Interactive Multimedia Applications User Center Design Model: Evaluation

Evaluation: What to Evaluate?

- **Usability**
  - Effectiveness, Efficiency, Safety, Utility, Learnability and Memorability
- **User Experience**
  - Positive: Satisfying, Enjoyable, Engaging, Pleasurable, Exciting, Entertaining, Helpful, Challenging, …
  - Negative: Boring, Frustrating, Making one feel guilty, Annoying, Childish, Unpleasant, Patronizing, Making one feel stupid, …

Evaluation: How to Evaluate?

- **Analytical Evaluation**
  - Inspection methods (heuristic evaluation)
  - Predictive models (predictive assessment)

- **Evaluation with USERS**
  - Measure the performance and satisfaction of users performing the tasks
    - Questionnaires
    - Interviews
    - User observation

Evaluation: When to Evaluate?

	Analytical Evaluation	Evaluation with USERS
Formative Evaluation	**Analysis**	Direct user observation Interviews
	Design and Implementation	
	Heuristic evaluation Evaluation with guidelines	Direct and indirect (log files or video recording) user observation Think aloud
Summative Evaluation	Evaluation with guidelines	Questionnaires or Surveys (Includes experimental tests of the application with users) Interviews (Includes experimental tests with users)

Evaluation: Formative

- **Formative**
  - During the iterative cycle (Analysis, Design, Implementation)
  - To improve the interface and develop a new refined version
  - Can be applied in various types of prototypes from paper to functional (computational) prototypes

Evaluation: Summative

- **Summative**
  - Carried out after the design and implementation is completed
  - To evaluate the success of a finished product
  - Also used to compare with other products (A/B Testing)

Heuristic Evaluation

Heuristic Evaluation (I)

- **Technique developed by Nielsen and Molich (1990, 1994)**
  - Experts check if the interface conforms to a heuristic set
  - During the evaluation the expert places himself in the position of the users

Heuristic Evaluation (II)

- **When should be done?**
  - Can be done at any stage of the process
  - Best suited for the Design and implementation phases

Analysis

Design

Implementation

Advantages and Disadvantages

- **Advantages**
  - Quick to do
  - Inexpensive
  - Easy to perform
- **Disadvantages**
  - An expert is not a typical user

Heuristics of Nielsen

H1. Visibility of system status

H2. Match between system and the real world

H3. User control and freedom

H4. Consistency and standards

H5. Error prevention

H6. Recognition rather than recall

H7. Flexibility and efficiency of use

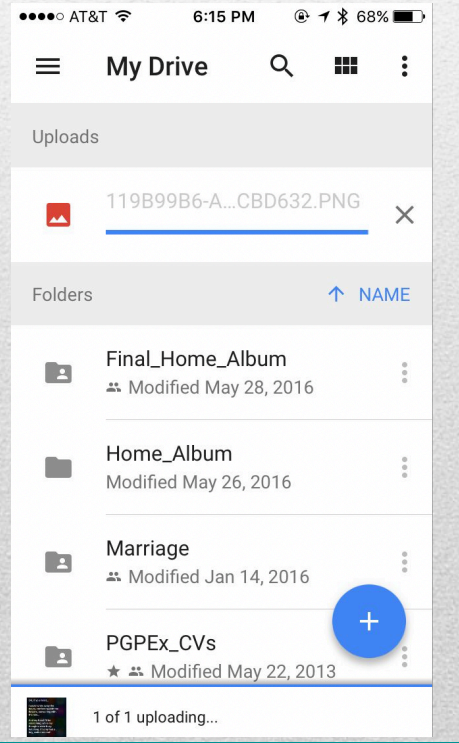
H8. Aesthetic and minimalist design

H9. Help users recognize, diagnose, and recover from errors

H10. Help and documentation

Heuristics of Nielsen: H1 (I)

- **H1. Visibility of system status**
  - System should always keep users informed about what is going on, through appropriate feedback within reasonable time

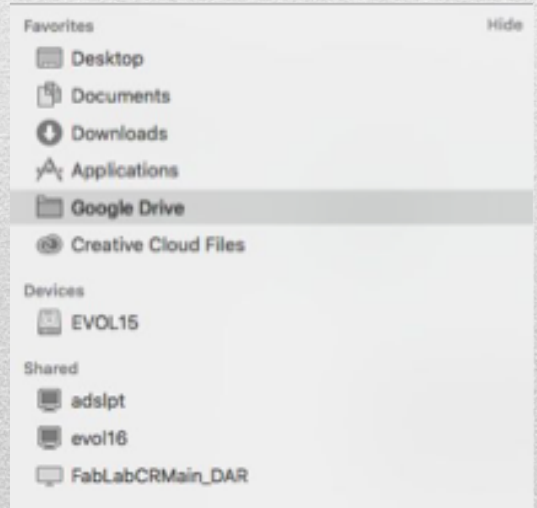


Heuristics of Nielsen: H1 (II)

- **H1. Visibility of system status**
  - Typical examples of the application of H1
    - Show how much time is left to complete an action
    - Show in what step we are of a set of necessary steps
    - Highlight menu option
    - Use status bars to display messages and progress indicators
    - Change of color once the user has clicked on a button

Heuristics of Nielsen: H2 (I)

- **H2. Match between system and the real world**
  - System should speak the users' language, with words, phrases and concepts familiar to the user, rather than system-oriented terms
  - Follow real-world conventions, making information appear in a natural and logical order

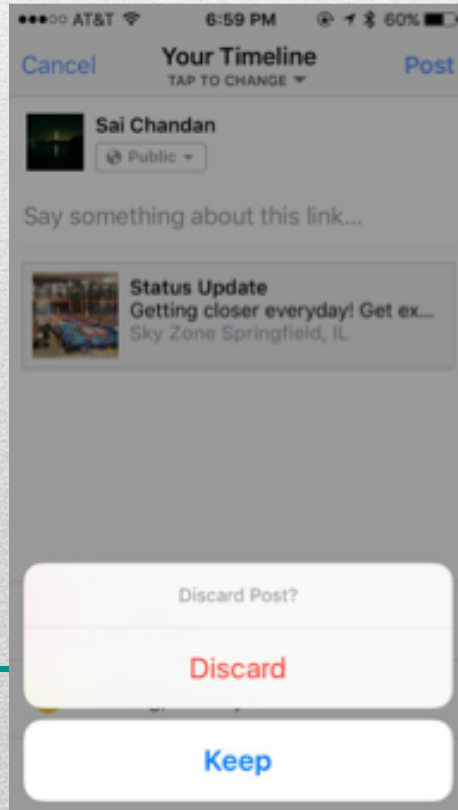


Heuristics of Nielsen: H2 (II)

- **H2. Match between system and the real world**
  - Typical examples of the application of H2
    - Used terms are part of the concept of the application and are not technical terms
    - Menu options sorted by their natural order
    - Related and interdependent fields appear on the same screen
    - Text with clear messages and respecting **Cultural Conventions**

Heuristics of Nielsen: H3 (I)

- **H3. User control and freedom**
  - Users often choose system functions by mistake and will need a clearly marked "emergency exit" to leave the unwanted state without having to go through an extended dialogue
  - Support **undo** and **redo** or similar functionalities

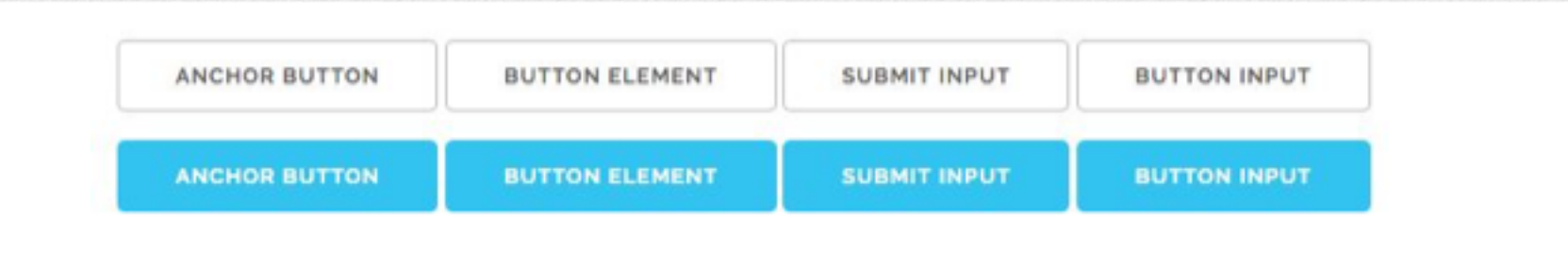


Heuristics of Nielsen: H3 (II)

- **H3. User control and freedom**
  - Typical examples of the application of H3
    - Undo option to go back
    - "Cancel" button in all dialogs with the user
    - User can cancel operations that are running
    - Tasks performed on multiple screens the user can return to the previous screen or cancel the task on any of the screens

Heuristics of Nielsen: H4 (I)

- **H4. Consistency and standards**
  - Users should not have to wonder whether different words, situations, or actions mean the same thing
  - Follow platform conventions



Heuristics of Nielsen: H4 (II)

- **H4. Consistency and standards**
  - Typical examples of the application of H4
    - Menus, 'OK' and 'Cancel' buttons always appear in the same area of the screen
    - Right-aligned integers and comma-aligned real numbers
    - The color code is always used in the same way throughout the application
    - The interface elements have equal sizes (all buttons have the same width and height)

Heuristics of Nielsen: H5 (I)

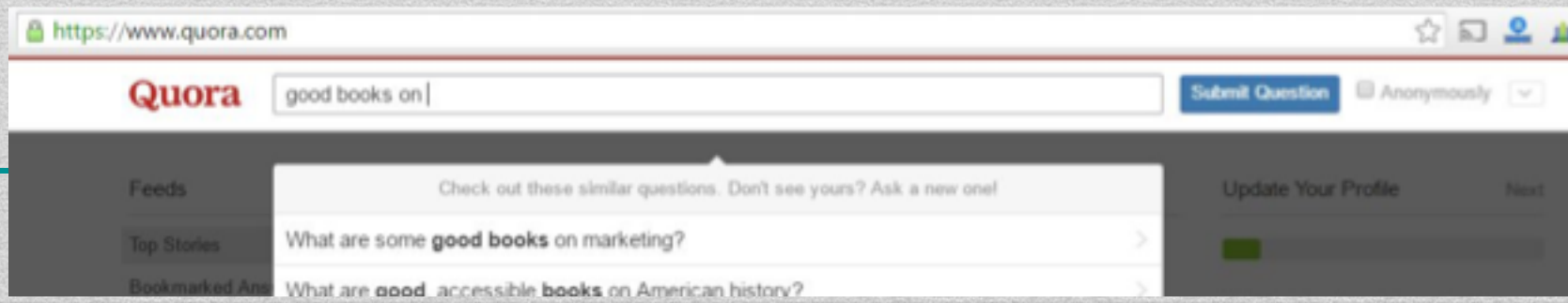
- **H5. Error prevention**
  - Even better than good error messages is a careful design which prevents a problem from occurring in the first place
  - Either eliminate error-prone conditions or check for them and present users with a confirmation option before they commit to the action

Heuristics of Nielsen: H5 (II)

- **H5. Error prevention**
  - Typical examples of the application of H5
    - Copy option disabled because the user has nothing selected
    - The 'next' button is disabled because the user has not yet completed everything
    - Menu options with opposite options should be away
    - Confirmation dialog whenever user performs destructive operation

Heuristics of Nielsen: H6 (I)

- **H6. Recognition rather than recall**
  - Minimize the user's memory load by making objects, actions, and options visible
  - The user should not have to remember information from one part of the dialogue to another
  - Instructions for use of the system should be visible or easily retrievable whenever appropriate

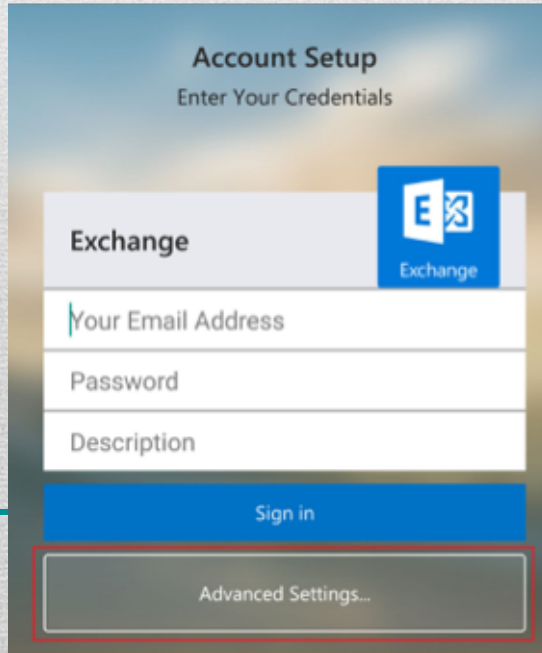


Heuristics of Nielsen: H6 (II)

- **H6. Recognition rather than recall**
  - Typical examples of the application of H6
    - User can choose from a list of products instead of remembering name
    - 'Delete' button has an associated waste bin
    - Extensive numbers are divided into fragments of information to facilitate memory storage

Heuristics of Nielsen: H7 (I)

- **H7. Flexibility and efficiency of use**
  - Accelerators — unseen by the novice user — may often speed up the interaction for the expert user such that the system can cater to both inexperienced and experienced users
  - Allow users to tailor frequent actions

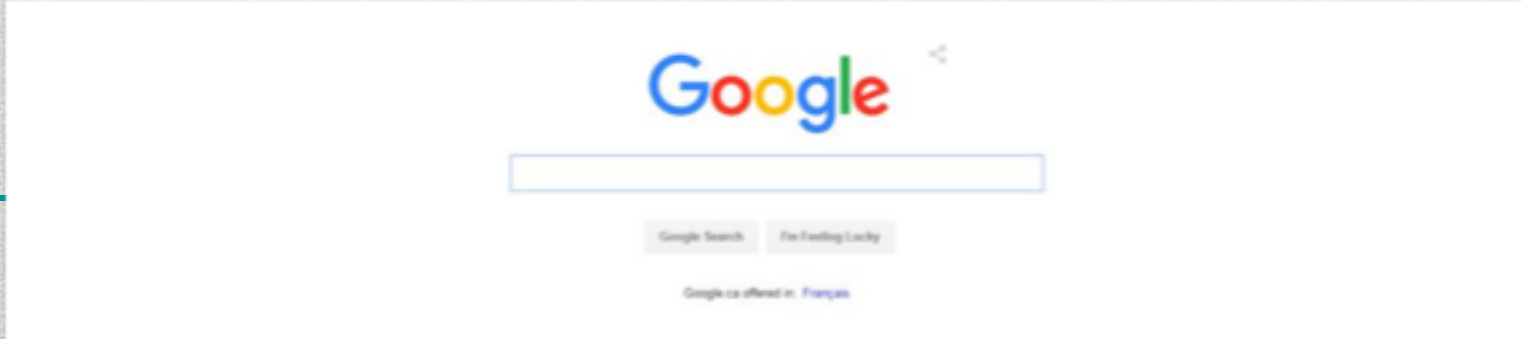


Heuristics of Nielsen: H7 (II)

- **H7. Flexibility and efficiency of use**
  - Typical examples of the application of H7
    - Option to select and deselect all
    - Default values in fields that require data entry
    - Accelerators in menus and buttons
    - Function keys for the most frequent commands
    - Being able to skip steps in a sequence of operations

Heuristics of Nielsen: H8 (I)

- **H8. Aesthetic and minimalist design**
  - Dialogues should not contain information which is irrelevant or rarely needed
  - Every extra unit of information in a dialogue competes with the relevant units of information and diminishes their relative visibility

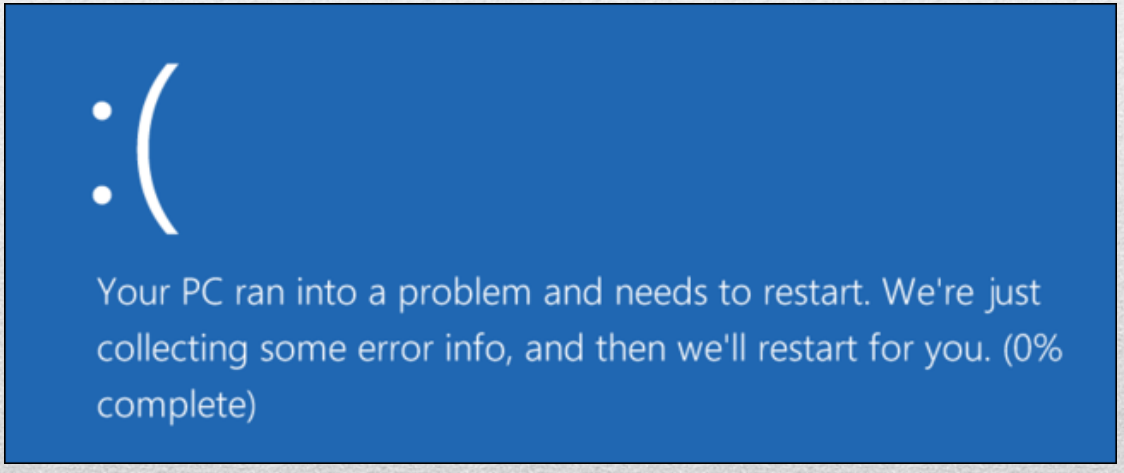


Heuristics of Nielsen: H8 (II)

- **H8. Aesthetic and minimalist design**
  - Typical examples of the application of H8
    - Align text to the left and integer numbers to the right
    - Contrast between text and background
    - Group spatial information if related
    - Use affirmative and active voice messages
    - Have on screen only the information necessary and sufficient for the user to make a decision
    - Use icons that are visually and conceptually different

Heuristics of Nielsen: H9 (I)

- **H9. Help users recognize, diagnose, and recover from errors**
  - Error messages should be expressed in plain language (no codes), precisely indicate the problem, and constructively suggest a solution

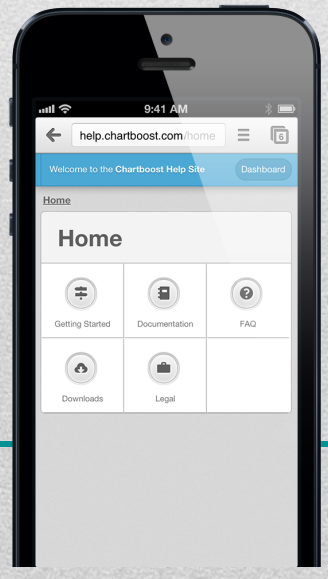


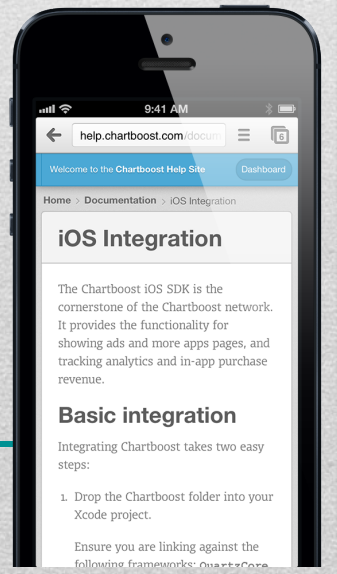
Heuristics of Nielsen: H9 (II)

- **H9. Help users recognize, diagnose, and recover from errors**
  - Typical examples of the application of H9
    - Use sound to signal the error
    - Use user language in error messages, do not use technical language
    - Do not blame the user for the error
    - Place cursor at error location

Heuristics of Nielsen: H10 (I)

- **H10. Help and documentation**
  - Even though it is better if the system can be used without documentation, it may be necessary to provide help and documentation
  - Any such information should be easy to search, focused on the user's task, list concrete steps to be carried out, and not be too large





Heuristics of Nielsen: H10 (II)

- **H10. Help and documentation**
  - Typical examples of the application of H10
    - Have 'help' button visible
    - Make it easy to return to the task after consulting Help
    - Tell what the program is for
    - Organize help information into user goals

Heuristic Evaluation Process: Phases 1 and 2

- **Pre-Evaluation (Design Team and Evaluators)**
  - Training meeting to explain to the evaluators the interface, potential users and main functionalities

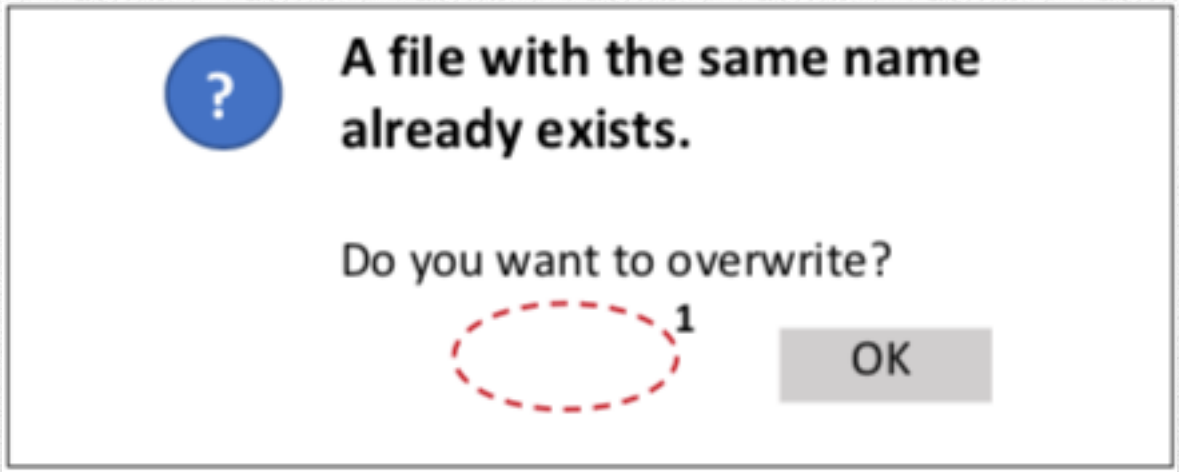
- **Evaluation**
  - Each evaluator analyzes the user interface separately by recording the problems

Heuristic Evaluation Process: Phases 3 and 4

- **Consolidation**
  - Group similar problems into one
  - Add the various problem descriptions to a single description
  - Calculate mean severity and use it as final severity

- **Balance (Design Team and Evaluators)**
  - Meeting to discuss the results
  - Problems and solutions consolidated in a report

Heuristic Evaluation: Register a Problem



1. Problem: Missing button to cancel operation

Heuristic: H3. User control and freedom

Description: Because there is no cancel button, the user gets stuck and may be forced to do something he does not want. There is no way to cancel the operation that is in progress.

Correction: Add button to cancel.

Severity: 4

Heuristic Evaluation: Degree of Severity

0 - **There is no consensus** that it is a usability problem

1 - **Aesthetic problem only**, does not need to be solved, unless there is still time and resources

2 - **Minor usability problem**, it should be given low priority to fix this problem

3 - **Important usability problem**, should be fixed, with high priority

4 - **Usability catastrophe**, it is imperative to correct this mistake

Heuristic Evaluation: Global Severity

		Proportion of users who had the problem	
		Few	Many
Impact of the problem on users who had it	Small	Low severity	Average severity
	High	Average severity	High severity

Evaluation with Users

Objective

- **Measuring the performance of users performing in-app tasks**

Advantages & Disadvantages

- **Advantages**

  Best way to get information about how users use the app

- **Disadvantages**

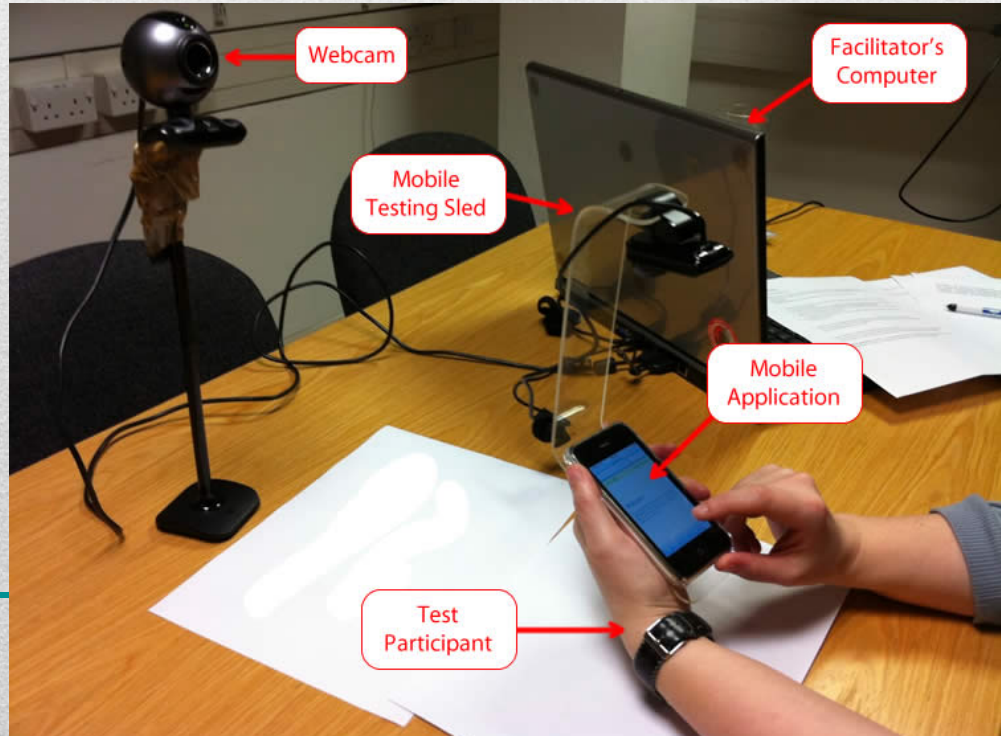
  More expensive and more time-consuming evaluation

Mobile UX Testing: Information to Capture

- Record the user's screen
- Record the user using their phone
- Record their face, body language or any additional information
- Collect user's feedback through a UX questionnaire

Mobile UX Testing: Elements

- Webcam
- Mobile Application
- Facilitator's Computer
- Mobile Testing Sled
- Participants
- Script / Questionnaire



What to Measure?

- **Usability**
  - Effectiveness, Efficiency, Safety, Utility, Learnability and Memorability
- **User Experience**
  - Positive: Satisfying, Enjoyable, Engaging, Pleasurable, Exciting, Entertaining, Helpful, Challenging, …
  - Negative: Boring, Frustrating, Making one feel guilty, Annoying, Childish, Unpleasant, Patronizing, Making one feel stupid, …

How to Measure?

- Time to complete a task
- Time spent navigating the menus
- Time taken to recover from errors
- Time spent consulting the help
- Number of tasks completed in a given time interval
- Number of errors made
- Number of clicks
- Number of commands or functions used by the user
- Number of commands or functions that the user can remember in the questionnaire
- Number of users who prefer our system
- Number of repeated errors
- Number of times you use manuals or aids
- Relationship between favorable/unfavorable comments
- Relationship between successful interactions and errors

Approach

- **Qualitative (Why?)**

  Based on observational findings that identify features easy and hard to use (e.g., direct or indirect users observation)

- **Quantitative (How many and How much?)**

  Based on measuring and aggregating data (e.g., server logs or surveys)

Approach - Example

- **Qualitative approach**
  - Why the user spend time in the app?

    It can be caused by **users being more engaged with the content** or caused by **users looking for the information they need**

- **Quantitative approach**
  - Measuring the time users spend in the app

Data Source

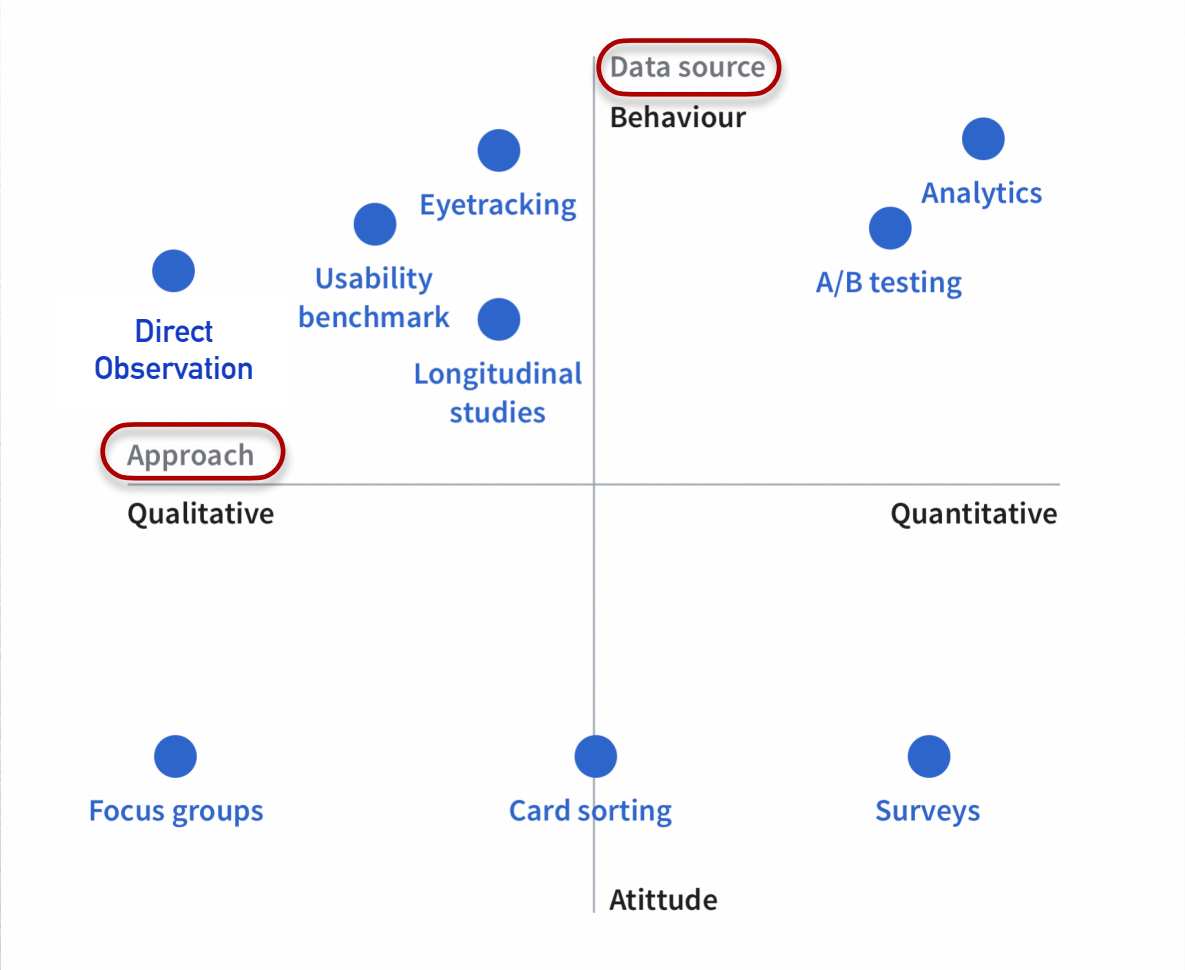
- **Behaviour Methods**

  Try to understand what user does with minimal intervention

- **Attitudinal Methods**

  Users provide the information themselves (based on subjective opinions)

How to Collect Information?



Direct Observation (I)

- **Observation in the environment where the user uses our application**
  - **Observer**

Must be invisible in order to not interfere with the work of the users

Take notes and film the way users use the system on-site

Direct Observation (II)

- **Advantage**

Capture behaviours that users do not tell us in the questionnaires because they do not admit them or do not notice them

- **Disadvantage**

Observation may influence the behaviour of users

Longitudinal Studies

- **To capture data over a period of time to understand the long-term effects of changes in products**
  - Repeated observation or examination of a group of users over time (days, week, month or years)
  - To follow changes in perception, behaviours, attitudes and motivation of use

Card Sorting

- **To help design or evaluate the information architecture of an app**
  - Participants organize topics into categories that make sense to them and group them accordingly
  - Can be used actual cards, pieces of paper, or one of several online card-sorting software tools

Focus Groups

- **Moderated discussion that typically involves 5 to 10 participants**
  - To learn about users' attitudes, beliefs, desires, and reactions to concepts

Think Out Loud

- **User says what he thinks and what he will do while trying the application**

  - **Advantage**

    Allows to help understand how users see the system and identify the parts of the interface where there are more usability problems

  - **Disadvantage**

    Affects the performance of users and therefore should not be used in conjunction with the collection of performance measures

Indirect Observation

- **Interaction registration can automatically collect detailed information about the system**
  - **Advantage**

    Collect a large amount of data

    Identifies usability issues that are not detected while observing users

  - **Disadvantage**

    Needs the permission of the users for video or voice recording

Questionnaires and Interviews

- **Gather information to characterize the users and to collect their opinions about the application**

- **Advantage**

Many of the usability aspects can be better studied

Best for satisfaction issues and problems that are difficult to measure objectively

Good to realize what users like about the application

- **Disadvantage**

Can be difficult to find a sufficient number of representative users of the audience

Questionnaires *versus* Interviews

- **Advantages (Questionnaires)**

Useful for large groups and scattered users

Faster than interviews

Can be analyzed more accurately

- **Disadvantages (Questionnaires)**

Possibility of some unanswered questions

Little flexible because we only get the answers to the questions that are in the questionnaire

Questionnaire/Script: Structure (I)

- **Introduction**

Describe the objectives, inform the estimated time for completion, explain the privacy issues and make the acknowledgments

- **Pre-Tests Questionnaire**

Set of questions to characterize the user (e.g., age, profession, or habits related to the application)

Questionnaire/Script: Structure (II)

- **During-Tests Questionnaire**

Specific questions to each **Task** grouped in **Topics** to be answered after completing the task

- **Post-Tests Questionnaire**

Set of questions for an overall evaluation of the application

Questionnaire/Script: Questions

- **Open Questions**

Can be answered without any restriction and are used when there are no predetermined answers

- **Multi-choice Questions**

User can choose one of the given option

Questionnaire: Open *versus* Multi-choice

- **Open Questions are a richer way of gathering information** than multiple-choice questions

- **Open Questions are more difficult** to analyse than multiple-choice questions

- Some users do not answer the **open questions**

- **Open question** should be used carefully

Questionnaire: Multi-choice Questions

Gender: ☐ Male ☐ Female

What is your preferred operating system?

- ☐ Windows
- ☐ Mac Os
- ☐ Linux
- ☐ Other: _____?

Questionnaire: Classification Scales (I)

- **Likert-type Scales**

Used to measure opinions, attitudes, beliefs and reactions

The application color scheme is excellent (1 means “Completely Disagree” and 5 means “Completely Agree”).

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Questionnaire: Classification Scales (II)

- **Semantic Differential Scales**

Most used to measure the User Experience (UX).

In my opinion, the product is generally

annoying	○	○	○	○	○	○	○	enjoyable
bad	○	○	○	○	○	○	○	good
unpleasant	○	○	○	○	○	○	○	pleasant
unfriendly	○	○	○	○	○	○	○	friendly
	1	**2**	**3**	**4**	**5**	**6**	**7**	

Questionnaire: Likert-type Scales

- **How many options?**

  The choice depends on the situation and the desired discrimination

  - **2 options** for YES/NO questions or 3 options for YES/DO NOT KNOW/NO
  - **5 options** to express agreement/disagreement or preference/dislike

Questionnaire: Likert-type Scales (I)

- **How many options?**

  The choice depends on the situation and the desired discrimination

  - **7 or 9 options** to evaluate with higher accuracy
  - Question with an **even number** of options should be used carefully

Questionnaire: General-Purpose Examples

- Computer System Usability Questionnaire (**CSUQ**)
  - Developed by Jim Lewis (1995, 2002) at IBM, is well-regarded and available in the public domain (should be used in a non-laboratory setting)
- Software Usability Measurement Inventory (**SUMI**)
  - Rigorously tested and proven method of measuring software quality from the end user's point of view

http://sumi.uxp.ie/en/index.php

Questionnaire: General-Purpose Examples (I)

- After Scenario Questionnaire (**ASQ**)
  - Developed by IBM, is available in the public domain (Bangor, Kortum, & Miller, 2008, p. 575)
- Post-Study System Usability Questionnaire (**PSSUQ**)
  - Developed by IBM (most suitable to be used in a laboratory setting), is available in the public domain (Bangor, Kortum, & Miller, 2008, p. 575)

Questionnaire: Website and Multimedia Evaluation

- Website Analysis and MeasureMent Inventory (**WAMMI**)
  - Short but very reliable questionnaire that tells you what your visitors think about your web site" (Human Factor Research Group, 1996b)

  http://www.wammi.com/questionnaire.html

- Measuring the Usability of Multi-Media Systems (**MUMMS**)
  - Questionnaire "designed for evaluating quality of use of multimedia software products" (Human Factor Research Group, 1996a).

Questionnaire: System Usability Scale (SUS)

- **SUS [John Brooke, 1986]**

Robust, most used and recommended. Questions are presented as simple declarative statements, each with a 5-point Likert scale anchored with "strongly disagree" and "strongly agree" and with values of 1 through 5

1.I think that I would like to use this website frequently

2.I found the website unnecessarily complex

3.I thought the website was easy to use

4.I think that I would need the support of a technical person to be able to use this website

5.I found the various functions in this website were well integrated

6.I thought there was too much inconsistency in this website

7.I would imagine that most people would learn to use this website very quickly

8.I found the website very cumbersome to use

9.I felt very confident using the website

10.I needed to learn a lot of things before I could get going with this website

Questionnaire: SUS Score

1. For each odd-numbered question, subtract 1 from the result obtained from each respondent

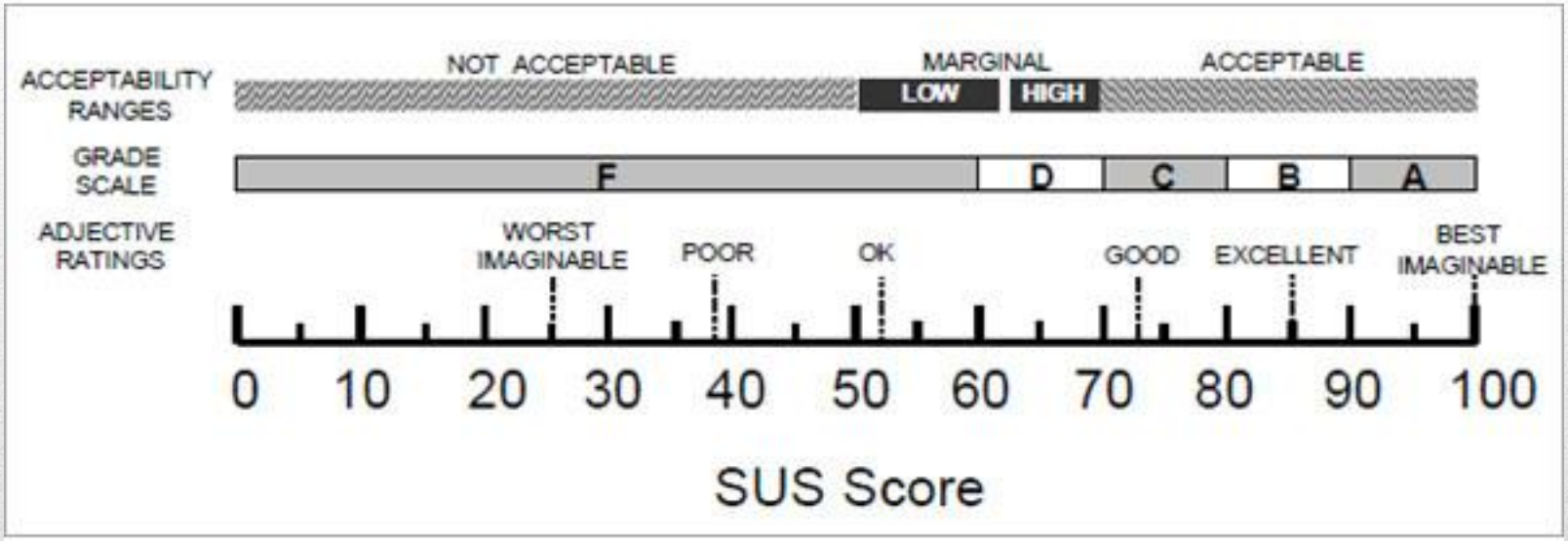
2. For each even-numbered question, subtract 5 from the result obtained from each respondent

3. Unanswered questions, assign a middle rating value of 3 so that it does not affect the outcome on either side

4. Add all values obtained per respondent and multiply by 2.5. This will give the value between 0 and 100 with which each user has rated the application

5. Calculate the average of the values obtained from the previous point

Questionnaire: SUS Score Meaning



SUS scoring method has a mean value of 68 points

If an application gets it below 68, it probably should have usability issues

Questionnaire: User Experience Questionnaire (UEQ)

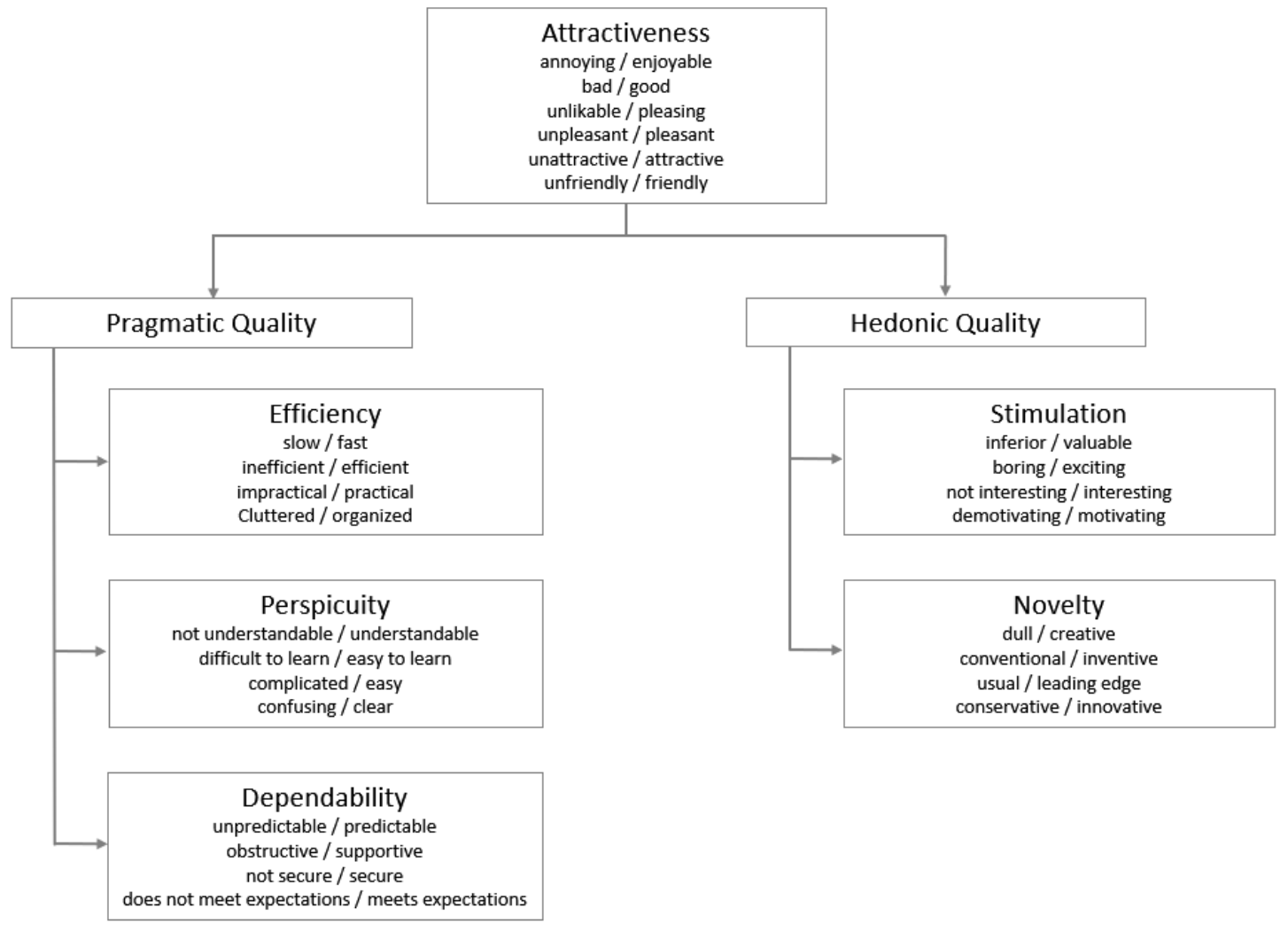
- **UEQ [Laugwitz, Schrepp and Held, 2005]**
  - A fast and reliable questionnaire to measure the User Experience of interactive products
  - Available in more than 30 languages
  - Easy to use due to rich supplementary material
  - Contains 6 scales (topics) with 26 items (questions)

www.ueq-online.org

Questionnaire: UEQ - Measures

Attractiveness	Perspicuity	Efficiency
Overall impression of the product. Do users like or dislike it?	Is it easy to get familiar with the product and to learn how to use it?	Can users solve their tasks without unnecessary effort? Does it react fast?
Dependability	**Stimulation**	**Novelty**
Does the user feel in control of the interaction? Is it secure and predictable?	Is it exciting and motivating to use the product? Is it fun to use?	Is the design of the product creative? Does it catch the interest of users?

Questionnaire: UEQ - Attractiveness, Hedonic and Pragmatic



Questionnaire: UEQ

- **Semantic Differential Scale**
  - UEQ Items are represented in semantic differential scale (1 to 7)
  - UEQ Items are rescaled to -3 to +3
    - -3 represents the most negative answer
    - 0 a neutral answer
    - +3 the most positive answer

Questionnaire: UEQ - Questions

Please only check one circle in each line.

	1	2	3	4	5	6	7	
Attractiveness								
In my opinion, the product is generally								
annoying	○	○	○	○	○	○	○	enjoyable
bad	○	○	○	○	○	○	○	good
unpleasant	○	○	○	○	○	○	○	pleasant
unfriendly	○	○	○	○	○	○	○	friendly
I consider the product property described by these terms as								
Completely irrelevant	○	○	○	○	○	○	○	Very important

Questionnaire: UEQ Benchmark (I)

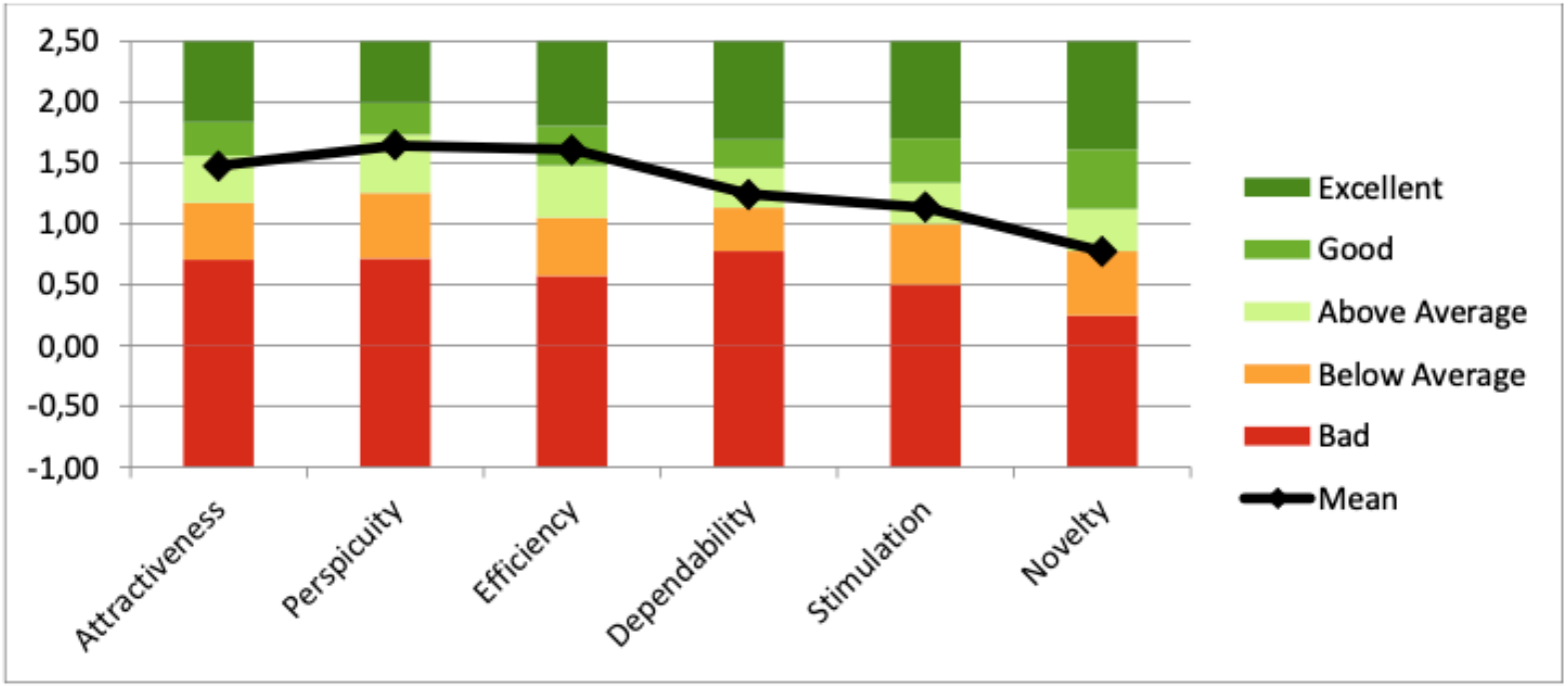
- The UEQ offers such a benchmark, which contains in the moment the data of 452 product evaluations with the UEQ (with a total of 20190 participants in all evaluations).

- The benchmark is updated once a year, so make sure that you always download the latest version of the Excel-Tool from the web-site www.ueq-online.org.

Questionnaire: UEQ Benchmark (II)

- **Benchmark classifies a product into 5 categories (per scale)**
  - **Excellent:** In the range of the 10% best results
  - **Good:** 10% of the results in the benchmark data set are better and 75% of the results are worse
  - **Above average:** 25% of the results in the benchmark are better than the result for the evaluated product, 50% of the results are worse
  - **Below average:** 50% of the results in the benchmark are better than the result for the evaluated product, 25% of the results are worse
  - **Bad:** In the range of the 25% worst results

Questionnaire: UEQ Benchmark Example (I)



Questionnaire: UEQ General Benchmark

- **Mean values**
  - **Item** - Mean value of each item
  - **Scale/topic** - Mean value of the mean value of the related items
- **Benchmark**

General Benchmark (452 product evaluations)

Category	Attractiveness	Perspicuity	Efficiency	Dependability	Stimulation	Originality
Excellent	1.86	2.03	1.90	1.70	1.70	1.61
Good	1.60	1.77	1.50	1.47	1.35	1.14
Above average	1.19	1.25	1.06	1.15	1.01	0.75
Below average	0.70	0.75	0.60	0.78	0.50	0.25

The value in a cell means that a product must exceed this value to be in the corresponding category

Questionnaire: UEQ and Usability Test

- **UEQ is used as part of a classical usability test** to collect some quantitative data about the impression of the participants concerning user experience

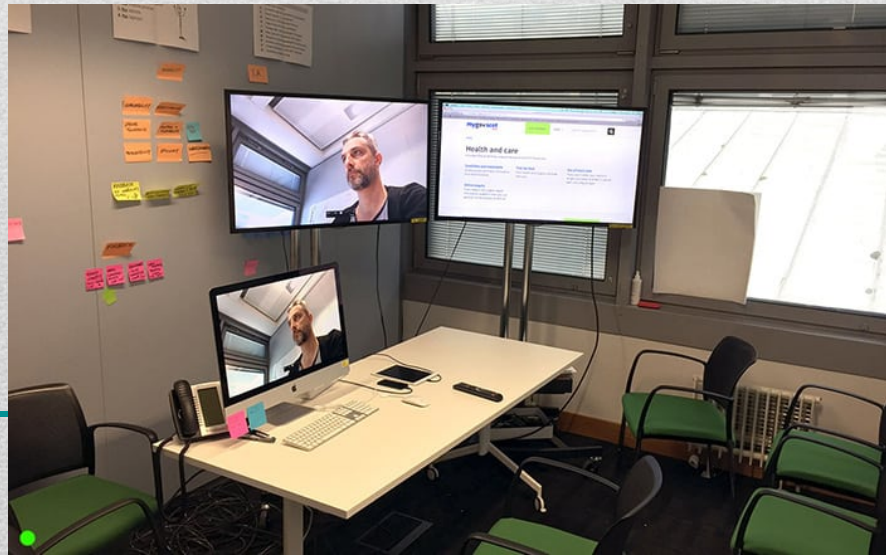
- The best point in time to hand over the questionnaire to the participants is directly after they finished working on the **Test Tasks**

- **If participants fill the questionnaire after they had a lengthy discussion about the product with the person conducting the test, this will influence the results**

- **The goal of the UEQ is to catch the immediate impression of a user towards a product**

Usability Tests with Users - 1st Phase

- **Preparation**
  - The test coordinator should ensure that everything is ready before the user arrives
  - Test room, the audio and video equipment, and the system to be tested must be in the planned state
  - Anything that may distract the user must be turned off



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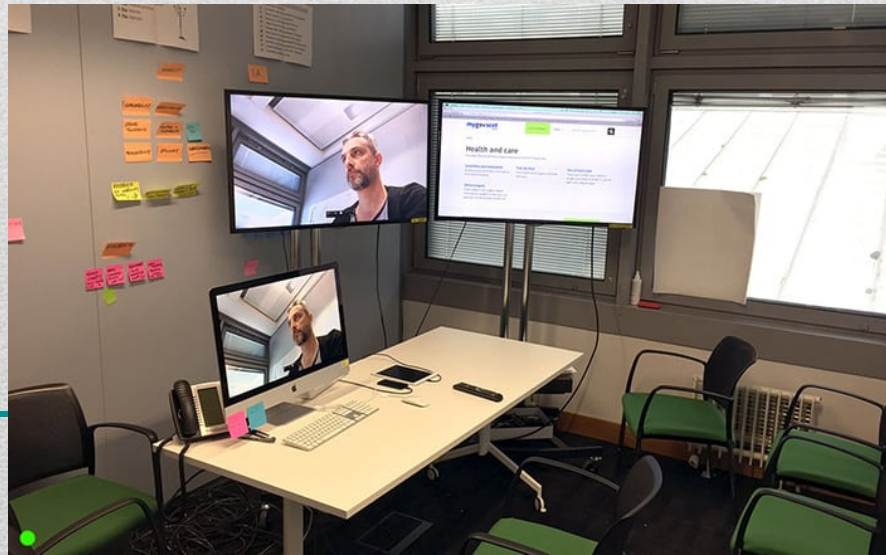


Usability Tests with Users - 2nd Phase

- **Introduction**
  - Coordinator explains the objectives of the test and the procedures
  - Application can be explained through a video or demonstration
  - Explain to the user that it is the application that is being evaluated and not the user
  - Coordinator should explain if it is important for the user to "think out loud"

Usability Tests with Users - 3rd Phase

- **Testing**
  - Coordinator is responsible for conducting the tests
  - Observer takes notes on what is going on
  - Coordinator must deliver the script with the tasks and the order they must be executed
  - Satisfaction/usability **questionnaire**
    - Users should respond to specific questions after completing the each task

Usability Tests with Users - 4th Phase

- **Final Remarks**
  - Ask for additional comments and suggestions from users
  - Thank users for participation
  - **Testing Report**
    - Objectives of the evaluation
    - System Description
    - Environment in which tasks were performed
    - Description of participants
    - Methodology used
    - Tasks
    - Questionnaires used
    - **Analysis of data collected**
    - List of problems identified

Usability Test with Users: How many users?

- **Formative Evaluation**
  - **15 Users** (**99%** of identified problems)
  - **5 Users** in **3 iterations** (**85%** of identified problems per iterations)
- **Summative Evaluation**
  - **10 to 20 Users** (should be large enough to be representative of the population and to allow the use of statistical measures)

Data Analysis

- **In the evaluation of an interactive system is collected a large amount of data**
  - **Statistical Analysis**
    - Population - all potential users
    - Sample - users representing the target public (subset of the population)

Statistical Analysis: Mean

- **Mean**

$$\mu_x = \frac{1}{n}\sum_{i=0}^{n} x_i$$

Slightly robust and sensitive to extreme values

<u>Example</u>

Number of errors made in the course of a task by 8 users

(2,3,3,2,2,2,15) $\mu_x = 4.14$

Mean = 4.14, does not reflect the mistakes made

Statistical Analysis: Variance and Standard Deviation

- **Variance**

$$S_x^2 = \frac{\sum_{i=0}^{n} \left(x_i - \mu_x\right)^2}{(n-1)}$$

Dispersion measure that gives us an idea of how the data is distributed

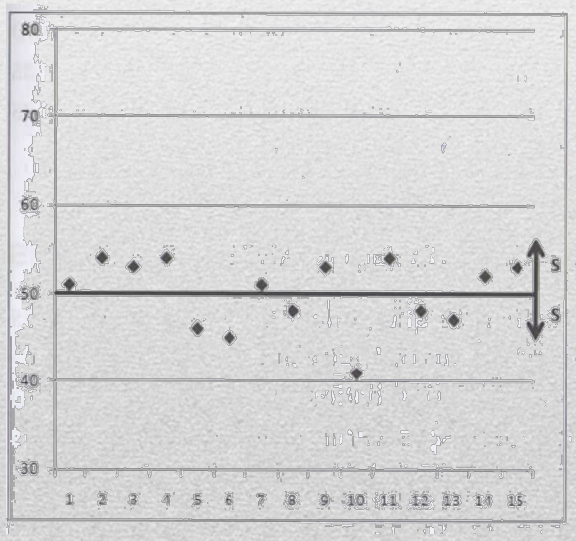
- **Standard Deviation**

Statistical Analysis: Standard Deviation

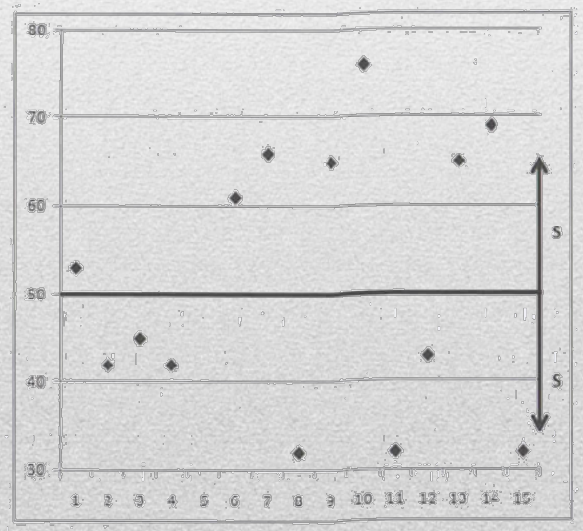
- Two samples, for a variable referring to the measured times, in seconds, to execute a task with two different alternatives for the interface

$$A_1 = (51,54, 53,54, 46,45, 51,48, 53,41, 54,48, 47, 52, 53)$$
$$A_2 = (53,42, 45,42, 27,61, 66,32, 65,76, 32,43, 65, 69, 32)$$

$\mu = 50$



$S_{A_1} = 3{,}96$



$S_{A_2} = 15{,}98$

Statistical Analysis: Mode

- **Mode**
  - Measure of central tendency that gives us the answer that occurred more often
  - Applicable to nominal variables and ordinal or continuous variables if the set of possible values is enumerable
  - What type of transportation do you use?

    On foot: 10 answers

    Car: 12 answers

    Bus: 21 answers

    Train: 6 answers

Statistical Analysis: Median

- **Median**

  Value that divides the list of values into two groups after sorting values

(2,3,3,2,2,2,15) after sorting (2,2,2,2,3,3,15)

Median = 2

Median is more representative than the mean (4,14)

Likert scale with 5 points to measure satisfaction

Median = 4

Half (at least) of users are satisfied