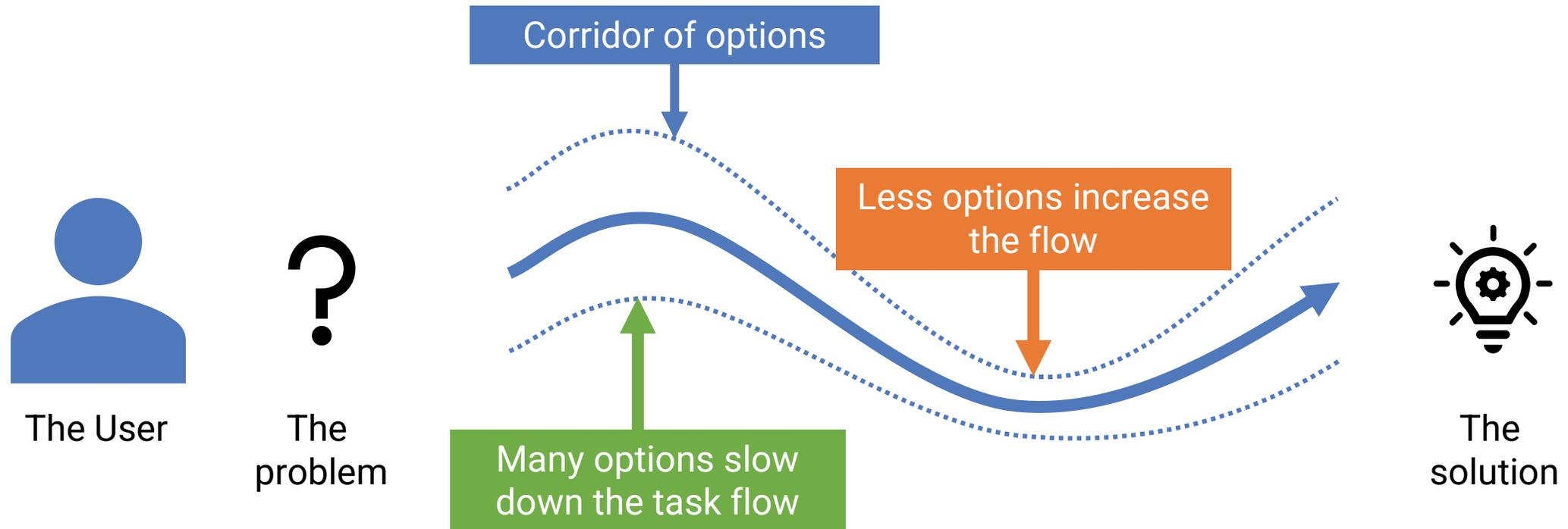
The users' path to solve the problem = task flow (composed of one or more tasks)

The Users' Flow

- Refers to a mental state of **absorption in an activity**, leading to a heightened **sense of focus, positive fulfillment** and **productivity**
  - › People in flow are **more likely to come up with solutions and ideas**
  - › Flow is an important requirement to be immersed (movies, games, etc.)
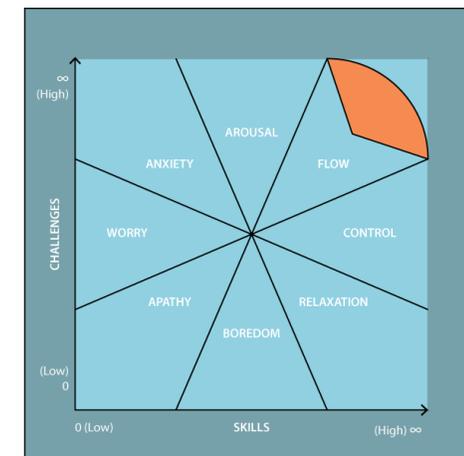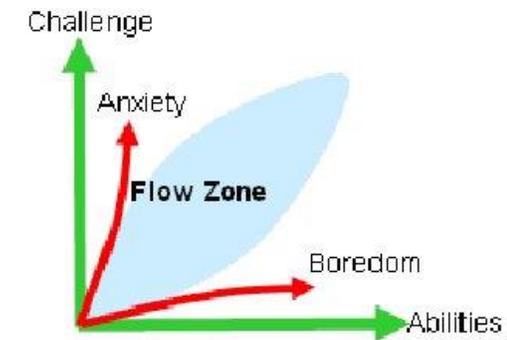 - › Thus, the "flow" is **a special case of user experience**
- Biochemically, flow is associated with neurotransmitter activity, including elevated levels of dopamine and endorphins, as well as regulated cortisol levels able to handle positive stress ("eustress")

Csikszentmihalyi, Mihaly. Flow: The Psychology of Optimal Experience. New York: Harper & Row, 1990. 74.

Csikszentmihalyi, Mihaly. Finding Flow: Psychology of Engagement with Everyday Life. New York: Basic, 1997. 31.

Guillon, B., Monteiro, J.-L., Checoury, C., Archambault, D., & Burger, D. (2004). Towards an Integrated Publishing Chain for Accessible Multimodal Documents. . doi: 10.1007/978-3-540-27817-7_75

Sawyer, R. K. (2006). Explaining creativity: The science of human innovation. Oxford University Press

About Using Tools

- From the perspective of a user: **every user interface is a tool (or utility)**

- *"The way humans make and use **tools** is perhaps what **sets our species apart** more than anything else. Now scientists are more and more uncovering the forces that drove our lineage to our heights of **tool use** — and how tool use, in turn, might have **influenced our evolution**."* [1]

→ The right tool influence evolution
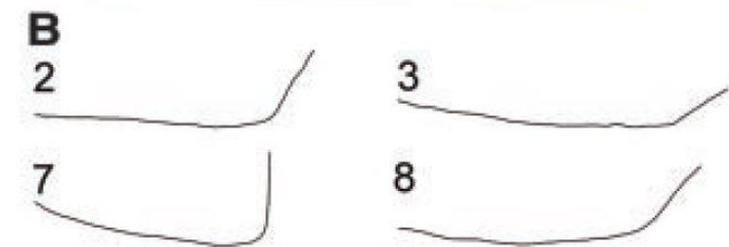
[1] Charles Q. Choi. 2009. Human Evolution: The Origin of Tool Use Live Science, November 11, 2009.
[2] Weir, A.A., Chappell, J. and Kacelnik, A., 2002. Shaping of hooks in New Caledonian crows. Science, 297(5583), pp.981-981

About Creating Complex Systems

- *"You can use an eraser on the drafting table or a sledgehammer on the construction site."* - Frank Lloyd Wright

- **Creating the user interface** at the end of the project will not work – **it has to be considered from the very beginning**
  - › Make Mistake Early and Recognize Them!

- Making changes and corrections to **early address the user needs** is considerably **easier and less costly** during the planning or design phase than after the implementation or release phase.
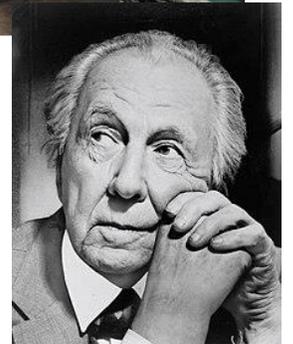
Images from https://www.pexels.com/de-de/foto/fallendes-wasserhaus-frank-lloyd-wright-moderne-architektur-2695872/ New York World-Telegram and the Sun staff photographer: Al Ravenna / Public domain https://commons.wikimedia.org/wiki/File:Frank_Lloyd_Wright_portrait.jpg

Xerox PARC

Birthplace of the printer, ethernet, many programming languages, graphical user interfaces, and entrepeneurs (Bill Gates, Steve Jobs, …)

Image from Xerox PARC in 2020 by Christopher Michel https://commons.m.wikimedia.org/wiki/File:Xerox_PARC_01.jpg

User Illusion and Metaphors

*"At PARC we coined the phrase **user illusion** to describe what we were about when designing the user interface. **There are clear connotations to the stage, theatrics, and magic - all of which give strong hints as to the direction to be followed**. For example, the screen as "Paper to be marked on" is a metaphor that suggests pencils, brushes, and typewriting. Fine as far as it goes. But it is the magic - understandable magic - that really counts. Should we transfer the paper **metaphor** so perfectly that the screen is as hard as paper to erase and change? Clearly not."* (p. 199)

Kay, A. (1990). User interface: A personal view. In B. Laurel, (Ed.), The art of human computer interface design (pp. 191–207). Reading , MA : Addison-Wesley.
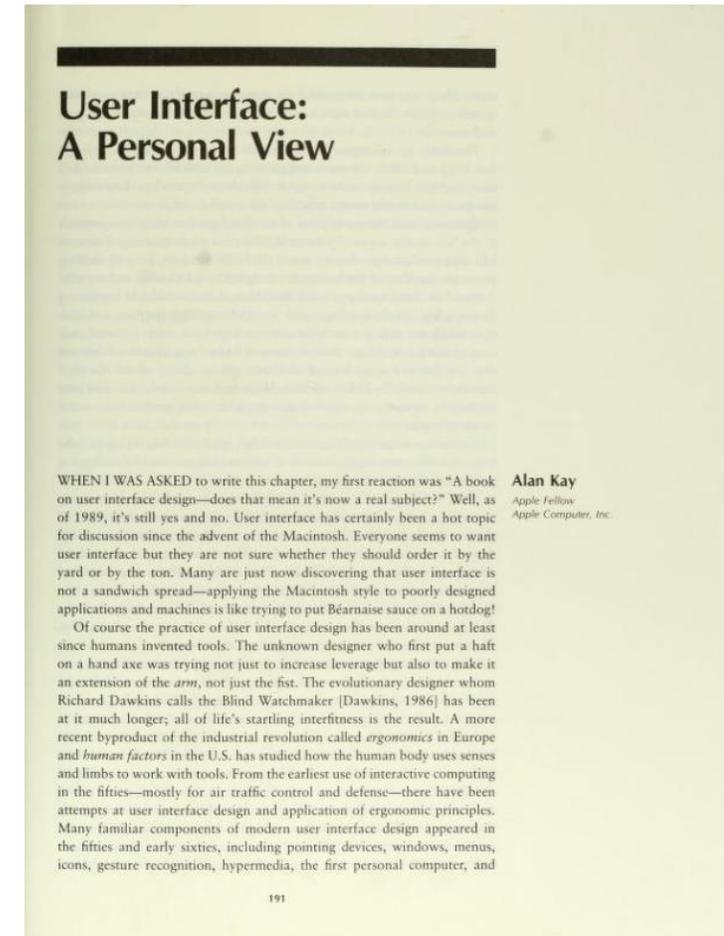
User Illusions and Magic

- **User illusion** describes the **perfect "magical" experience** or **the optimal illusion you want to create**
- The idea is that **users do not need to understand the intricate details of how a system works**; they only need a "useful illusion" that allows them to interact effectively with it.
  - › Implies that hiding unnecessary complexities and only exposing users to essential functionalities, the system becomes more user-friendly
- The primary goal of creating a "User Illusion" is to **facilitate smooth interaction** between the user and the system.
- Discussion:
  - › What supports/enables the user illusion?
  - › What breaks the user illusion?

Image from https://www.pxfuel.com/en/free-photo-jgfkb

Metaphors

- **Metaphors are figures of speech** that describe an object or action as something other than what it is, usually by drawing a comparison between two seemingly unrelated entities.

- For example:
  - **"Desktop":** used in many operating systems **helps users understand the functions of a computer** by likening it to a familiar physical workspace
  - **"Trash Can"/"Recycle Bin"**: used to represent the deletion of files. Just like throwing away physical trash, files can be "dragged" into a virtual trash can or recycle bin.
  - **"Surfing":** "surfing" the web likens the experience to riding waves on a surfboard, capturing the sense of freedom and exploration.
  - **"Streams"/"Feeds"**: used in social media and news platforms to describe the continuous flow of information, much like a river stream or a news feed.

Metaphors

- *"If people employ metaphors in learning about computing systems, the designers of those systems should anticipate and support likely **metaphorical constructions to increase the ease of learning and using** the system."* [1]
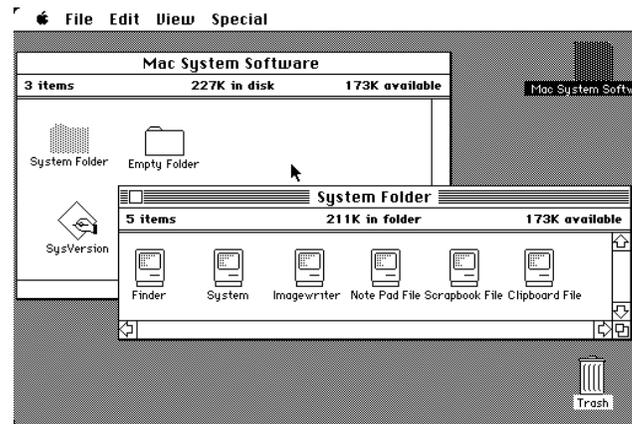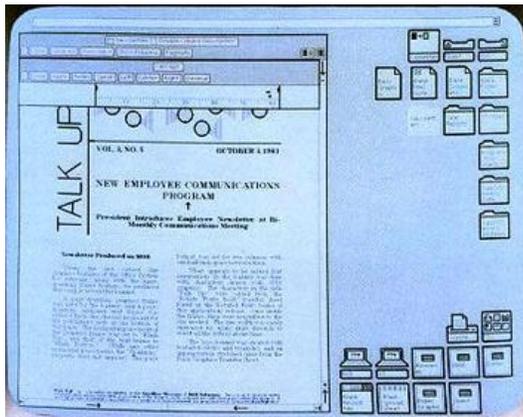
Desktop Metaphor – Alan Kay at Xerox Parc
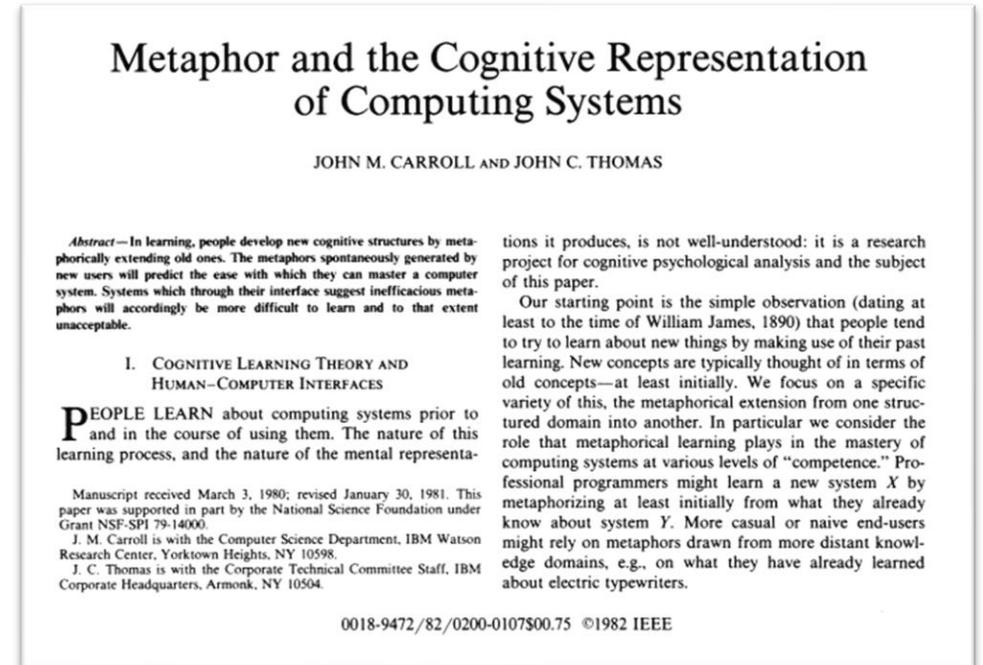
[1] Carroll, J. M., & Thomas, J. C. (1982). Metaphor and the cognitive representation of computing systems. IEEE Transactions on systems, man, and cybernetics, 12(2), 107-116.

Metaphors can cause problems

- *"However, metaphors suffer from numerous problems that make them unsuitable for expressing rich application semantics, and inappropriate for the reusable computational structures we seek. […] Metaphors are slippery things, and not just because **they contain irrelevancies** (do we set the trash can out for garbage pick-up on Friday mornings?) and **incompletenesses** with respect to the domain they are meant to represent. […] Metaphors tempt us to **over-generalize** and to forget distinctions that we should be remembering."* [1]

[1] Nardi, B. A., & Zarmer, C. L. (1993). Beyond models and metaphors: Visual formalisms in user interface design. Journal of Visual Languages & Computing, 4(1), 5-33.

Focus on Technology or User?

Thomas Alva Edison (1880)

Emil Berliner (1887)

Users will win…

- Benefits of a disc
  - › Easy mass-production
  - › Less storage space
  - › Easier shipping
  - › Allows double-sided recordings
  - › Better marketing (front and back face)
  - › People can collect them

Emil Berliner (1887)

Why caring about the user-friendly design?

- **You are surrounded by some misconceptions:**
  - › If I (the developer) can use it, everyone can use it
  - › If our non-technical staff can use it, everyone can use it
  - › Good designs/user interfaces are applied common sense
  - › A system is usable if all standards, norms, and style guidelines are met
  - › Users will/must understand what I (the developer) meant
  - › Users will/must adapt
  - → That is why a process is required
- **However, if you do not care about a users and userfriendly design, your product will fail.**

Designing for Users

- *"Any system designed for people to use should be **easy to learn** (and remember], **useful**, that is, contain functions **people really need** in their work, and be **easy and pleasant to use**."*

- *"…three principles of system design which we believe must be followed to produce a useful and easy to use computer system […]"*
  - › Early focus on users and tasks
  - › Empirical measurement
  - › Iterative design

Key Principles by Gould and Lewis, 1985
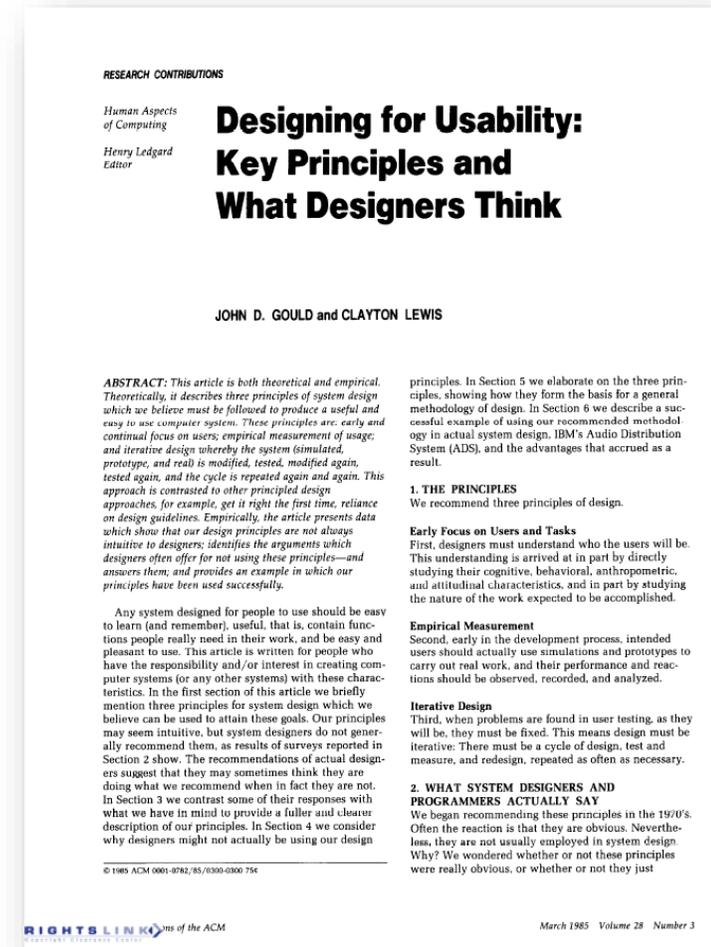
Four Basic Activities of Interaction Design

- We must **understand computers** (limitations, capacities, tools, platforms)
- We must **understand people** (psychological, social aspects, human error)
- **Interactions** between computers vs people **are too complex**
  1. **Identifying needs** and establishing requirements for the user experience
  2. **Developing alternative designs** that meet those requirements
  3. **Building interactive versions** of the designs
  4. **Evaluating what is being built** throughout the process and the user experience it offers

Understanding the Context

Development of Designs

Protoyping the Designs

Evaluation of the Designs
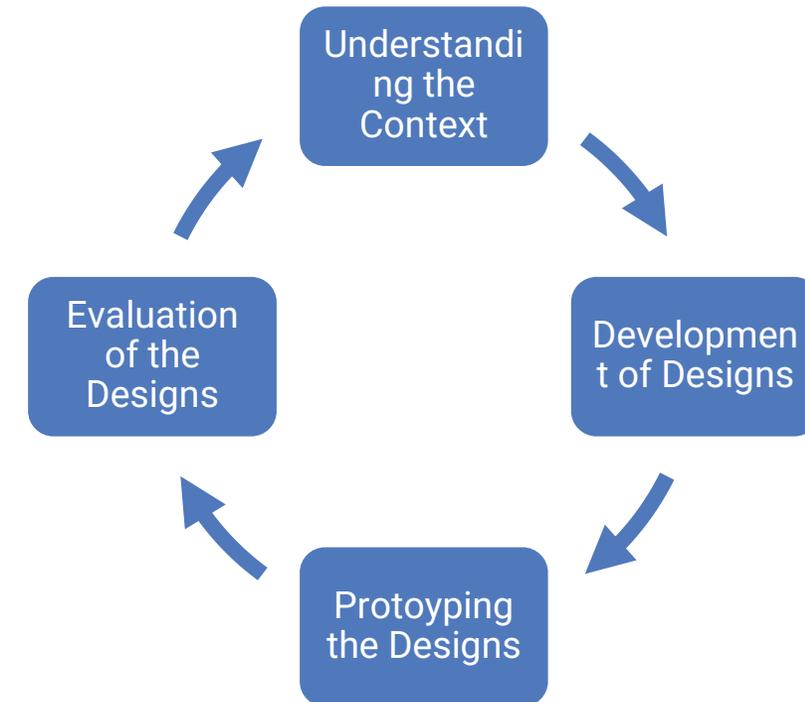
Asking the Users?

That Disastrous Car Homer Simpson Designed Was Actually Ahead of Its Time

Homer Simpson once designed a spectacularly bad car...or was it just ahead of its time?

FOX
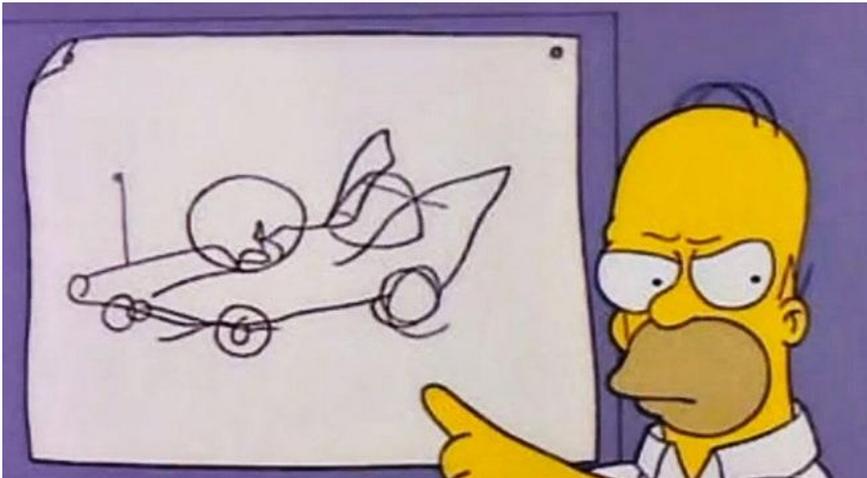
Screenshots from https://www.wired.com/2014/07/homer-simpson-car/ Images from FOX STUDIOS

User Needs

- **Functional Needs**: Task-oriented needs, specifying what the system should do

- **Usability Needs**: The "ease of use" of a system and encompass factors like affordance, intuition, and efficiency

- **Emotional Needs**: The psychological aspects of interaction, such as enjoyment, trust, and aesthetics

- **Informational Needs**: Users often seek specific information or wish to accomplish certain goals to gain knowledge

- **Accessibility Needs**: The system should be accessible with handicaps or disabilities

- **Social and Cultural Needs**: These needs take into account the social and cultural context in which the system will be used

Norman, D. A. (1988). The Design of Everyday Things. Basic Books.
Rubin, J., & Chisnell, D. (2008). Handbook of Usability Testing: How to Plan, Design, and Conduct Effective Tests. Wiley.

Maslow's Hierarchy of Needs

Self-actualization
morality, creativity, spontaneity, problem solving, lack of prejudice, acceptance of facts

Esteem
self-esteem, confidence, achievement, respect of others, respect by others

Love/Belonging
friendship, family, sexual intimacy

Safety
security of body, of employment, of resources, of morality, of the family, of health, of property

Physiological
breathing, food, water, sex, sleep, homeostasis, excretion

Instagram?
Tinder?
TikTok?
Photoshop?
Amazon?
Google?
LinkedIn?
DeviantArt?

Task-Artifact Cycle

- Humans have changing needs and preferences

- Technologies are created once to suit these needs

- As and when humans use the technologies needs and preferences change
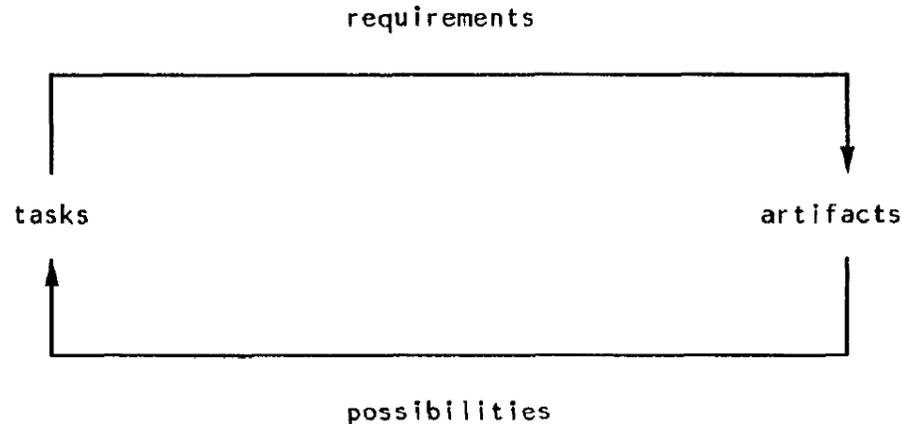
John M. Carroll. 1990. Infinite detail and emulation in an ontologically minimized HCI. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '90). Association for Computing Machinery, New York, NY, USA, 321–328. DOI:https://doi.org/10.1145/97243.97303

INFINITE DETAIL AND EMULATION IN AN ONTOLOGICALLY MINIMIZED HCI

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ABSTRACT
By default, we attempt to define practical areas of technological endeavor as "applications." For example, the applied psychology of human-computer interaction has characteristically been defined in terms of the methods and concepts basic psychology can provide. This has not worked well. An alternative approach is to begin from a characterization of current practice, to take seriously the requirements of the domain of endeavor, and to define areas of "science" and "application" as possible and appropriate in that context.

KEYWORDS: ontology, theory, hermeneutics, interpretation, task-analysis, design rationale

One of the most appealing aspects of human-computer interaction (HCI), and also one of the most vexing, is the commitment — pursued energetically through the 1980s — to produce an intellectually rich applied psychology that could effectively support the design of usable computer equipment. Appealing chutzpah! The general case is that basic science provides uncertain and indirect support to practical endeavors [4, 20, 24, 29].

This ambitious project in HCI has unfortunately not succeeded, however, at least not yet. The most sustained, focussed and sophisticated attempts to develop explicit extensions of academic information processing psychology for HCI have had no discernible impact on design practice [8, 34]. Indeed, even the more mundane efforts to adapt the laboratory methods of experimental psychology have often foundered: to get clear and statistically strong results, too many investigators have been led to "discover," for example, that organized menus are better than disorganized menus [25].

The key problem is that both the concepts and the methods of basic psychology have been specialized for simple and abstract situations. Too much attention was paid to applying psychology and too little to understanding what it was that psychology was being applied to.

In this paper, I adopt a framework developed by Pat Wright, John Long and Phil Barnard for understanding applied psychology. I seek to develop this framework to address two difficult requirements in the HCI domain, that I call Infinite Detail and Emulation. The general thrust of my approach is to urge that we take seriously as *scientific* objects the objects that are of obvious practical importance in the everyday commerce of a domain (hence the term "ontologically minimized"). In HCI, the important objects are user tasks and designed artifacts. This approach meets the requirements that no other approach can, and because it is built out of the practical essence of the domain, it offers unique and direct leverage for the pragmatics of design as well.

INFORMATION FLOW
How can we do better at coordinating and integrating basic science with practical endeavor? An interesting line of thinking starts with Wright's [41] examination of the relationships between pure and applied work on text. She found "few points of contact" between psycholinguistics and design of text. She suggested an "information flow among researchers ... that starts with applied solutions to practical problems, continues through pure explanations of why these solutions are successful, and so enables the refinement of the original applied solutions."

John Long [27] and Phil Barnard [2] are developing a framework for understanding the activity in HCI as what amounts to an information flow in Wright's sense. (From my standpoint, it is convenient to collapse Long and Barnard's work, though they would clearly want to make distinctions). This is sketched in Figure 1 (based on figures from Long and Barnard). The key idea is that science provides a *representation* of the real world. To construct and to apply this representation, we must be able to map between it and the world. This mapping involves intermediary, or bridging representations, specialized for the intended domain of endeavor.

Key Principles

Early Focus on Users and Tasks: First, designers must understand who the users will be. [...] studying their cognitive, behavioral, anthropometric, and attitudinal characteristics, and in part by studying the nature of the work expected to be accomplished.

Empirical Measurement: Second, early in the development process, intended users should actually use simulations and prototypes to carry out real work, and their performance and reactions should be observed, recorded, and analyzed.

Iterative Design: Third, when problems are found in user testing, as they will be, they must be fixed. This means design must be iterative: There must be a cycle of design, test and measure, and redesign, repeated as often as necessary.

Key Principles by Gould and Lewis, 1985

Summary

- Humans have their **own perception** and a **basic set of needs**

- **Customization** is a good way for **personalized experiences**, however, **asking** the user is **not sufficient to reveal the user needs**, **goals**, and **economic solutions**

- Maslow states a **hierarchy of needs** (physiological needs, safety needs, love needs, esteem needs, need for self-actualization)

- The **task-artifact cycle** describes how humans use the **technologies changes needs**

- In real world scenarios it is likely that **user needs are conflicting**

- Understanding **user needs is essential**, **but** this is **not sufficient** to create a successful product

Mental Models

Human-Computer Interaction Lecture

The Mental Model of Room Heating

- You came back and it is only 15°C in your room. You want a room temperature of 21°C. What do you do?

  1. You put the thermostat to 21°C and wait

  2. You put the thermostat to max (=35°) and switch it back to 21° once it is warm?

- What different mental models do people have who chose strategy 1 or 2?
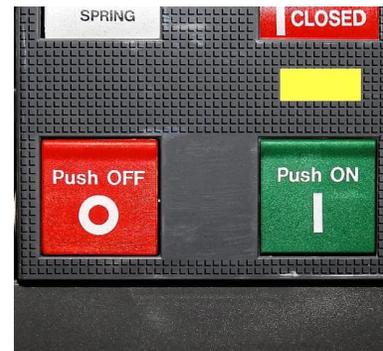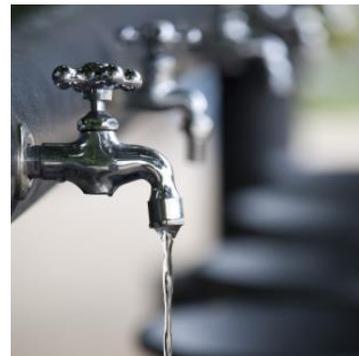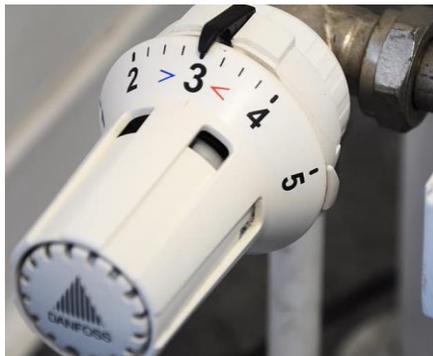
William Hudson. Mental Models, Metaphor and Design (2003).UK UPA and HCI2003 http://www.syntagm.co.uk/design/articles/mmmad.pdf

How the user reasons and understands

- Kenneth Craik (1943): *"the mind constructs '**small-scale models**' of reality that it uses **to anticipate events**, **to reason**, and **to underlie explanation**"*

- Users acquire mental models by

  › **Interaction** / **observation**

  › **Explanation**

- Two types

  › **Functional** – users know what to do, but not why

  › **Structural** – users know why to do something

William Hudson. Mental Models, Metaphor and Design (2003).UK UPA and HCI2003 http://www.syntagm.co.uk/design/articles/mmmad.pdf

Learning from Failures

- **Signs and explanations** are an indicator for a **potential design problem**
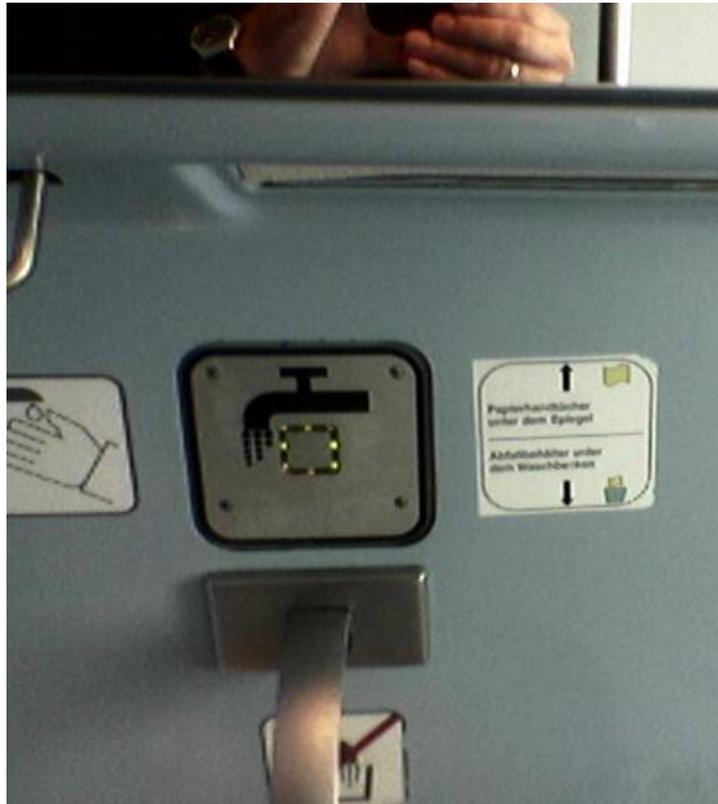
Images from Albrecht Schmidt

What is a Mental Model?

- *„In human-computer interaction research, the notion of "mental models" has come to be a very general catch-phrase for **anything having to do with end users' knowledge** of an application (van der Veer, 1990). There is a feeling that **if we could "capture" mental models, then we could build good interfaces** […] But many […] are much less convinced of the alleged benefits of mental models and of our ability to use them for reasoning or other complex cognition. […] Researchers who have investigated mental images have been struck by how **incomplete and inflexible they** are…"* [1]

[1] Nardi, B. A., & Zarmer, C. L. (1993). Beyond models and metaphors: Visual formalisms in user interface design. *Journal of Visual Languages & Computing, 4*(1), 5-33.

Mental Model by Jakob Nielson

- A mental model is what the user believes about the system at hand

- *"A mental model is based on **belief, not facts**: that is, it's a model of what users know (or think they know) about a system such as your website. Hopefully, users' thinking is closely related to reality because they **base their predictions** about the system on their mental models and thus plan their future **actions** based on how that model predicts the appropriate course."*

- *"It's a **prime goal for designers to make the user interface communicate the system's basic nature** well enough that users form reasonably accurate (and thus useful) mental models."*

Jakob Nielsen. Mental Models on October 17, 2010 https://www.nngroup.com/articles/mental-models/

Three Mental Models

- **Conceptual Model** = **Designer Model**: "A conceptual model is a high-level description of how a system is organized and operates." [1]
  - › is deliberately designed
  - › it allows to user to understand and operate the UI
  - › it draws on prior knowledge of the user
  - › is communicated through the interface and interaction design
- **Mental Model** = **User Model** = **User's Conceptual Model**
- **System Model** = **Programmer's Conceptual Model** = **Programmer's Model** = Implementation Model

[1] Johnson, J., & Henderson, A. (2002). Conceptual models: begin by designing what to design. *interactions*, *9*(1), 25-32.

Conceptual Model

- The model the designers wants the user to have

- The conceptual model

  › is deliberately designed

  › allows to user to understand and operate the UI

  › draws on prior knowledge of the user

  › is communicated through the interface and interaction design

- *"A conceptual model is a high-level description of how a system is organized and operates."* [1]

FIGURE 1.11. The Designer's Model, the User's Model, and the System Image. The designer's conceptual model is the designer's conception of the look, feel, and operation of a product. The system image is what can be derived from the physical structure that has been built (including documentation). The user's mental model is developed through interaction with the product and the system image. Designers expect the user's model to be identical to their own, but because they cannot communicate directly with the user, the burden of communication is with the system image.

[1] Johnson, J., & Henderson, A. (2002). Conceptual models: begin by designing what to design. *interactions*, *9*(1), 25-32.
[2] Norman, D. A. (2013). The design of everyday things: Revised and expanded edition. New York: Doubleday.

Mental Models for Designers, Programmers, Users
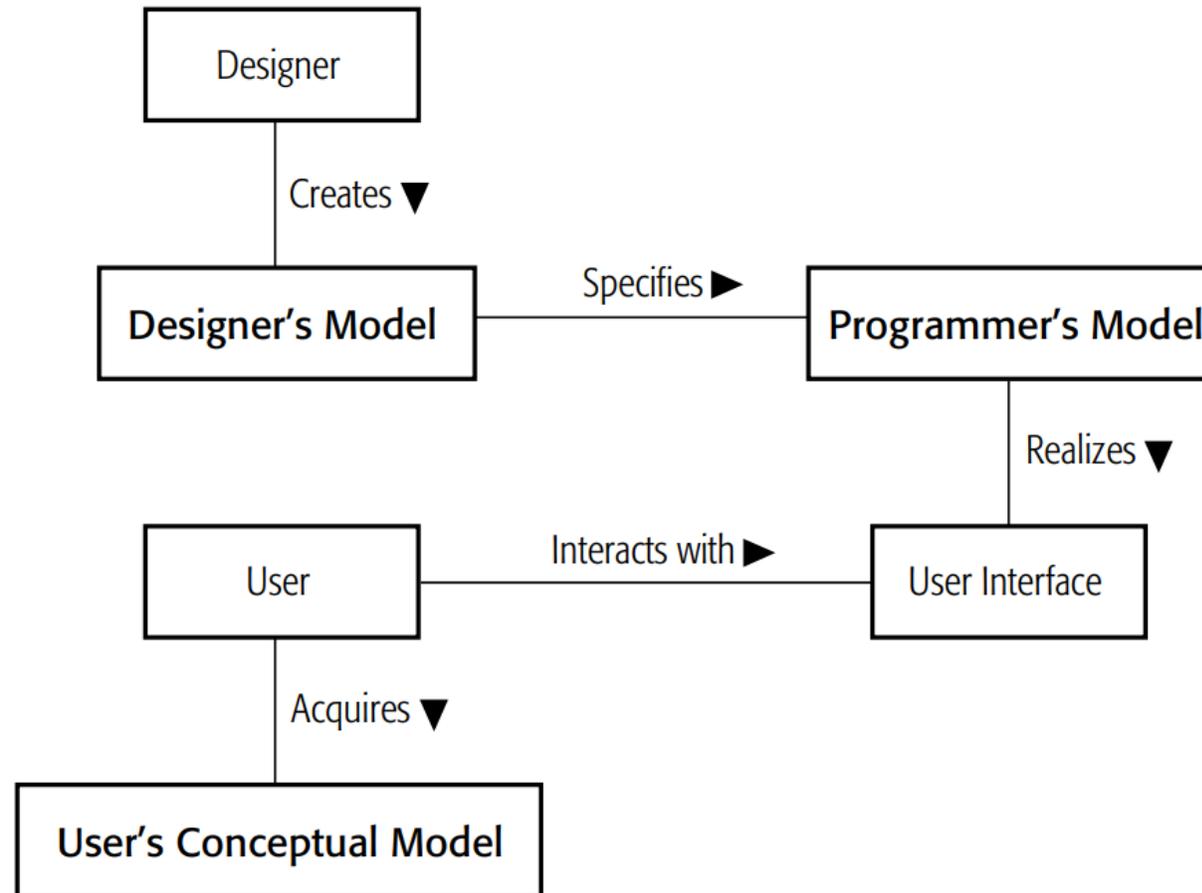
Hudson, W. (2001). Toward unified models in user-centered and object-oriented design. Object Modeling and User Interface Design: Designing Interactive Systems, 313-362.

Human-Centered Design (ISO 9241-210)

Human-Computer Interaction Lecture

Image from: https://pxhere.com/de/photo/1451435

Prof. Dr. Valentin Schwind

The Human, the Person, and the User

Image from https://pixabay.com/de/photos/frau-alte-faltig-alte-frau-portr%c3%a4t-1795054/

User-Centered Design or Human-Centered Design ?

- **Human-centered is the more modern term**

- The terms user-centered design and human-centered are used interchangeable.

- **Human-centered focus on the person as a whole** and not only the role of the human as a user

- The **ISO 9241-210 Human-centered design for interactive systems** addresses the rationale for adopting human-centered design

  › Enforces a separation between interaction design and technical realization

ISO Standards and DIN Norms

Images from: https://pixabay.com/de/photos/industrie-bolzen-verschluss-3075420/ https://pixabay.com/de/photos/schraube-schraubenmutter-metall-2117600/

ISO 9241 - Ergonomics of Human−System Interaction
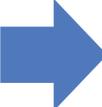
- 100 series: **Software ergonomics**
- 200 series: **Human system interaction processes**
- 300 series: **Displays and display related hardware**
- 400 series: **Physical input devices - ergonomics principles**
- 500 series: **Workplace ergonomics**
- 600 series: **Environment ergonomics**
- 700 series: **Application domains - Control rooms**
- 900 series: **Tactile and haptic interactions**

ISO 9241 Ergonomics of human−system interaction

INTERNATIONAL STANDARD

ISO 9241-210

First edition
2010-03-15

Ergonomics of human−system interaction —

Part 210:
Human-centred design for interactive systems

Ergonomie de l'interaction homme–système —

Partie 210: Conception centrée sur l'opérateur humain pour les systèmes interactifs

Reference number
ISO 9241-210:2010(E)

© ISO 2010
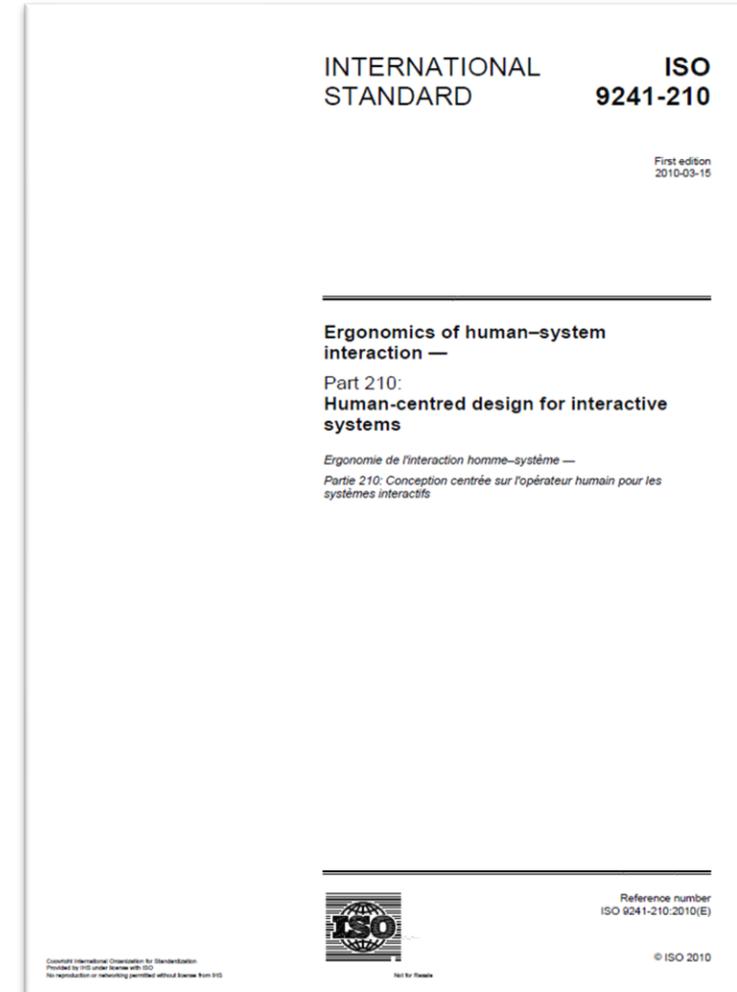
Part 210: Human-Centered Design for Interactive Systems

- Table of Contents
  1. Scope
  2. Terms and definitions
  → 3. Rationale for adopting human-centered design
  4. Principles of human-centered design
  5. Planning human-centered design
  6. Human-centered design activities
  7. Sustainability and human-centered design
  8. Conformance

ISO 9241 Ergonomics of human−system interaction

INTERNATIONAL STANDARD

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Partie 210: Conception centrée sur l'opérateur humain pour les systèmes interactifs

Reference number
ISO 9241-210:2010(E)

© ISO 2010
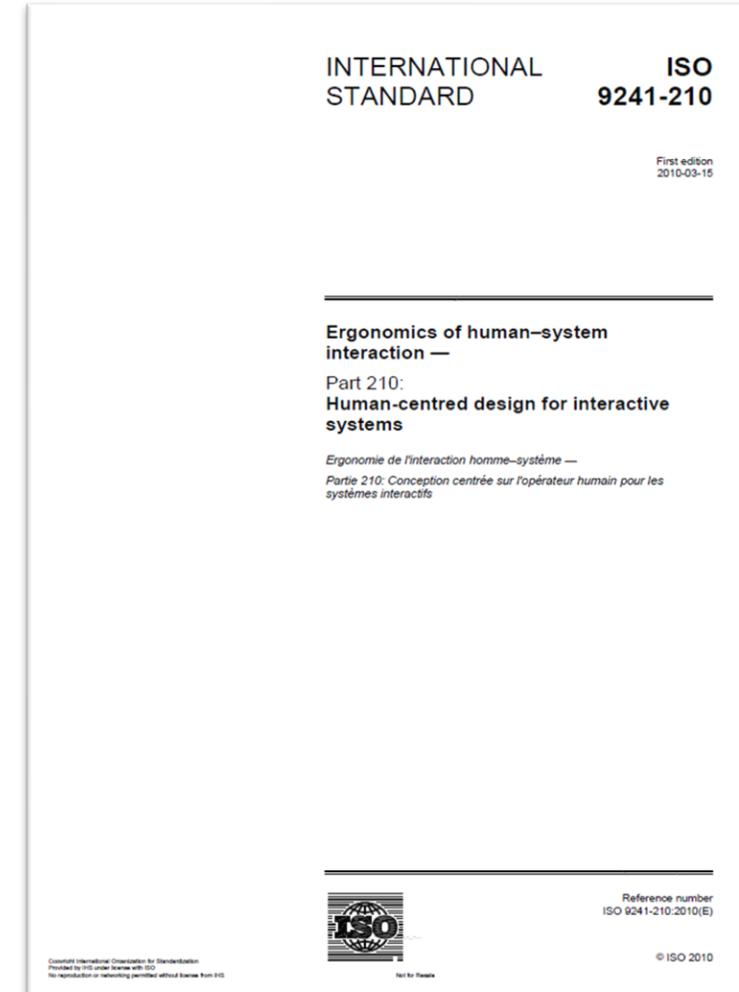
3. Rationale for adopting human-centered design

- "Using a human-centered approach to design and development has substantial **economic and social benefits for users, employers and suppliers**. Highly usable systems and products tend to be more **successful both technically and commercially**."

- "Systems designed using human-centred methods improve quality, for example, by:
  - a) increasing the **productivity** of users and the operational efficiency of organizations;
  - b) being **easier to understand and use**, thus reducing training […] costs;
  - c) increasing usability for **people with a wider range of capabilities** […]
  - d) improving user experience;
  - e) **reducing** discomfort and **stress**;
  - f) providing a **competitive advantage** […]
  - g) contributing towards sustainability objectives."

ISO 9241-210:2019(EN) Human-centered design for interactive systems

4. Principles of human-centered design

- a) the design is based upon an explicit **understanding of users, tasks and environments** […]

- b) **users are involved** throughout design and development […]

- c) the design is **driven and refined by** user-centered **evaluation** […]

- d) the process is **iterative** […]

- e) the design addresses the **whole user experience** […]

- f) the design team includes **multidisciplinary skills** and perspectives"

ISO 9241-210:2019(EN) Human-centered design for interactive systems

6. Human-centered design activities

"a) understanding and specifying the **context of use**"

> *What are the tasks or objectives associated with the design?*

"b) specifying the **user requirements**"

> *What expectations or requirements must the design accommodate?*

"c) producing **design solutions**"

> *prototyping, rendering, mockup building, implementation*

"d) **evaluating** the design"

> *conduct initial evaluations, usability testing, and ergonomic assessment*

ISO 9241-210:2019(EN) Human-centered design for interactive systems

The Human-centered design process

Plan the human-centered design process

Understand and specify the context of use

Specify the user and organizational requirements

Product design solutions to meet the user requirements

Evaluate designs against requirements

Design solution meets the user requirements

iterate where appropriate

ISO 9241-210:2019(EN) Human-centered design for interactive systems

The Human-centered design process (slow cycle)

Plan the human-centered design process

Design solution meets the user requirements

iterate where appropriate

Understand and specify the context of use

Evaluate designs against requirements

very slow

Specify the user and organizational requirements

ISO 9241-210:2019(EN) Human-centered design for interactive systems

The Human-centered design process (fast cycle)

Plan the human-centered design process

Understand and specify the context of use

Design solution meets the user requirements

iterate where appropriate

Evaluate designs against requirements

very fast

Specify the user and organizational requirements
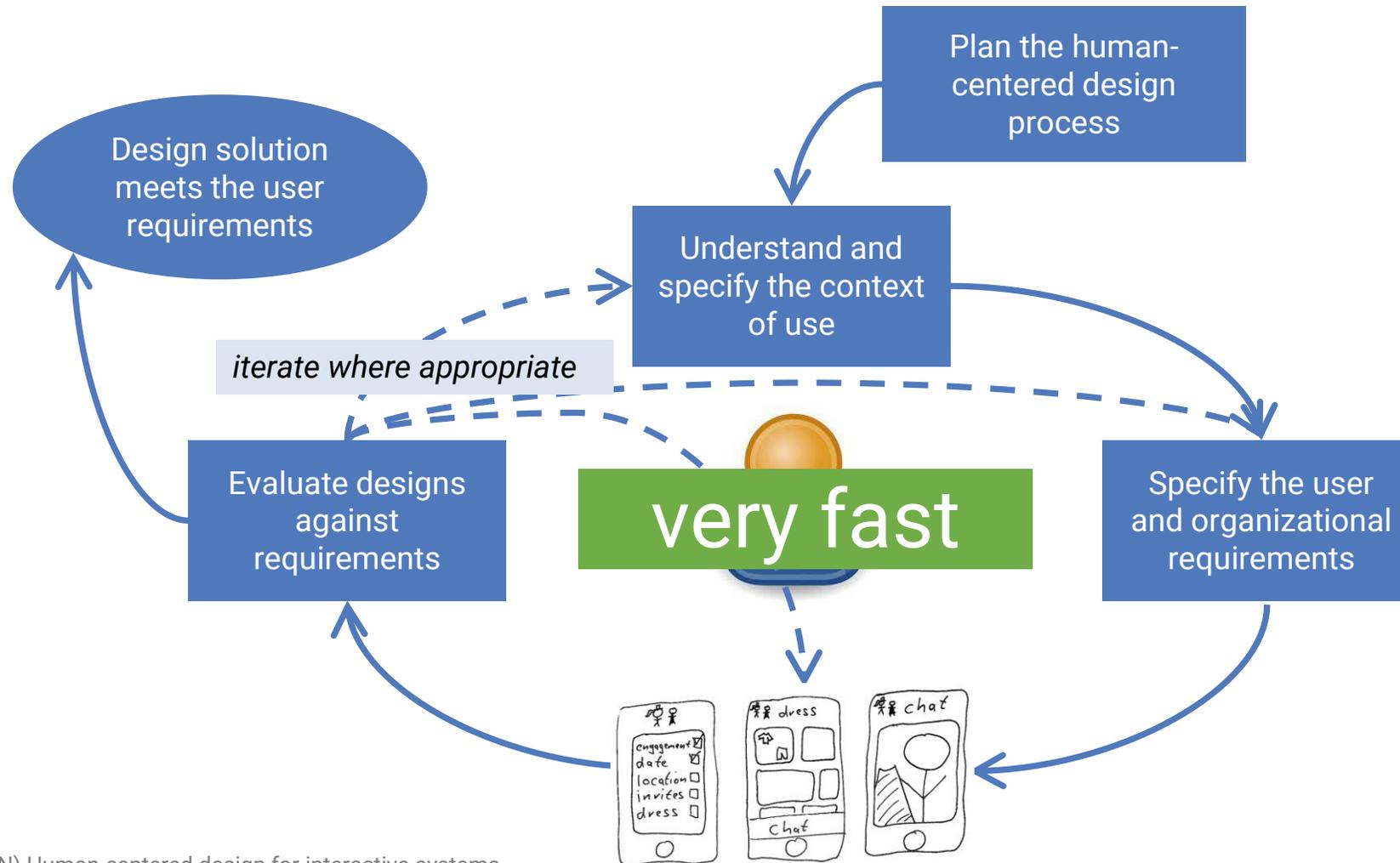
ISO 9241-210:2019(EN) Human-centered design for interactive systems

The Typical Separation

- **1st – Concept Development and Interaction Design** (quick iterations)
  - Application and interaction concept
  - Interaction design
  - Prototypes to evaluate the concept and interaction design
- **2nd – Technical Realization** (slow iterations)
  - Technical analysis
  - Technical specification (e.g. architecture, platform)
  - Implementation
  - Evaluation and Quality management

Waterfall vs Human-Centered Design Process

- Will the Human-Centered design process work well with the **waterfall model**?
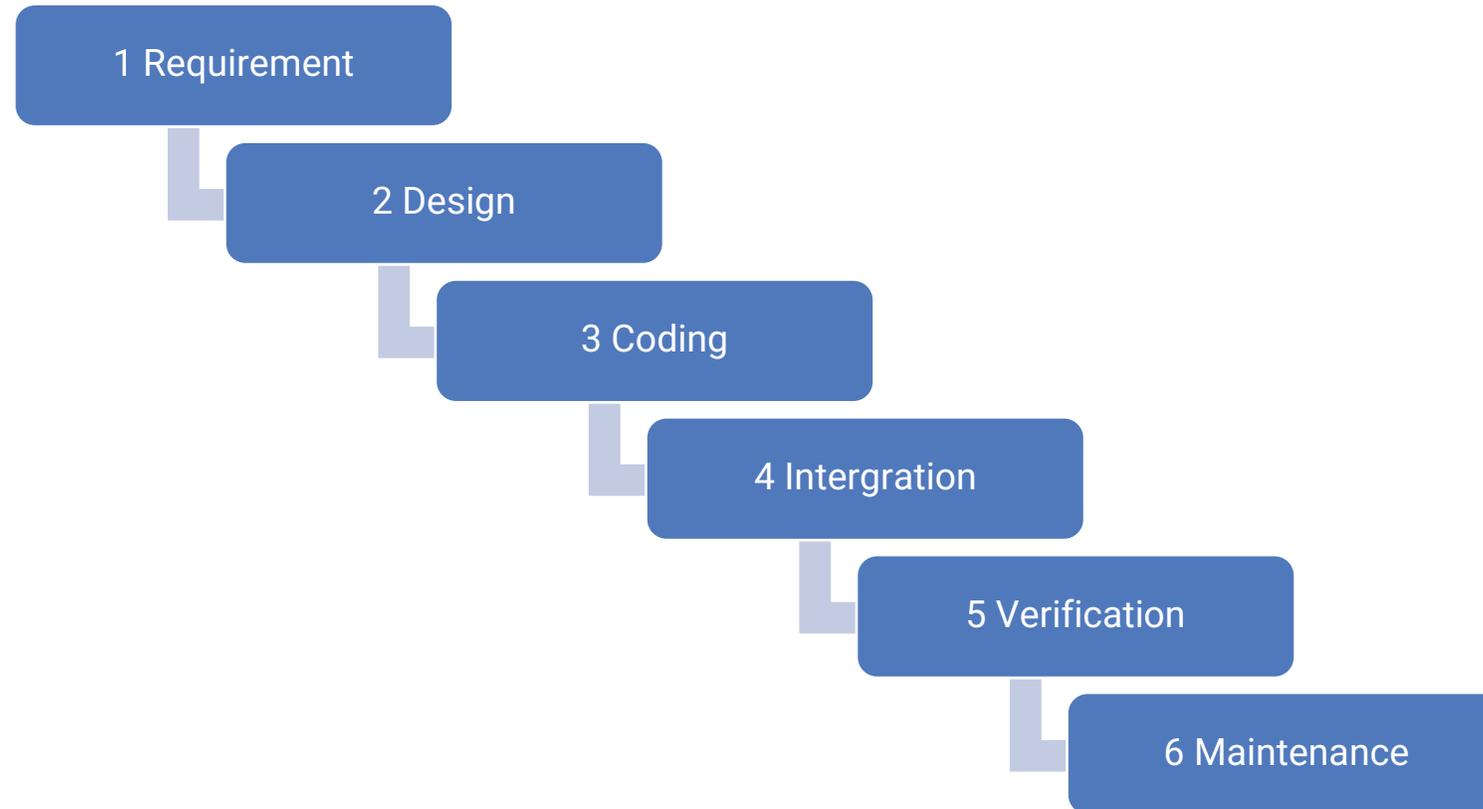
Agile/SDLC vs Human-Centered Design Process

- Will it fit with **Agile Development** and **Software Development Life Cycles (SDLC)**?
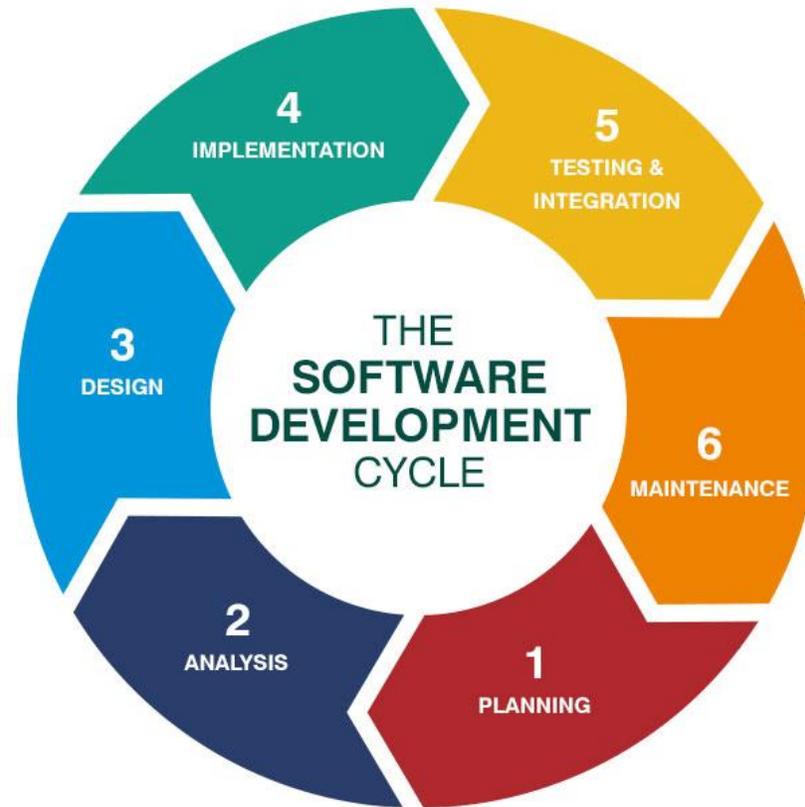

Image from https://saigontechnology.com/blog/6-stages-for-software-development-procedure-you-need-to-know

Problems of Human-Centered Design

- Users may
  - › **expect disadvantages** (e.g., being replaced by software)
  - › **have conflicting views** (e.g., Mike likes dark surfaces, Daisy likes pink)
  - › **be wrong** (e.g., "I am quicker with my old mouse")
  - › **be resistant** to change (e.g., "I do that every time in this way")
- **In a "business environment"** you are expected to create a system with regards to the **goals specified by stakeholders** and this is unfortunately **NOT necessarily the system users would like to have**
  - › More iterations are required, difficult to predict their outcomes, and the process lasts longer if the requirements are not satisfied (stakeholders hate that)
  - › Difficult to find a trade-off between the goals of customer or stakeholders, the users, and the project developers (typically you)

Working in Multidisciplinary Teams

- **Many people are involved in the process of designing and implementing an interactive product**
  - › Different background (e.g. design, business, CS, marketing, administration)
  - › Different and conflicting high and low level objectives
  - › Different views and opinions
- **Communication can be very difficult**!
  - › To be able to work in a team is essential!
  - › Team work is a skill that can be learned
  - › Competence of this course
  - › Working remote vs onsite?
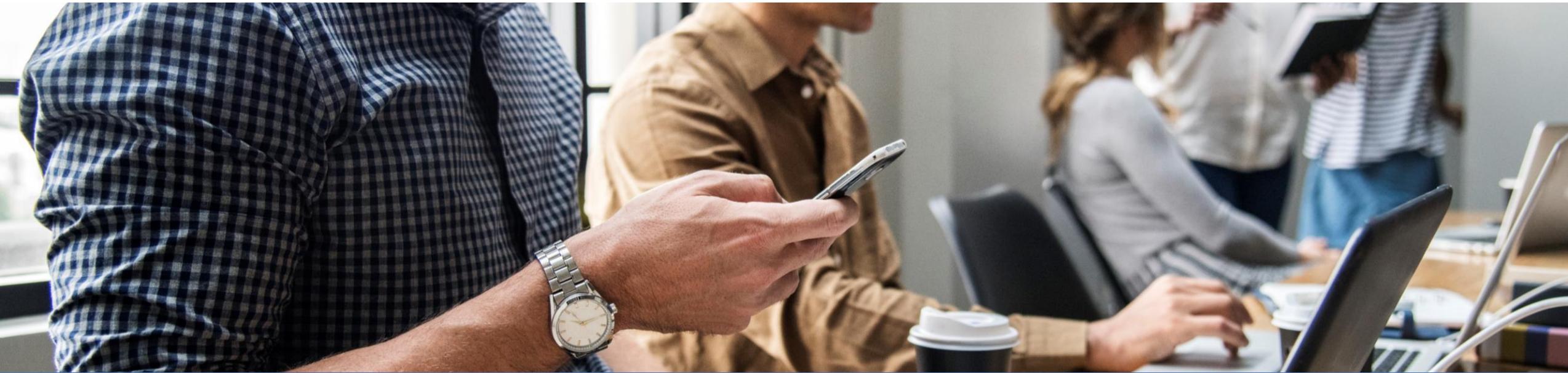
Know your Users and their Tasks

Human-Computer Interaction Lecture

Image from: https://pxhere.com/de/photo/1451191

Prof. Dr. Valentin Schwind

Who is the User? We need respect for…

- **Diversity** of the individual
  - › Each of you has inherently different requirements for their interaction with computers
- **Demographics** (gender, age, nationality, culture):
  - › goals, motivation, personality, …
  - › education, cultural background, training, …
  - › age, gender, physical abilities, …
- **Training** and previous knowledge:
  - › Novice users
  - › Knowledgeable intermittent users
  - › Expert frequent users
  - › Users who think that they know how it works, but they didn't

Where is the Average User?

- In empirical research, **we always assume an average user**

- However, **there is no average user, and any number can lie!**

- Number game…

  › Creating a software that is appropriate for a very specific target group (e.g., 0,1% of the population) may still find a large user base, e.g., in Europe and the US this may be more than half a million people

  › Designing for 90% of the users will leave alone in Germany 8 million users out

- Therefore, it is often better to focus on certain target groups. For a requirement analysis including target groups, HCI researchers of use **Personas**

  › Typical, representative users with individual needs – but not the average

Personas

- **Personas are fictional yet realistic representations of target user groups** encapsulating their needs, goals, and pain points.
- They **allow interaction designers and developers to create more targeted and effective solutions** as they often assume (implicitly) that users have the same goals and abilities.
  - › For example, if a persona representing an elderly user highlights the need for simplified navigation, the design team can prioritize this feature, thereby making the product more accessible to that demographic.
- Personas can serve as **common reference** that can be easily communicated across different departments in an organization (from design to customer support).
- Employing personas **minimizes the risk of developing features or products that do not resonate with the end-users.**
- If not well-crafted, they can lead to stereotypes and may not represent the user base accurately.

Ethnography?

- Example: https://de.statista.com/

Medien › Videospiele & Gaming

Verteilung der Videogamer in Deutschland nach Alter im Jahr 2023

© Statista 2023

Image from
https://mariamz.wordpress.com/2011/05/10/online-ethnography-for-social-media-research-and-reporting/

PERSONA LARA SCHNEIDER

VERSION: 1.0

"Meine Familie ist mir das wichtigste. Ich mache vieles, damit es ihr gut geht."

Alter	**35**
Beruf	**Industriekauffrau (halbtags)**
Wohnort	**Städtisch, Eigentumswohnung**
Familienstand	**Verheiratet, 2 Kinder (4 & 2)**
Kunde?	**Nein**
Milieu	**B23 Bürgerliche Mitte**

Gains (Lust) aktueller Produkte

- Hohe Qualität der Ware
- Genussfaktor
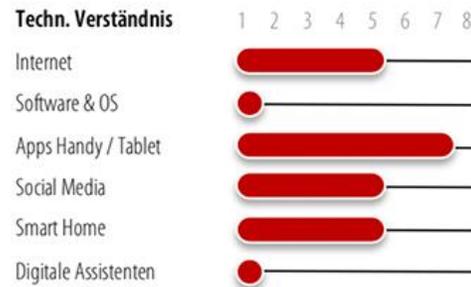- (meist) freundlicher Kontakt mit Lieferanten an der Tür

Pains (Frust) aktueller Produkte

- Dass die Kinder in der Hinsicht spezielle Vorlieben haben – sie will möglichst vermeiden, "doppelt" zu kochen.
- Fehler in Apps / Webshops
- Unsicherheit, was zu ihrer angepassten Ernährungsweise (⟶ Gewichtsreduktion) in den Speiseplan passt
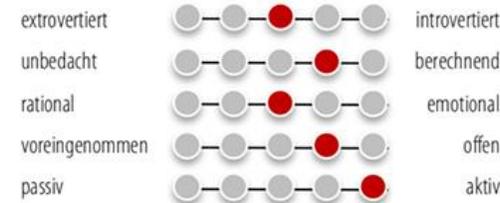
Aktivierungsfaktoren

Anreiz, Angst / Sorge, Leistungsangebot, Persönliches Wachstum, Relevanz, Soziale Aspekte

Techn. Verständnis

Internet, Software & OS, Apps Handy / Tablet, Social Media, Smart Home, Digitale Assistenten

Jobs-to-be-done

- Wenn ich als Familienmanagerin die Mahlzeiten meiner Familie plane, dann möchte ich, dass ich die unterschiedlichen Geschmäcker treffe und nicht zu viel Zeit für die Zubereitung aufwende, damit ich im eng getakteten Alltag nicht in Zeitnot gerate.
- Wenn ich das Essen für meine Familie zubereite, dann möchte ich passendes, schmackhaftes, gesundes und qualitativ hochwertiges Essen servieren, damit die Kinder anständig essen und ich nichts wegwerfen bzw. selber aufessen muss.

Persönlichkeit

extrovertiert – introvertiert
unbedacht – berechnend
rational – emotional
voreingenommen – offen
passiv – aktiv

Erreichbarkeit

Post, Zeitungsanzeige, E-Mail, Online-Banner, Social Media Post & Ads, Blogs, Persönliche Empfehlung, Events / Öffentliche Orte

Hypothesen

- Die Produkte helfen ihr aufgrund der einfachen Zubereitung und Lieferung bei ihrer eigenen Zeittaktung dabei, den Tag planbarer zu machen.
- Der Bestellkanal mit der Empfehlung von passenden und ähnlichen Produkten ihr bei der Planung der Mahlzeiten dabei hilft, die Familie gesund und abwechslungsreich zu ernähren, und damit die Bestätigung zu haben, das richtige gekocht zu haben.
- Der Bestellkanal mit der direkten Abfrage von Wünschen hilft ihr bei der Essensplanung, die richtige Ware problemlos zu bestellen und das richtige zu kochen.
- In einer idealen Welt: Der Bestellweg (Bestellung, Terminvereinbarung, Check-out) ist einfach und intuitiv und unterstützt sie dabei im engen Tagesablauf, keine Zeit zu verlieren.
- Die Produkte helfen ihr aufgrund ihrer Vielfalt und aufgrund ihrer hohen Qualität dabei, die Familie gesund und abwechslungsreich zu ernähren – speziell die Kinder.

Marken, Apps, Personen

Facebook, WhatsApp, FitBit, Aldi, Lidl, Edeka, REWE

Geräte und Plattformen

Samsung-Smartphone, Amazon Echo Dot, Tablet

Image from https://www.ort-online.net/de/news/wie-wir-personas-verwenden.html ORT Medienverbund GmbH, veröffentlich am 10.04.2018

Chia Bee Choo

- 68 years old
- Female
- Widowed
- Lives alone and apart from her 2 children for more than 2 years

Background Information

Used to be quite active in her social circles

Had a major fall a year ago

Limited her mobility, had to stay at home more often

Enjoys watching drama serials on TV

Concerns and Needs

Communication with close friends and family

Values her privacy

Unfamiliar with modern communication methods e.g. Skype

Wants to call family members but unsure of what to talk about

How might we help elders at home stay active and engaged in their social circles?

- Interaction methods should be familiar and inituitive
- Should be open-ended and ambiguous to inspire new uses
- Has to be non-obligatory and respect user's privacy

How to create personas

1. **Data Collection:** Gather qualitative and quantitative data about the target audience through **interviews**, **surveys**, **log data**, or **ethnography**

2. **Analysis and Segmentation:** Analyze the collected data, cluster, and segment it to identify **common characteristics or behaviors**.

3. **Drafting Personas:** Create one or more personas based on the segmentation, each with a **name**, **image**, and **detailed description**.

4. **Validation:** Validate the personas with real users or stakeholders to **ensure their relevance and accuracy**.

5. **Implementation:** Integrate the validated personas into the development process as a **reference or template for design decisions**.
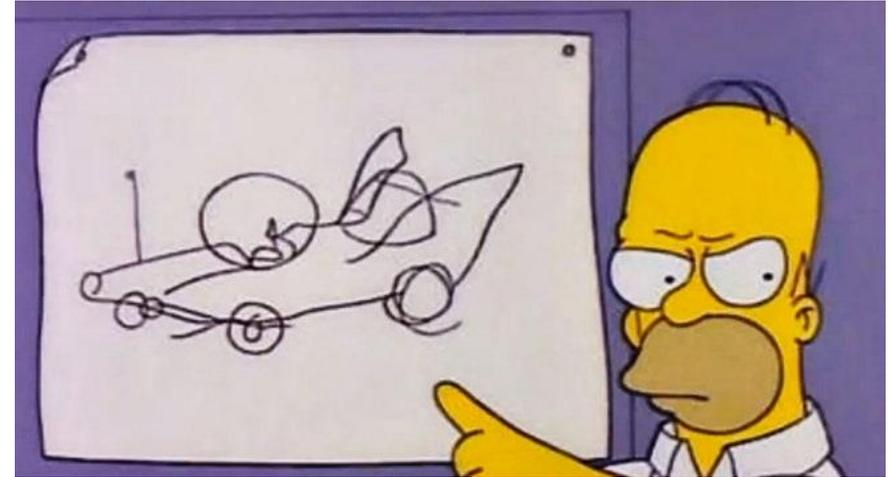
Personas for Car Design

- **Personas and goals**
  - Alesandro (fast and fun)
  - Marge (safe, comfortable)
  - Dale (big loads, reliable)
  - Homer (automated driving, custom horn sounds, separate soundproof dome for kids, cup holders for soda cups from Kwik, easy entry)
- **Results in designs that differ**, e.g.
  - Porsche
  - City SUV
  - Pick-up
  - Homer's custom car

Screenshots from https://www.wired.com/2014/07/homer-simpson-car/ Images from FOX STUDIOS

User-Needs vs Task Profiles

- Find out what the user is trying to do!

  › **the goal**

  › what their **needs** are

  › resulting **tasks**

- Supported tasks should be determined before the design starts

- Functionality should only be added if identified to help solving tasks

  › Temptation: If additional functionality is cheap to include it is often done – this can seriously compromise the user interface concept (and potentially the whole software system)!

- **Frequency of tasks** related to **user profiles (personas)**

Task Analysis

- The process of **analyzing the way people perform their jobs**
  - the things they do, the things they act on, and the things they need to know
- There are three different approaches to task analysis, which overlap but which lay their emphases on slightly different areas:
  - **Task decomposition** which looks at the way a task is split into subtasks, and theorder in which these are performed.
  - **Knowledge-based techniques** which look at what users need to know about the objects and actions involved in a task, and how that knowledge is organized.
  - **Entity−relation-based analysis** which is an object-based approach where the emphasis is on identifying the actors and objects, the relationships between them and the actions they perform.

Dix, A. J., Finlay, J., Abowd, G. D., & Beale, R. (2003). Human-computer interaction. Pearson Education   https://hcibook.com/.

Task Decomposition

- The top-level tasks of "**make a cup of tea**":
  - › 0. make a cup of tea
  - › 1. boil water
  - › 2. empty pot
  - › 3. put thea leaves in pot
  - › 4. pour in boiling water
  - › 5. wait 4 or 5 minutes
  - › 6. pour tea
- Plans help us to define conditions and sequences

Dix, A. J., Finlay, J., Abowd, G. D., & Beale, R. (2003). Human-computer interaction. Pearson Education   https://hcibook.com/.
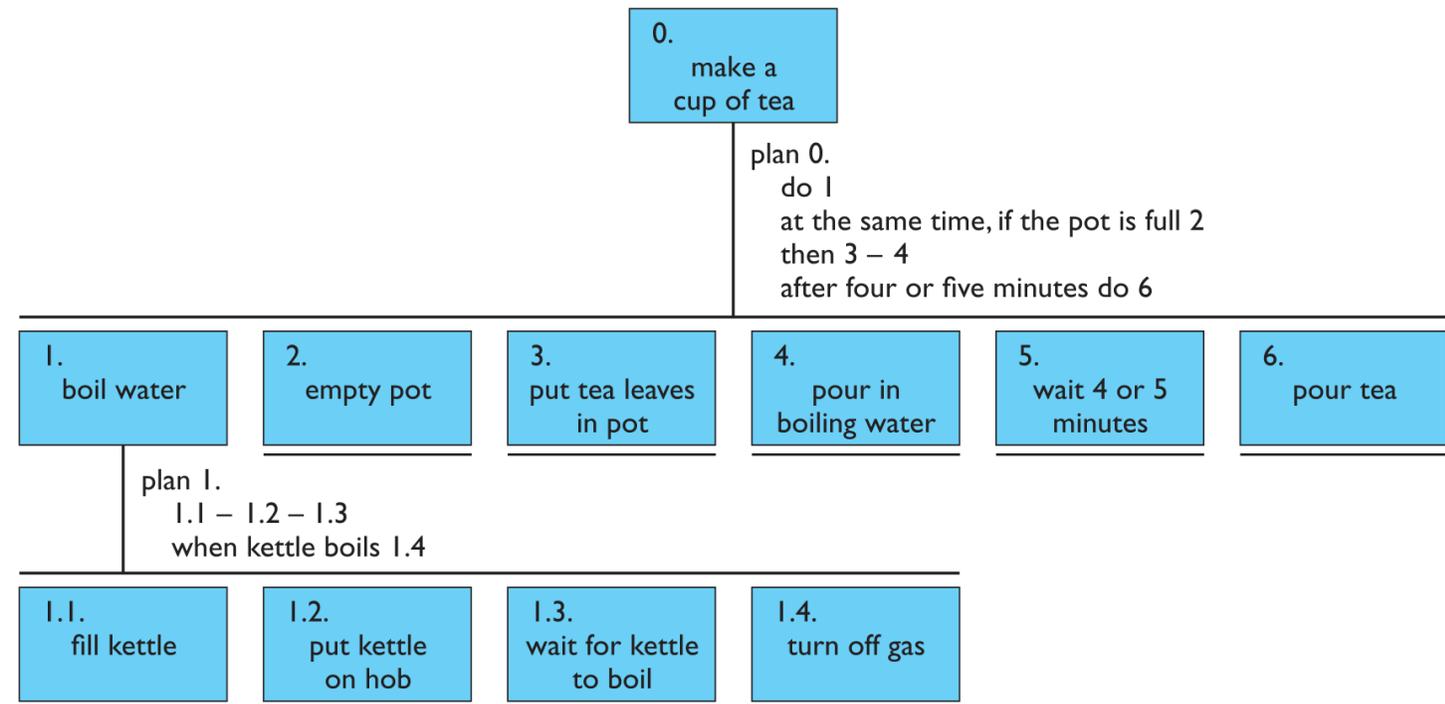
Task Decomposition
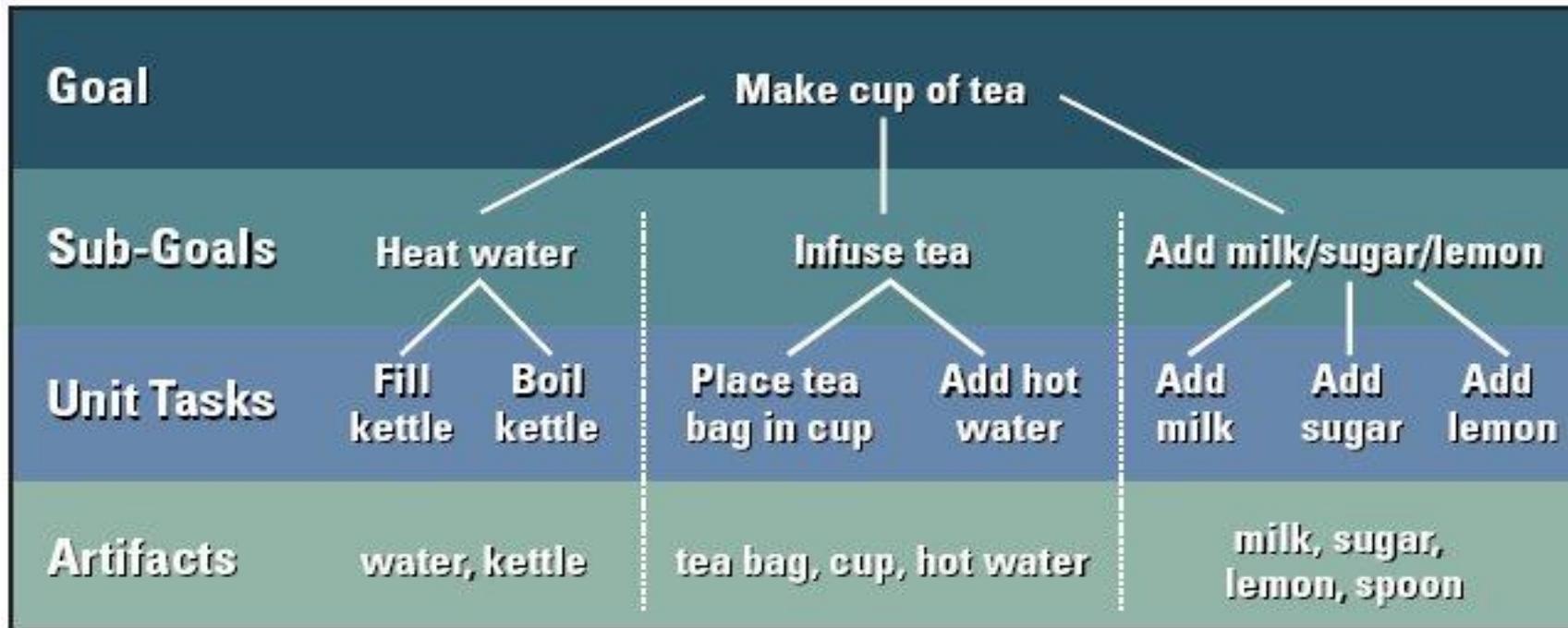
■ The top-level tasks of
"**making lots of cups of tea**":

> 0. make a cup of tea

> 1. boil water

> 2. empty pot

> 3. make pot

> 4. wait 4 or 5 minutes

> 5. pour tea
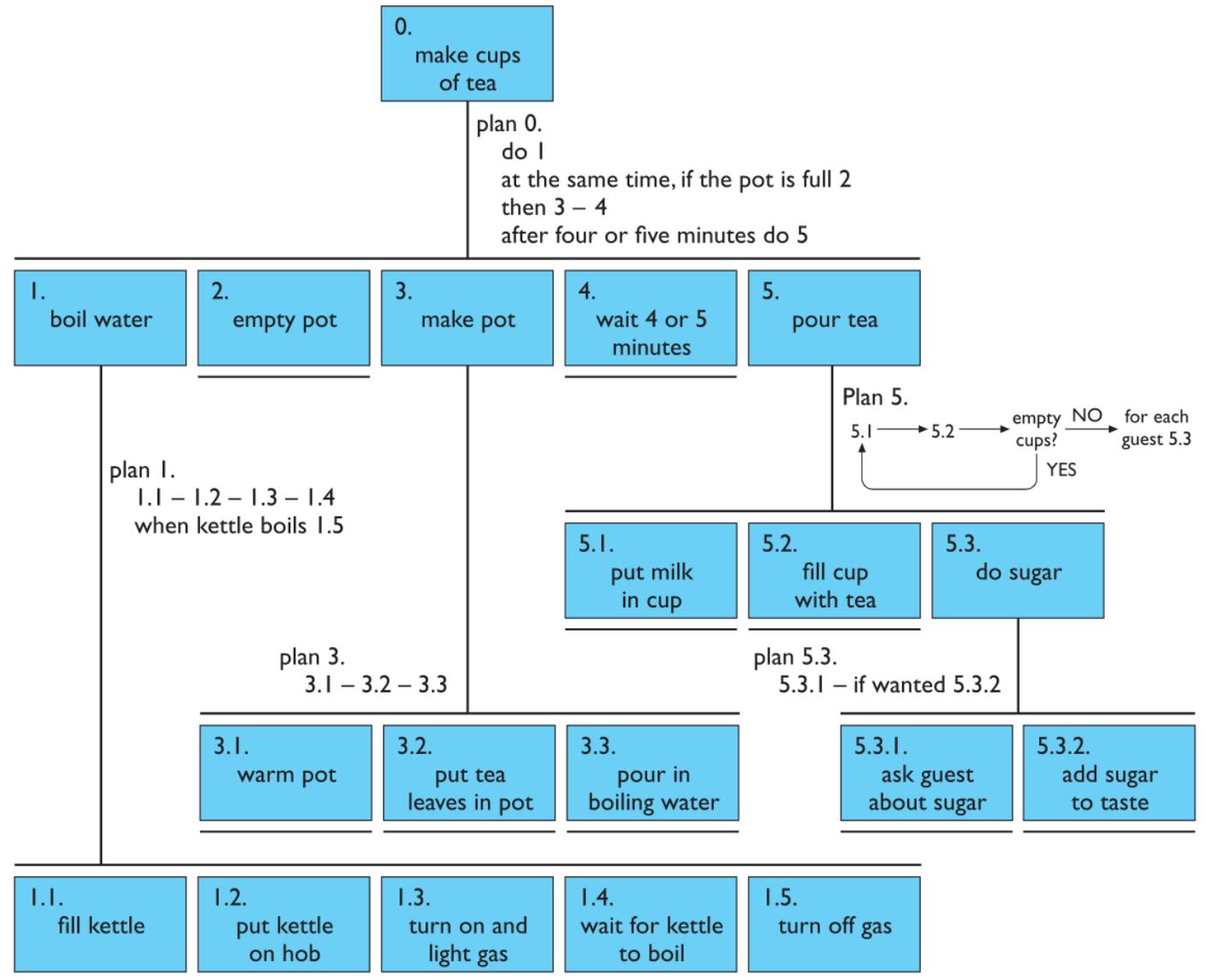
Dix, A. J., Finlay, J., Abowd, G. D., & Beale, R. (2003). Human-computer interaction. Pearson Education   https://hcibook.com/.

Hierarchical Task Analysis

■ Adding Artifacts

William Hudson. HCI and the Web: a Tale of Two Tutorials: a Cognitive Approach to Interactive System Design and Interaction Design Meets Agility. *ACM interactions* 12(1), 2005, 49-51

Knowledge Based-Analysis

- **Listing all the objects and their functions** involved in the task, and then building taxonomies **with logical operators**:

```
› kitchenitem AND
  › / shape XOR
    › | dished: (mixing bowl, casserole, saucepan, soup bowl, glass)
    › | flat: (plate, chopping board, frying pan)
  › / function OR
    › preparation: {mixing bowl, plate, chopping board}
    › cooking: {frying pan, casserole, saucepan}
    › dining XOR
      › | forfood: plate, soup bowl, casserole
      › | fordrink: glass
```

→ kitchenitem/shape(flat)/function{preparation,dining(forfood)}/

Dix, A. J., Finlay, J., Abowd, G. D., & Beale, R. (2003). Human-computer interaction. Pearson Education   https://hcibook.com/.

Entity–Relation-Based Analysis

- Associated with data-base designs and more recently object-oriented programming

  › Not for tasks but for entities with an object-based approach

- Can include physical objects, the actions performed on them and the people who perform them
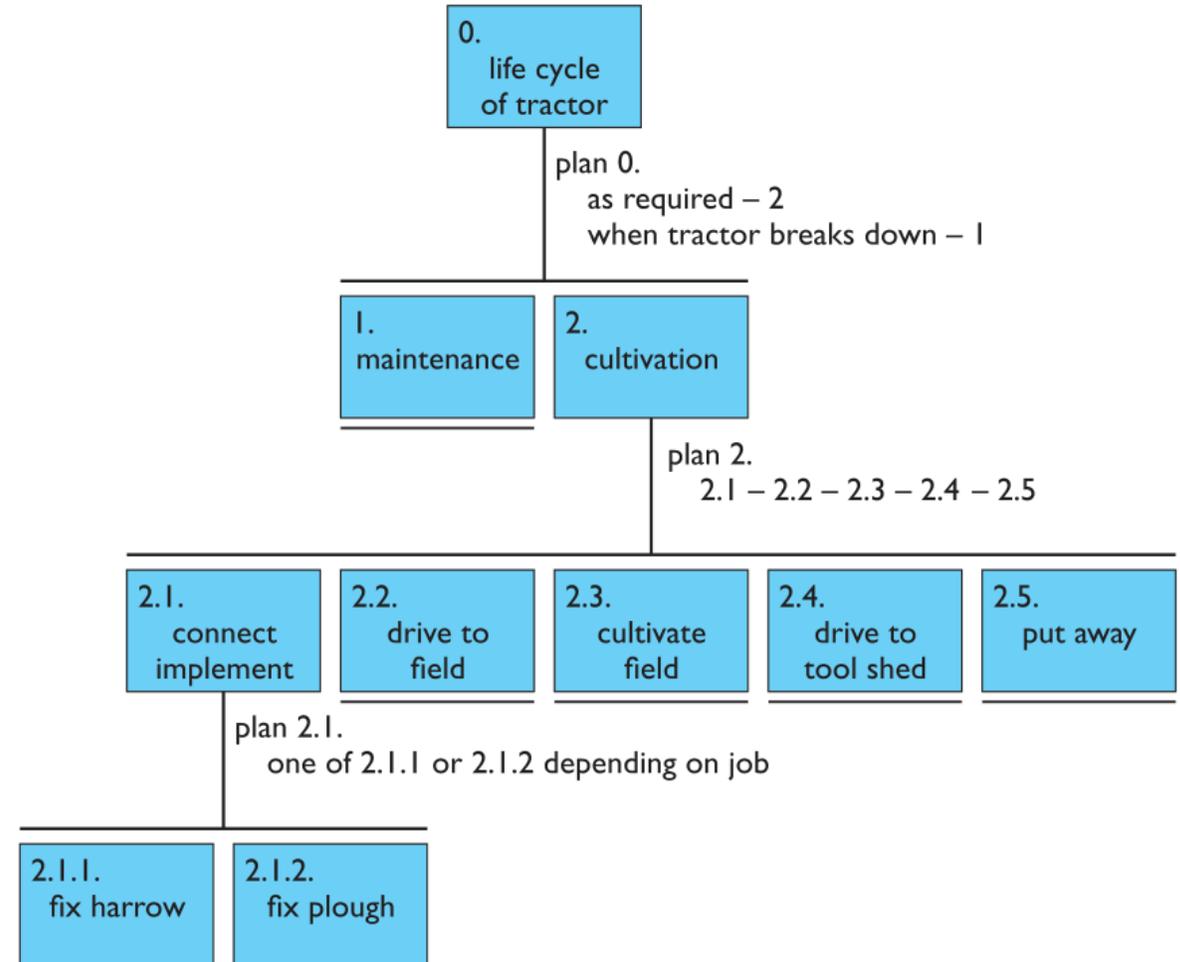
Dix, A. J., Finlay, J., Abowd, G. D., & Beale, R. (2003). Human-computer interaction. Pearson Education   https://hcibook.com/.

Respecting the Users' Diversity

- Example: flight booking webpage
  - Travel agent booking many flights a day – everyday
  - A teacher organizing a field trip (once a year) and making bookings for a large group
  - A businessperson changing bookings while travelling
  - A family looking for a package holiday
- Basic concepts to structure the problem
  - Usage profiles
  - Task profiles

Task Frequency Analysis

- Another Example: Will one website fit all the users?

Task Persona	Group reservation	Change of itinerary	Booking child care	Sales agent
Sales agent	0.2	0.1	0.1	0
Manager	0	0	0	0.4
Family	0.05	0.05	0.3	0
Business traveler	0.01	0.2	0.01	0

- Task Frequency Analysis can be used in conjunction with Personas to provide a more comprehensive understanding of user behavior and needs.

- Used to **identify and evaluate how often specific tasks are performed** by users or systems.

- **Prioritize features and functionalities based on their frequency of use**.

Kirwan, B. and Ainsworth, L. (Eds.) (1992). A guide to task analysis. Taylor and Francis.

The User Journey

- A visualization or narrative that describes the **various stages and touchpoints** a user goes through **while interacting** with a product, system, or service.

- Map out the **user's experience** from initial contact **through the interaction process** of engagement, usage, and long-term relationship.

- User Journeys can be particularly useful when **used in conjunction with** other UX tools like **Personas** or **Task Frequency Analysis**.

  › While Personas give you a sense of who your users are, and Task Frequency Analysis tells you what they do most often, **the User Journey helps you understand the actions**.

  › Be careful: It may oversimplify complex interactions or miss out on edge cases.

- Designers and developers can **identify potential pain points**, **opportunities** for **improvements**, and **areas where the user might experience delight**, thereby creating a more user-centric product.

User Journey

User Journey: Becoming a New Patient

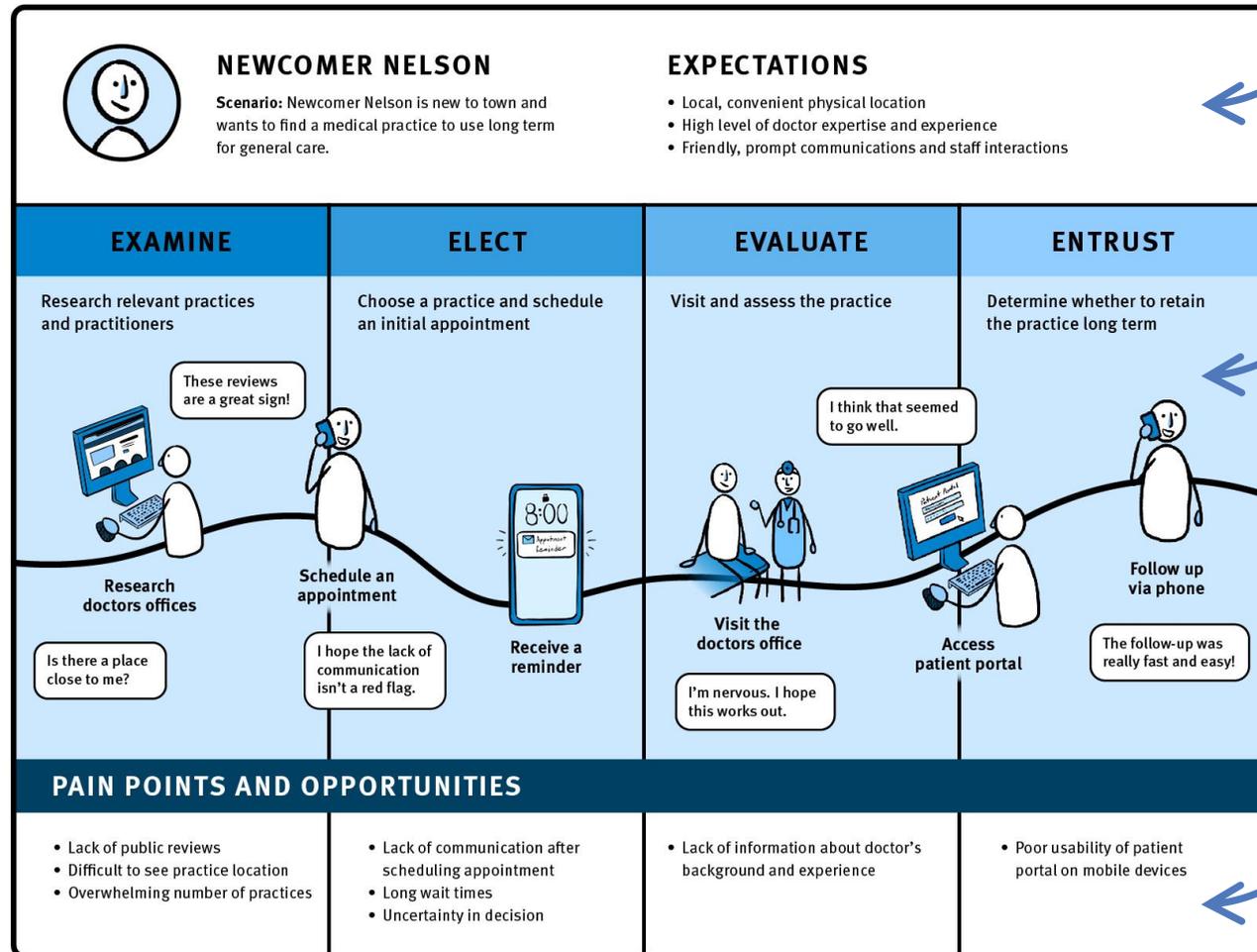Research doctors offices — Schedule an appointment — Receive a reminder — Visit the doctors office — Access patient portal — Follow up via phone

NNGROUP.COM NN/g

https://www.nngroup.com/articles/user-journeys-vs-user-flows/

User Journey Map
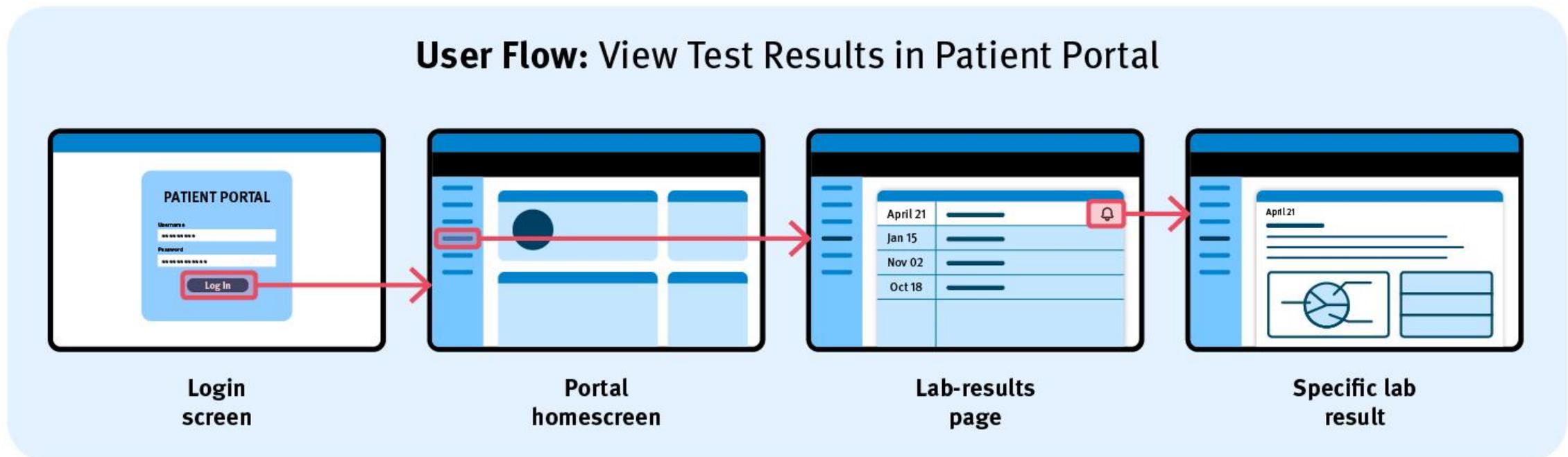

https://www.nngroup.com/articles/user-journeys-vs-user-flows/

User Flows / Flow Diagrams / Flow Charts / Wireframes

- A **user flow is a set of granular interactions that describe the typical or ideal set of steps** on needed to accomplish a common task performed with a product.

User Flow: View Test Results in Patient Portal

Login screen

Portal homescreen

Lab-results page

Specific lab result

NNGROUP.COM **NN/g**

Combining User Journeys and User Flows

https://www.nngroup.com/articles/user-journeys-vs-user-flows/
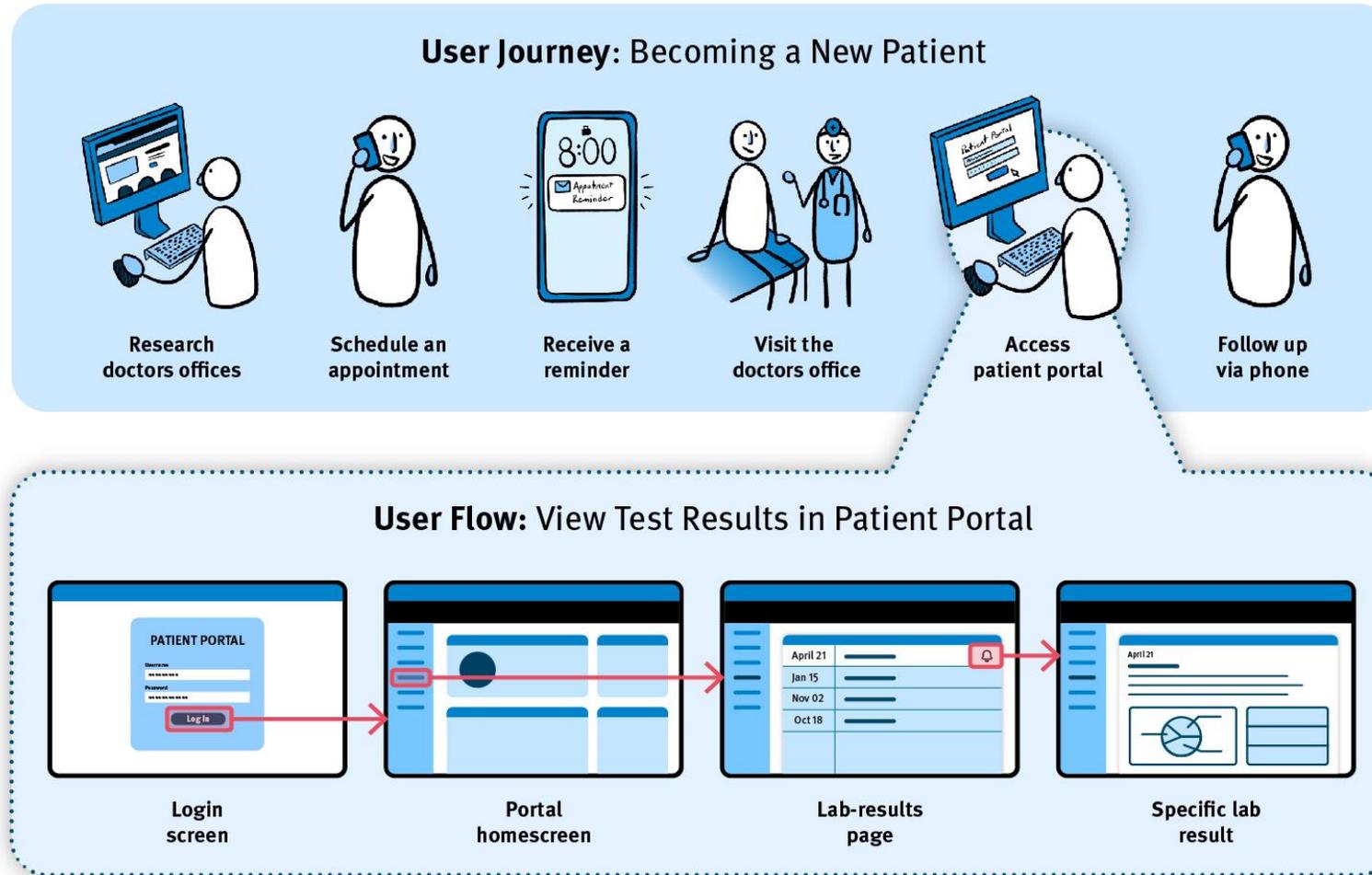
Stakeholder Analysis

- **Understanding stakeholders** is key to many of the approaches to requirements capture, since in an organizational setting it is not simply the end-user who is affected by the introduction of new technology.

- **Example**: An international airline is considering introducing a new booking system for use by associated travel agents to sell flights directly to the public. The stakeholders can be classified as follows:

  › **Primary stakeholders**: travel agency staff, airline booking staff

  › **Secondary stakeholders**: customers, airline management

  › **Tertiary stakeholders**: competitors, civil aviation authorities, customers' traveling companions, airline shareholders

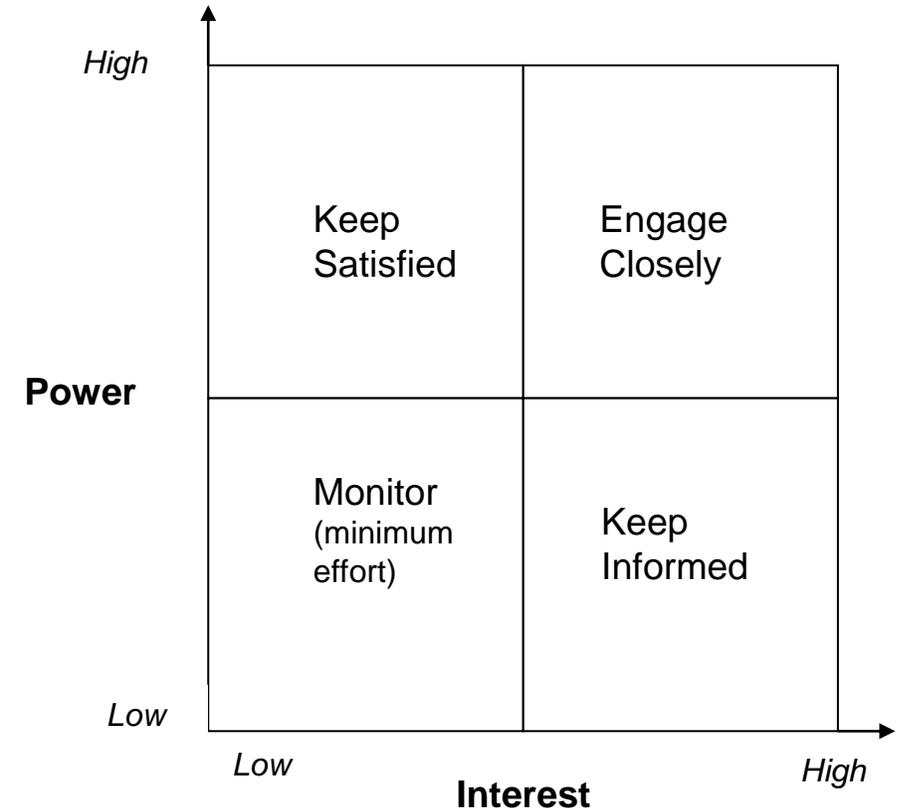 › **Facilitating stakeholders**: design team, IT department staff

Dix, A. J., Finlay, J., Abowd, G. D., & Beale, R. (2003). Human-computer interaction. Pearson Education   https://hcibook.com/.

CUSTOM Stakeholder Analysis

- A **socio-technical methodology** based on the User Skills and Task Match (USTM) approach and designed to be practical to use in small organizations
- **All stakeholders are considered, not just the end-users**, and its questions investigate:
  - What does the stakeholder have to achieve and **how is success measured**?
  - What are **the stakeholder's sources of job satisfaction / dissatisfaction** and stress?
  - What **knowledge and skills** does **the stakeholder have**?
  - What is **the stakeholder's attitude toward work, design,** and **technology**?
  - Are there any **work-group attributes that will affect the acceptability** to the stakeholder?
  - What are the characteristics of the stakeholder's task?
    - Frequency, fragmentation, and choice of actions
  - Does the stakeholder have any issues relating to **responsibility**, **security** or **privacy**?
  - What are **the physical conditions** in which the stakeholder is working?

Stakeholder Analysis

- **Identify stakeholders**, e.g.
  - › Customers, team members, investors, management, suppliers, public, press, shareholders, government, community, sales partners, family, …
- **Categorize stakeholders**
  - Interest in the project?
  - Influence on the team and project (Power)
  - Attitude (positive / negative)
  - Reasons for attitude
- **Force-field analysis**
  - Place people in the diagram
  - Revisit throughout the project

	Keep Satisfied	Engage Closely
High		
Power	Monitor (minimum effort)	Keep Informed
Low		
	Low	High

Interest

Adapted with permission from Mendelow, A.L. (1981). 'Environmental Scanning - The Impact of the Stakeholder Concept,' ICIS 1981 Proceedings, 20.

Summary

- **User**, **Task**, and **Stakeholder Analysis** help you to **understand the roles and goals** of the people involved in the development of your system.

- They help your in **understanding** and **balancing the needs and expectations** of all parties involved.

- They also help you to **work in a multidisciplinary team**

- These techniques are **often used in conjunction with Human-Centered Design** (and Agile Development) using an iterative development cycle based on user feedback.

References (1)

- B. Shneiderman (2002). Leonardo's Laptop: Human Needs and the New Computing Technologies. http://mitpress.mit.edu/main/feature/leonardoslaptop/index.html

- B. Buxton (2010). Sketching user experiences: getting the design right and the right design. Morgan Kaufmann.

- Harry Brignull (2006). Bad usability is like a leaky pipe. https://90percentofeverything.com/2006/11/13/bad-usability-is-like-a-leaky-pipe/

- Paula Zuccotti (2015): Every Thing We Touch: A 24-hour Inventory of Our Lives. Penguin UK. https://www.theguardian.com/society/2015/nov/06/its-the-little-things-everything-i-touched-today

- Nina Runge, Johannes Schöning, Rainer Malaka, and Alberto Frigo (2016): You Can Touch This: Eleven Years and 258218 Images of Objects. In Proceedings of the 2016 CHI Conference Extended Abstracts on Human Factors in Computing Systems (CHI EA '16). ACM, New York, NY, USA, 541-552. DOI: https://doi.org/10.1145/2851581.2892575

- James J. Gibson (1977): The theory of affordances. Hilldale, USA 1.2 https://monoskop.org/images/2/2c/Gibson_James_J_1977_The_Theory_of_Affordances.pdf

- Don Norman (2008): Affordances and Design, jnd.org https://jnd.org/affordances_and_design/

- Norman, D. A. (2013): The design of everyday things: Revised and expanded edition. New York: Doubleday.

- Maslow, A. H. (1943): A theory of human motivation. Psychological Review, 50(4), 370-396. https://doi.org/10.1037/h0054346

- John M. Carroll. (1990): Infinite detail and emulation in an ontologically minimized HCI. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '90). Association for Computing Machinery, New York, NY, USA, 321–328. DOI:https://doi.org/10.1145/97243.97303

- John M. Carroll.(2013): Human Computer Interaction - brief intro. In: Soegaard, Mads and Dam, Rikke Friis (eds.). "The Encyclopedia of Human-Computer Interaction, 2nd Ed.". Aarhus, Denmark: The Interaction Design Foundation. http://www.interaction-design.org/encyclopedia/human_computer_interaction_hci.html

- Alan Cooper, Robert Reimann, and Hugh Dubberly (2003): About face 2.0: The essentials of interaction design. John Wiley & Sons, Inc.

References (2)

- Kay, A. (1990). User interface: A personal view. In B. Laurel, (Ed.), The art of human computer interface design (pp. 191–207). Reading , MA : Addison-Wesley.

- Nardi, B. A., & Zarmer, C. L. (1993). Beyond models and metaphors: Visual formalisms in user interface design. Journal of Visual Languages & Computing, 4(1), 5-33.

- William Hudson. Mental Models, Metaphor and Design (2003).UK UPA and HCI2003. http://www.syntagm.co.uk/design/articles/mmmad.pdf

- Jakob Nielsen. Mental Models on October 17, 2010. https://www.nngroup.com/articles/mental-models/

- Norman, D. A. (2013). The design of everyday things: Revised and expanded edition. New York: Doubleday.

- Hudson, W. (2001). Toward unified models in user-centered and object-oriented design. Object Modeling and User Interface Design: Designing Interactive Systems, 313-362.

- Frank Halasz and Thomas P. Moran. 1982. Analogy considered harmful. In Proceedings of the 1982 Conference on Human Factors in Computing Systems (CHI '82). Association for Computing Machinery, New York, NY, USA, 383–386. DOI:https://doi.org/10.1145/800049.801816

- https://www.interaction-design.org/literature/book/the-encyclopedia-of-human-computer-interaction-2nd-ed/personas

- https://www.mindtools.com/pages/article/newPPM_07.htm

- Mendelow, Aubrey L. "Environmental Scanning-The Impact of the Stakeholder Concept." ICIS. 1981