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VISUAL DATA ANALYSIS

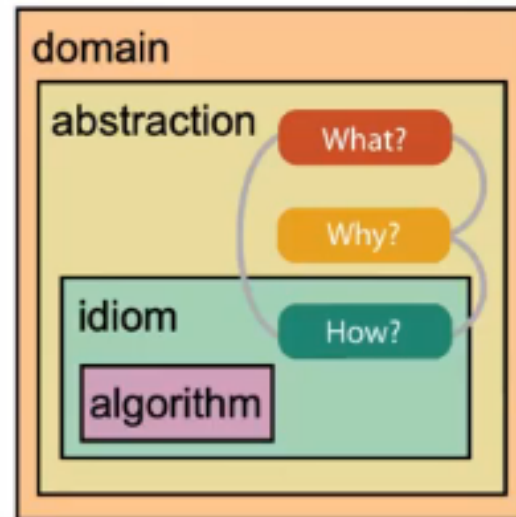
LECTURE 6

AGENDA

- F1: Introduction
- F2: Information visualization 1
- F3: Human perception and cognition
- F4: Information visualization 2
- F5: Guest lecture - Spotfire
- F6: Human-computer interaction and evaluation of VDA applications

Evaluation

Human-computer interaction

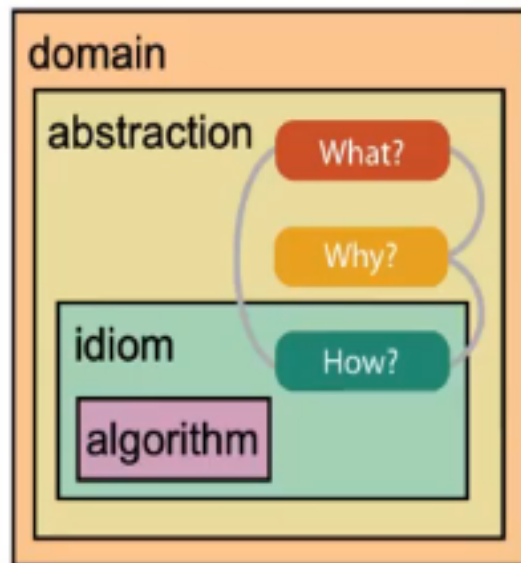


Human perception and cognition

Information visualization

DIFFICULTIES OF VALIDATION

Different ways to get it wrong at each level...



Domain situation

You misunderstood their needs



Data/task abstraction

You're showing them the wrong thing



Visual encoding/interaction idiom

The way you show it doesn't work



Algorithm

Your code is too slow

OUTLINE

- Human-Computer Interaction
 - Definition
 - Why important?
 - Usability
 - Guidelines and heuristics
- Evaluation
 - Usability testing
 - Evaluation and VDA
- Course recap



- HCI – termed in the mid 80s to strengthen their own field of research

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

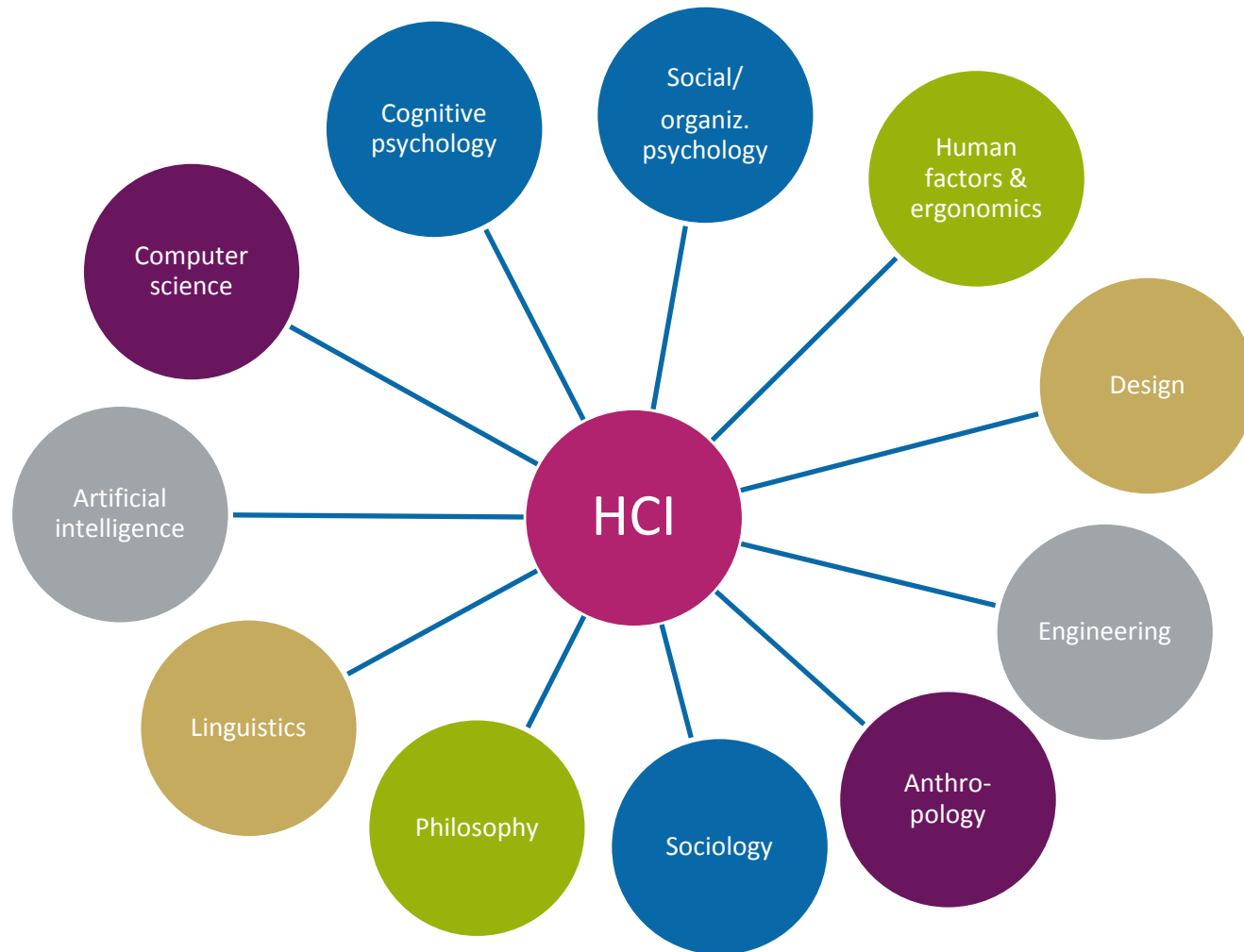
(ACM Special Interest Group on Computer-Human Interaction (SIGCHI) Curriculum Development Group, 1992)



INTERDISCIPLINARY FIELD



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GENERALLY HCI IS ABOUT

- Methods for designing novel computer interfaces
 - Optimizing a design for a desired property (i.e. learnability etc.)
- Methods for implementing interfaces (software tool kits, libraries)
- Methods for evaluating and comparing interfaces with respect to different properties
- Methods for studying human computer use and its sociocultural implications
- Models and theories of human computer use and conceptual frameworks for design



WHY IMPORTANT?

User interfaces matter

- Efficiency (time is money)
- Convenience
- Commercial success
- Even life and death



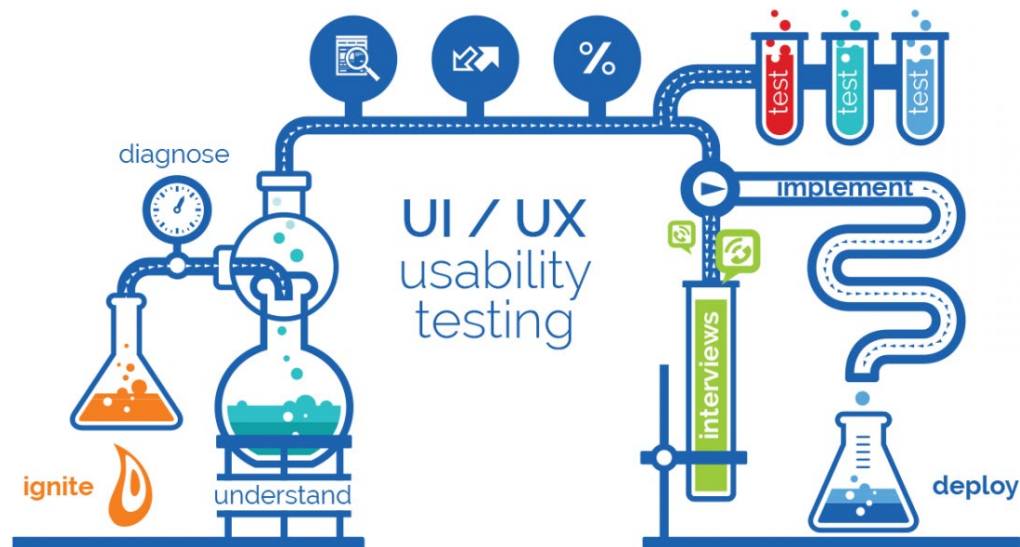
WHY DIFFICULT?

- Difficult to deeply analyse human behaviour
- Creativity is challenging
- Easy to get design fixation
- Cost/features may be considered over good human factors



HOW DESIGN FOR GOOD HCI?

- Designing and analysing according to common sense?
- Develop a theory of human cognitive processing to predict users' problems?
- Test the user interface on actual users?



USABILITY

*“The extent to which a product can be **used by specified users to achieve specified goals** with effectiveness, efficiency and satisfaction in a **specified context of use**”*
(ISO 92241-11)

- Specific users
- Specified goals
- A specific context of use

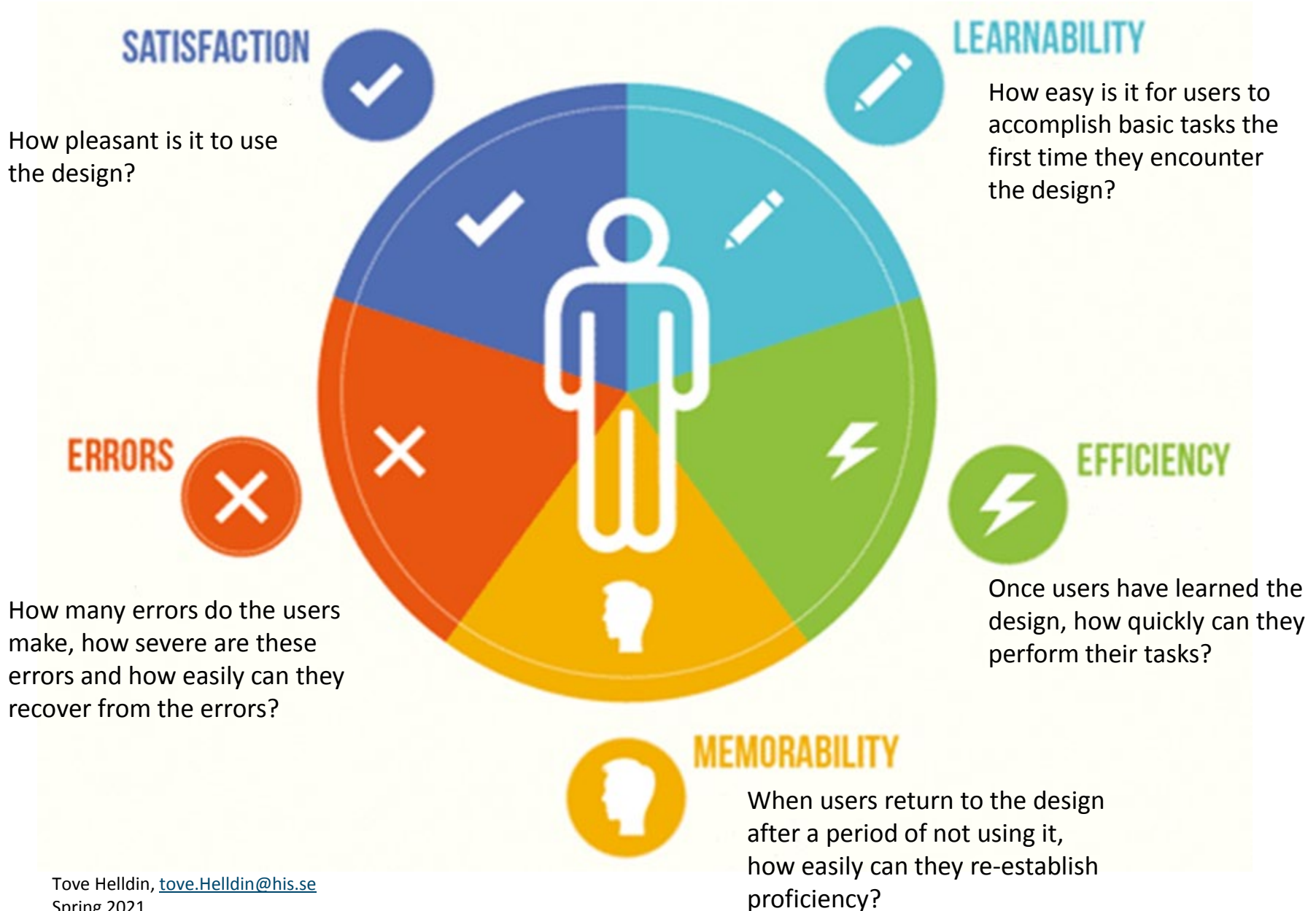
Focuses on the critical measures of usability

- Effectiveness
- Efficiency
- Satisfaction



*“When usability is inherent in the products we use, it’s invisible.
We don’t think about it. But we know it’s there.”*
(Barnum, C., 2011)

USABILITY ISO 92241-11



NIELSEN'S USABILITY HEURISTICS



- Visibility of system status
 - Keep the users informed of what is happening, feedback within reasonable time
- Match between system and real world
 - Speak the users' language, make information appear in a natural and logical order
- User control and freedom
 - Support undo and redo
- Consistency and standards
 - Follow platform conventions to avoid misinterpretations
- Error prevention
 - Eliminate error-prone conditions, prevent users from committing probable bad actions

<http://www.usabilityfirst.com/usability-methods/heuristic-evaluation/>

NIELSEN'S USABILITY HEURISTICS



- Recognition over recall
 - Minimize the user's memory load by making options, actions and objects visible
 - Instructions should be easily retrievable and not force the user to remember
- Flexibility and efficiency of use
 - Design for both novices and experts (short-cuts etc.)
- Aesthetic and minimalist design
 - Only present relevant information
- Help users recognize, diagnose and recover from errors
 - Error messages should be easy to understand and suggest a constructive solution
- Help and documentation
 - Easily searchable, focused on the users' tasks, list concrete steps to be carried out

<http://www.usabilityfirst.com/usability-methods/heuristic-evaluation/>

NORMAN'S PRINCIPLES

- Visibility
 - Where is the button?
- Mapping
 - Where am I and where can I go?
- Constraints
 - Drop-down menu showing available options only
- Affordability
 - We see that it is a button that can be pressed
- Feedback
 - Is the program loading?
- Consistency
 - Answer call button is always green

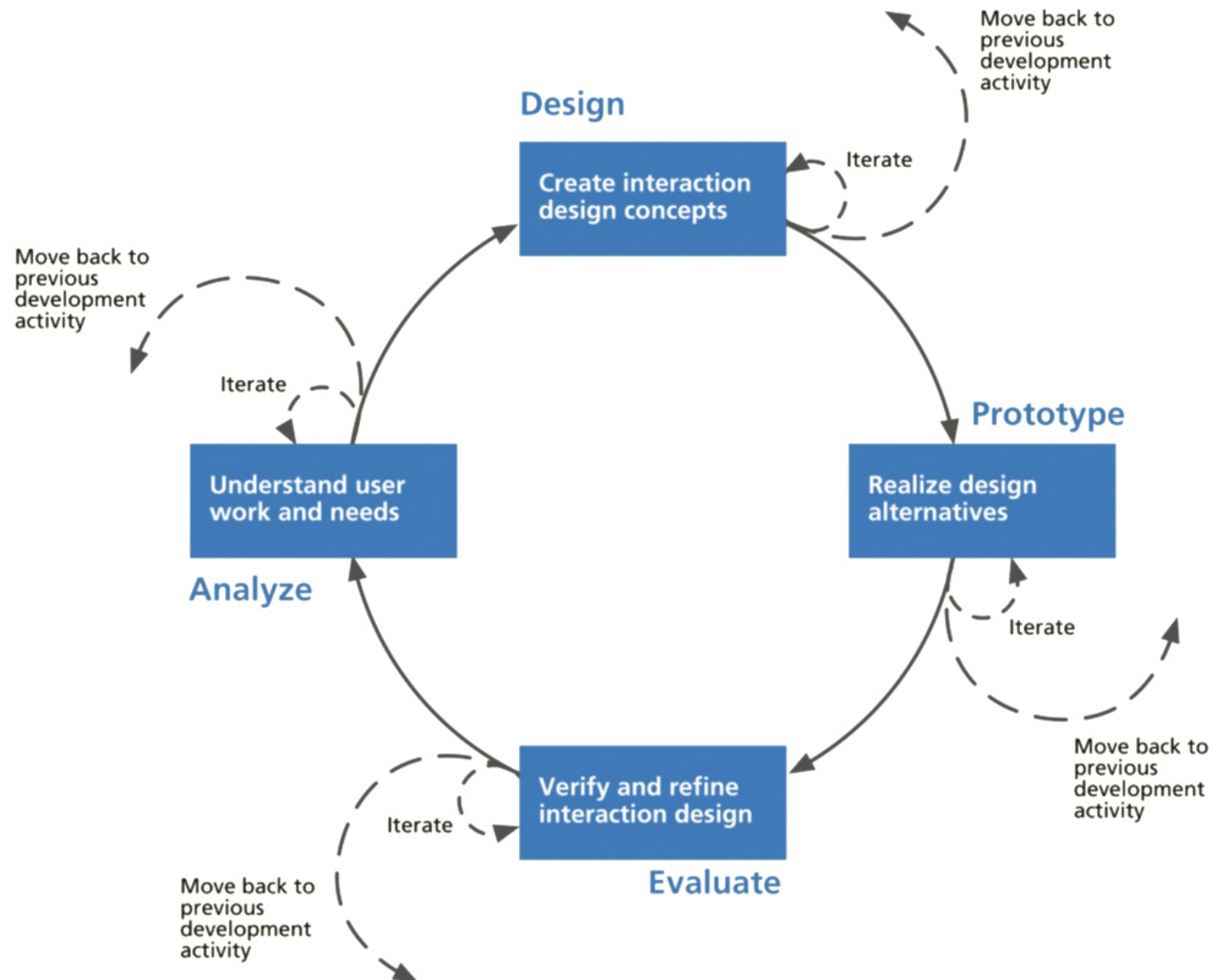


USER-CENTRED DESIGN

- Early focus on users and tasks
- Users' involvement in the process
- Actual measurement: observe, record, analyse user's reactions and performance
- Iterative design

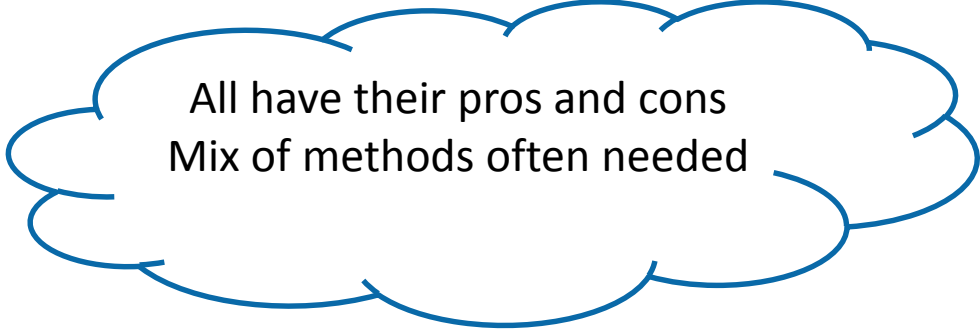


BASIC HCI PROCESS OF DESIGN



Example methods

- Workshops
- User interviews
- “Guided storytelling”
- Task analysis
- Focus groups
- Observations
- “Think-aloud”
- Workplace studies
- Diary studies
- Questionnaires
- Heuristic evaluation – following guidelines and evaluate how well these are achieved in the design



All have their pros and cons
Mix of methods often needed



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Carol M. Barnum

Usability

Testing

Essentials

Ready, Set...Test!

MK
Morgan Kaufmann

Foreword by Steve Krug, author
of *Don't Make Me Think!*

USABILITY TESTING

HOW TO PERFORM USABILITY TESTING?

- When?
 - Formative (smaller studies) vs summative (larger studies)
- How to?
 - Understanding the users and their goals
 - Personas and scenarios
 - Plan, prepare and conduct usability tests
 - Analyse and report the findings

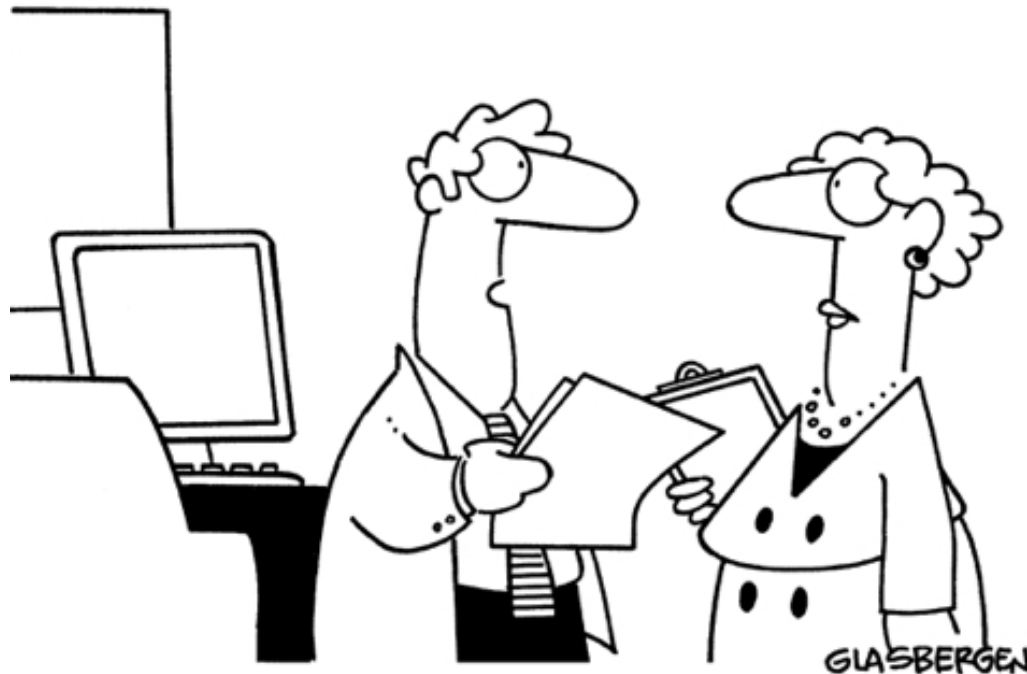


More info here:

<https://www.usability.gov/how-to-and-tools/methods/usability-evaluation/index.html>

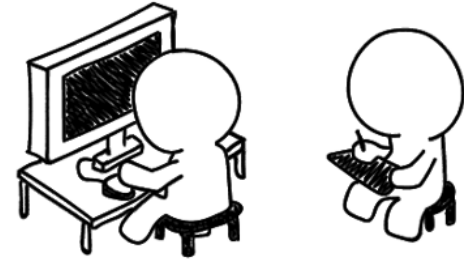
Usability testing mantra: “We are testing the product, not you.”

Copyright 2006 by Randy Glasbergen. www.glasbergen.com



**“My team has created a very innovative solution,
but we’re still looking for a problem to go with it.”**

USABILITY TESTING



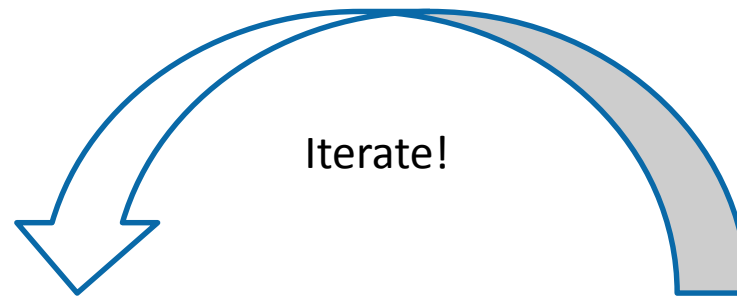
- You will learn
 - what works/what doesn't work for your users
 - what pleases, what puzzles, and what frustrates them
- Your users' experience with the product determines whether the design matches their expectations and supports their goals (does the design help to answer the user's visual queries?)
- In a testing situation, you have a chance to elicit their comments, observe their body language, discover their wishes and hopes for the product, and to learn how well the product supports them in their goals.

Two types of usability testing, which one to choose depends on

- When is the testing conducted?
 - What is the goal for testing?
-
- **Formative testing:** while the product is in development, with the goal of diagnosing and fixing problems; typically based on small studies, repeated during the development.
 - **Summative testing:** after the product is finished, with the goal of establishing a baseline of metrics or validating that the product meets the requirements; generally requires larger numbers for statistical validity (success/failure rates, average time on task, completion rates, error rates etc.)

Today, the formal methodology of experimental design has largely given way to *informal, formative studies*.

HOW?



Planning



- Identifying the Goals
- Defining the scope
- Agreeing upon the metrics
- Estimating the cost of study

Define the user profile
Create task-based scenarios

Recruiting



- Assembling the resources
- Explaining the goals & scope
- Assigning the Tasks
- Reporting Tools & Templates

Test Execution



- Communication of Scope
- Capturing Unbiased Results

Collect data through for example
think-aloud protocol

Analysis



- Categorization of Results
- Identifying Patterns
- Generate Inferences

Reporting



- Actionable Recommendation
- Stakeholder Briefing

HOW – DEFINE THE USER PROFILE



For smaller studies

When you are planning a small study with 5-6 participants, you need to pick **one subgroup** of the user population, create a profile of this user and make this the basis for recruiting participants for your study.

→ This is probably the most important part of planning so that you get good results!

To select this, you need to make a **pre-study: *who are the typical users?*** Make interviews with some of them to get to know them better. Does the company know the characteristics of a typical user?

For larger studies

When you are planning a larger study, you can increase the number of profiles you create and reduce the number of participants from each subgroup (there are likely overlaps in the findings from the different subgroups).

Personas help you **get to know your users**

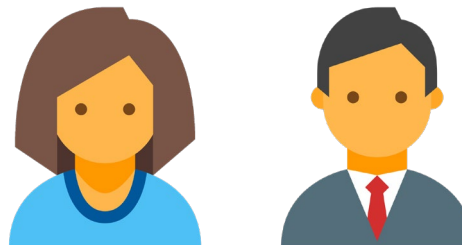
- An early step in getting ready for usability testing, widely adopted method
- Personas are fictional representations of people that are created from real data about your users (performed in the pre-study)
- Enables you to focus on the user when designing – what does the user want to do with the product



HOW – PERSONAS

Essential characteristics of a persona:

- Name and picture
- Demographic info: age, education, ethnicity, family status
- Job title/main focus of activity: student, teacher, retired person etc.
- Goals: product related and experience related
- Environment: context of use or relevant information about the environment
- Technical and product domain expertise: could also include attitude toward technology
- A quote that sums up what matters most to the persona (often taken from actual interviews)



HOW – PERSONAS



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Jill Anderson



"I'm looking for a site that will simplify the planning of my business trips."

AGE 29

OCCUPATION Regional Director

STATUS Single

LOCATION Portsmouth, NH

TIER Frequent Traveler

ARCHETYPE The Planner

Organized

Practical

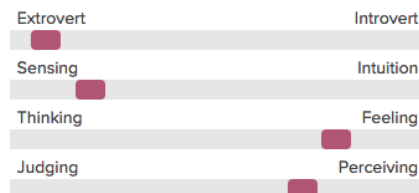
Protective

Hardworking

Bio

Jill is a Regional Director who travels 4-8 times each month for work. She has a specific region in which she travels, and she often visits the same cities and stays in the same hotel. She is frustrated by the fact that no matter how frequently she takes similar trips, she spends hours of her day booking travel. She expects her travel solutions to be as organized as she is.

Personality



Brands



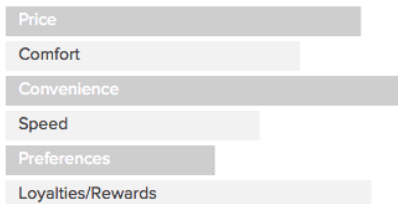
Goals

- To spend less time booking travel
- To maximize her loyalty points and rewards
- To narrow her options when it comes to shop

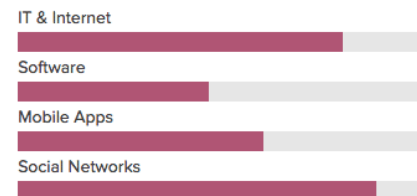
Frustrations

- Too much time spent booking - she's busy!
- Too many websites visited per trip
- Not terribly tech saavy - doesn't like the process

Motivations



Technology



HOW – PERSONAS



A creative activity, but don't get carried away

- personas need to be anchored in real data.

You use the data to personalize the characteristics of a composite user with details that are relevant to the product you are developing.

- Does the information help you to understand user motivation, fears, concerns and goals as they relate to your product?

You can have many personas, but focus on your primary users. Then add secondary ones if necessary.

- More than 2, less than 12, depending on your study

HOW – TASK-BASED SCENARIOS

Before the usability test, provide the participants with **specific tasks** to perform

- embed them in scenarios – realistic descriptions of the users' **goals**
- observe the users' methods for achieving the task/goal during the usability tests

Without such instructions, it can be difficult to see patterns of usage and recurrence problems among and between users

Depending on the goal with your study, the scenarios used can be broader, for example when testing the general “look-and-feel” of a product.



HOW – SCENARIOS

For each persona you need to create meaningful scenarios that **reflects the goals** of the persona (the result or outcome that the users seek – not the same as what they do, the tasks).

- Establish a problem or situation, create the scene with the environment
- Describe the persona's main goals
- Use the real data that you have collected to ground the story

Gives “life” to the persona, and will help you understand your users and will make it easier to plan your usability tests.



HOW – THINK-ALLOUD PROTOCOL

During your usability test: use a think-aloud protocol

- encourage the participants to **share their thoughts** with you while working with the product

It helps you understand their experience:

- Which actions are the users performing?
- Why are they performing these actions?
- What do they think of the process?

Often does not feel “normal” for the participants

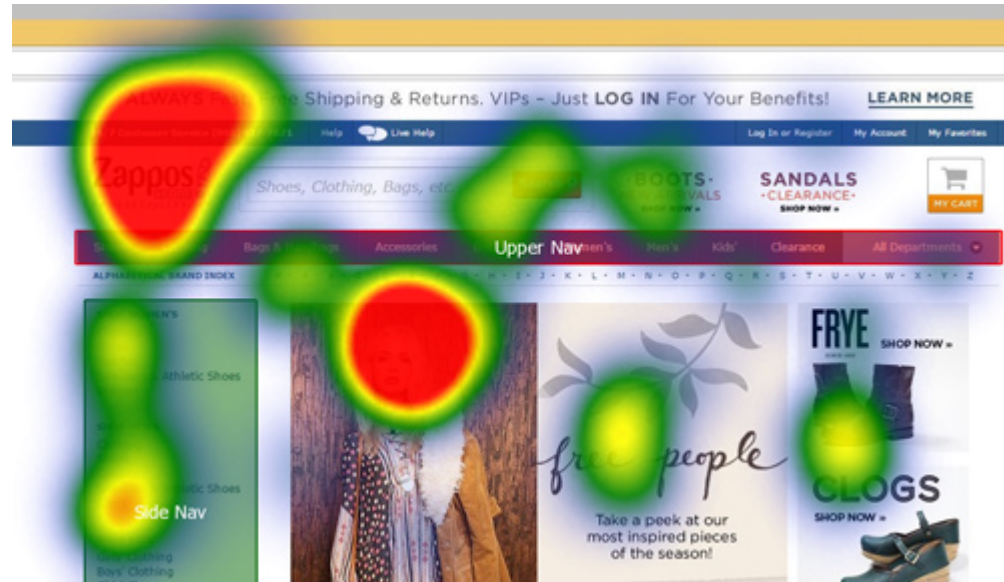
- You may need to remind them to think-aloud



HOW – LAB TESTING

Lab room

- Camera
- Microphone
- Logging software (such as Morae)
- Eye-tracking equipment
 - Where is the user looking?
 - Eye movements
 - Fixations
 - Hotspots
 - A color-coded heat map
 - areas that receive the largest number of fixations and the longest time for fixations (individuals/all users)



Field testing

- Learn about the context of the user (lightning conditions, access to documents, Internet connectivity)
- The artefacts that the user uses
- The impact of noise, distractions

However, you cannot control the environment, the user might not want to think aloud in the presence of others, often more expensive to take up the employees' time...

Remote testing

- often convenient, you can reach out to a larger population, less costly
- But you can't observe the participants in the same way, setup can be problematic etc. However, Mechanical Turk is very widely used in research settings.

HOW – HEURISTIC EVALUATION



If a formal evaluation is needed, you will probably follow Nielsen's guidelines for conducting a **heuristic evaluation**.

- 3-5 evaluators are needed – there is often a high degree of overlap in their findings
- Only 1 evaluator will usually only discover 35% of the usability problems
- Each evaluator should independently review the product at least twice:
 - Once to become familiar with it, and the second time to inspect the product against the set of heuristics.
 - The evaluator should assign findings **severity codes**, like
 - Catastrophe
 - Major problem
 - Minor problem
 - Cosmetic problem

Which method to choose?

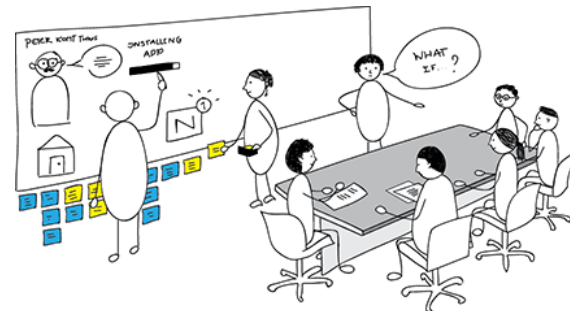
- No inspection method predicts end-user problems as well as actual usability testing
- Even inspection experts are likely to find twice as many minor problems than major ones
- Usability testing and inspection methods do not have a high degree of overlapping findings.
- Most optimal solution: **put the two methods together.**
 - First perform the heuristic evaluation to clean up the interface to get rid of those issues that can interfere with the user's experience.
 - If you won't have time to implement changes in the product before the usability test, use the heuristic review to identify goals for the usability testing.

PLANNING FOR USABILITY TESTING

- **Establish test goals**
 - What do you want to learn about the users' experience?
 - If you are not sure, you could use criteria such as Whitney Quesenbery's 5Es: Efficient, Effective, Engaging, Error tolerant, Easy to learn:
<http://www.wqusability.com/articles/getting-started.html>
- **Determine how to test – what, how, where?**
- **Agree on user subgroup(s) – personas**
 - If your study is small, make sure that the users all come from the same subgroup!
 - For each subgroup, come up with a list of characteristics
 - Familiarity with the product/type of product you are testing
 - Domain knowledge
 - Technical skills, computer skills, software skills
 - Etc.

Create scenarios based on tasks that match the test goals

- Which tasks should the users perform with the product?
- Match the tasks to you users' goals for the product and yours for the study.
- Create “real” scenarios
 - Use the language of the user, not the product.
 - Put the tasks into a context that matches the user's world.
 - Give the user a goal, not a list of steps to accomplish the task and reach the goal.
 - Say as little as possible to present the goal. Don't give away more than you have to.



Determine quantitative and qualitative feedback methods

- Formative or summative evaluation?
- Depending on your goals for the study, you may want to focus on one type of data collection or another.
 - A combination is often needed to get a fuller understanding of the user experience.
- Performance and preference data are quantitative: measurements of users' actions (time, errors, task completions, use of help, Likert-scale questionnaires)
- Observations and user comments are qualitative data: body language, think-aloud protocols, open ended questionnaire, interviews.

PREPARING FOR A USABILITY STUDY

Prepare the usability study

- Observer form
- Questionnaires: pre-test, post-task, post-test
- There are standard post-test questionnaires
 - SUS – System Usability Scale
 - CSUQ – Computer System Usability Scale
- Create interview questions
- Test your test!

The System Usability Scale Standard Version		Strongly disagree					Strongly agree				
		1	2	3	4	5	1	2	3	4	5
1	I think that I would like to use this system.		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>				
2	I found the system unnecessarily complex.		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>				
3	I thought the system was easy to use.		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>				
4	I think that I would need the support of a technical person to be able to use this system.		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>				
5	I found the various functions in the system were well integrated.		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>				
6	I thought there was too much inconsistency in this system.		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>				
7	I would imagine that most people would learn to use this system very quickly.		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>				
8	I found the system very cumbersome to use.		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>				
9	I felt very confident using the system.		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>				
10	I needed to learn a lot of things before I could get going with this system.		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>				

CONDUCT THE USABILITY TEST



Developer watching videotape of usability test.

Meet, greet, brief

- Room arrangement
- Presence of observers
- Describe the think-aloud procedure to the users
- The study protocol: scenarios to give to the user, when is the user done?
- Inform the user of the status of the product (how finished is it?)
- Try to be an unbiased moderator – mind your body language, ask the “right” questions.
 - If the user asks “Did I do that right?” don’t answer it! Say something like “Is that what you were expecting?”
 - Avoid “why” questions – better with what/how (why tend to suggest that the user has done something wrong).
 - Unbalanced example: “So, how difficult was that for you?”
 - Balanced example: “So, how easy or difficult was that for you?”
- Only intervene if you have to, like if the system crashes, the participant is struggling very much or if the participant wanders off task.
- Log observations

ANALYSING THE FINDINGS



Logs, observer forms, participant questionnaires, session recordings ...

Often a lot of data!

Three steps of analysing the findings:

1) What did we see?

- Collect top positive/top negative findings, as well as top surprises
- Either top-down or bottom up approach:
 - Top-down: start with categories/codes (like the heuristics)
 - Bottom-up: start with individual findings, and cluster them into groups (affinity matching)

2) What does it mean?

- The categories/clusters from 1) – describe them more in detail
- If the users had trouble with for example terminology, give examples of words that caused confusion

3) What should we do about it?

ANALYSING THE FINDINGS

PRESENT QUANTITATIVE DATA

The exact minimum number of participants is not universally agreed upon

- It can range from fewer than 20 to 50 or more participants.
- Larger numbers increase the **confidence interval** – the measure of the accuracy of your claim that your percentages represent findings that are likely to be duplicated in another study.
- Moderated studies that are designed to produce statistics often fall within the 12-to-20 participant range.
 - These studies are likely to use **descriptive statistics**, which reflect the results from the sample used for the study.
 - In contrast, bigger studies provide the numbers for **inferential statistics**, since these allow you to make statements that can be inferred for the population at large (often fully automatic tests and analyses).

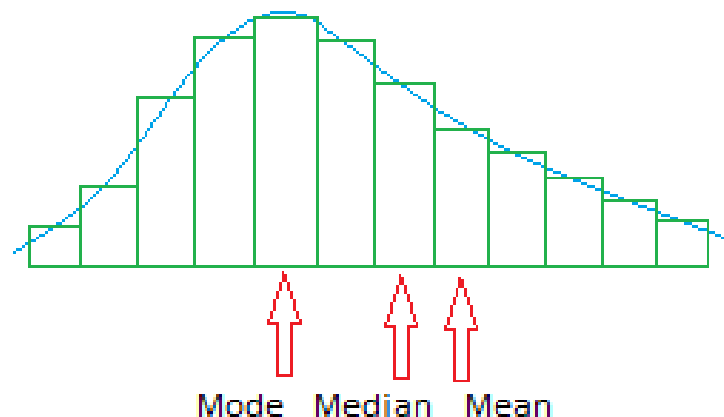
ANALYSING THE FINDINGS

MEAN/MEDIAN/MODE

The **mean**: most often used, the average for all the data points

The **median**: best to use when the range is widely distributed (big difference between highest and lowest point in the range). Shows the midpoint of the distribution.

The **mode**: the most commonly recurring value. Not as commonly used as the other two, but can be good if you want to show that most people completed the tasks in 4 minutes rather than reporting the average time to complete the task across all users.



ANALYSING THE FINDINGS

USE QUANTITATIVE DATA IN SMALL STUDIES?



If your study is small - carefully consider whether to use such metrics!

Misinterpretations are common!

- Small variations in time/task within a small group of users could make it difficult to report the average time/task.
- Eliminating a “bad” data point can result in too few data points to present results in any meaningful statistical way.

In these cases, it's best to **use a table of the actual time/task** for each participant.

For small studies, preferably use numbers instead of percentages – you avoid suggesting a validity that is not borne out by the small number of participants in your study.

However, findings can be significant, without being statistically significant!

ANALYSING THE FINDINGS

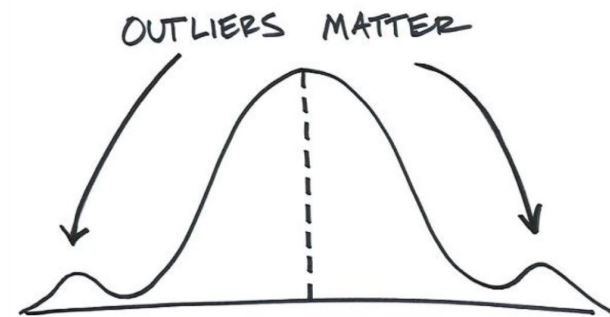
OUTLIERS

Should outliers be thrown away?

- But, if you are testing with 5 users and one person's experience is an outlier, the finding could represent 20% of your users...

Take a closer look at the outlier

- What did we see?
- What does it mean?
- What should we do about it?
- Is the participant a true representative of a target user? Would others have the same problem?
- Does it require further studies?



ANALYSING THE FINDINGS

WHAT DO THE FINDINGS MEAN?

Not all findings are self-evident. They need to be analysed to be understood.

A typical example is how to count success/failure for a task. There can be many variations:

- Successful completion of the task within the predicted time frame
- Successful completion of the task beyond the predicted time frame
- Successful completion of the task with assistance
- Failure to complete the task – recognized by the user
- Failure to complete the task – not recognized by the user (the user thinks it was done correctly)
- And others...

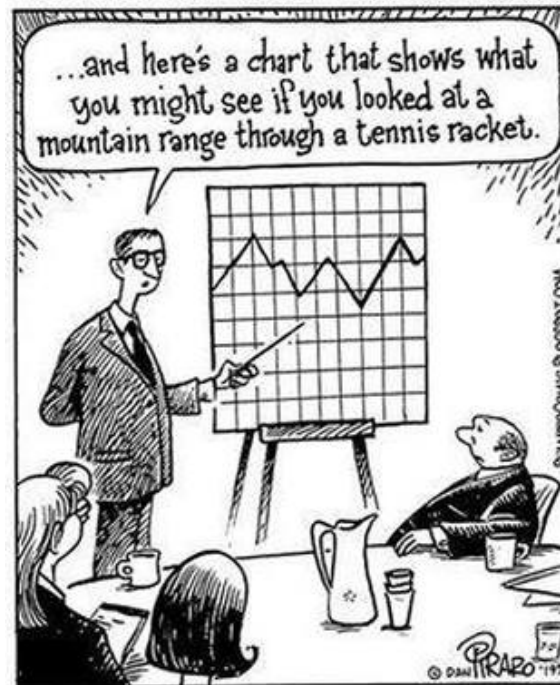


ANALYSING THE FINDINGS

QUESTIONNAIRES

Questionnaires can help you collect both quantitative and qualitative data:

- **Quantitative** responses: responses to questions or statements using a rating scale
- **Qualitative** responses: comments, opinions, perceptions expressed through open-ended questions



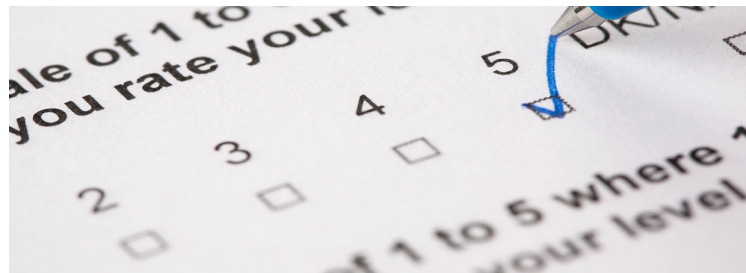
ANALYSING THE FINDINGS QUESTIONNAIRES

Quantitative responses

- If the study is large enough, you can represent these ratings in percentages using the mean, median or mode.
- In small, formative studies, you will want to present your findings as numbers (5 out of 6 participants...)

However...

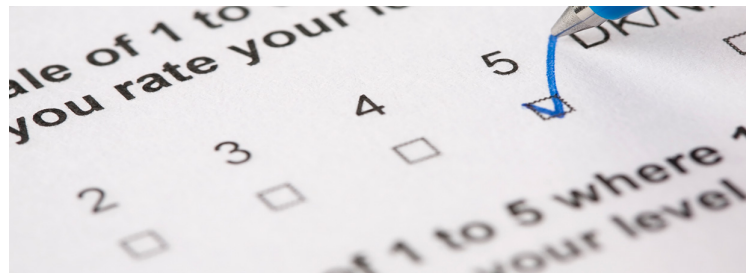
- People tend to avoid extremes on the scale – “**error of central tendency**”
- People tend to rate responses **consistently** – if they choose a 4 out of 5 for the first couple of responses, they are likely to stay close to that response throughout.



ANALYSING THE FINDINGS QUESTIONNAIRES

Qualitative responses

- Quoting users' comments to support your findings makes for a better understanding of the users' experience.
- You can sort the comments by keywords or issues.
- If not so easily sorted, organize by negative/positive comments.

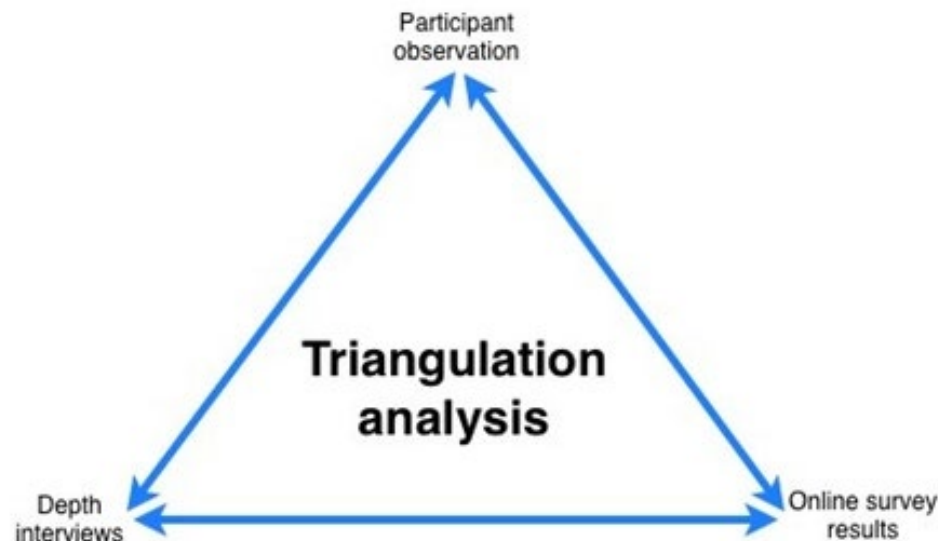


ANALYSING THE FINDINGS

TRIANGULATION

Triangulating the data from findings

- A technique often used in qualitative studies to demonstrate the dependability of the findings by examining the data from **multiple perspectives**.
- Triangulation is the process of comparing separate sources of findings to look for consistencies/discrepancies.



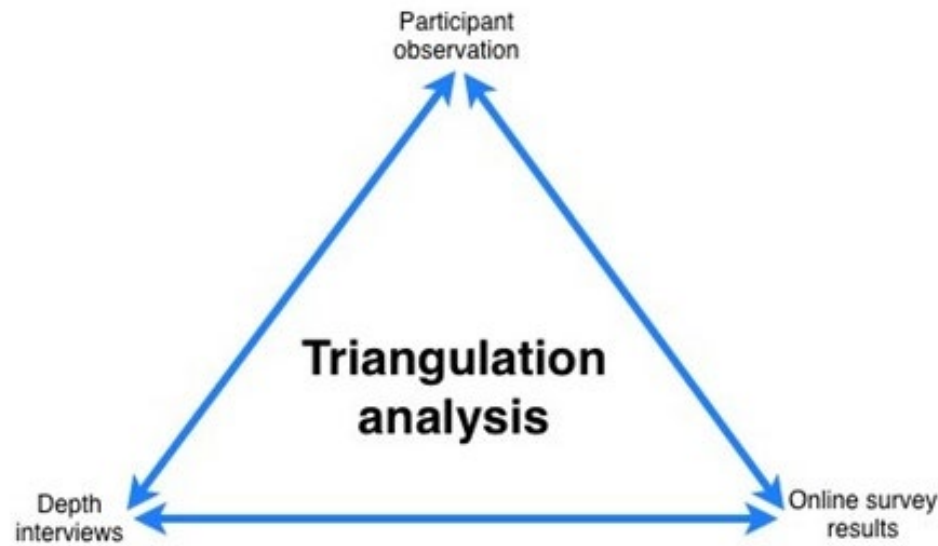
ANALYSING THE FINDINGS

TRIANGULATION

Triangulating the data from findings

For example: comparison of qualitative and quantitative data: task completion.

- Solve task x under 5 minutes – use this as a baseline.
- Look at the time/task for all participants – did they solve this?
- Then look at participant comments – did they say anything about this?
- What did they think about the task?



ANALYSING THE FINDINGS

SCOPE AND SEVERITY

Characterize the findings by **scope** and **severity**

Is the finding **global** or **local**?

- Broad findings affecting product design
- Local findings, only affecting a particular part of the interface

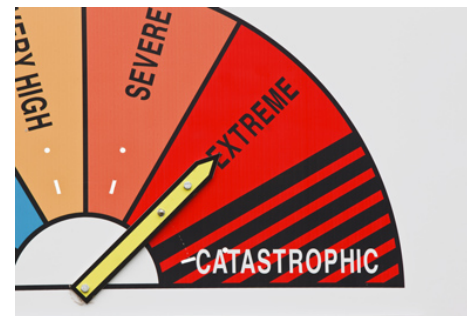


How **severe** is the finding?

- Frequency of occurrence
- Impact of the problem on user experience (recover from errors, success/failures)
- Persistence of the problem (can the users learn how to avoid the problem)

Often reported using a 3-point scale:

- catastrophe (high)
- serious problem (medium)
- cosmetic problem (low)



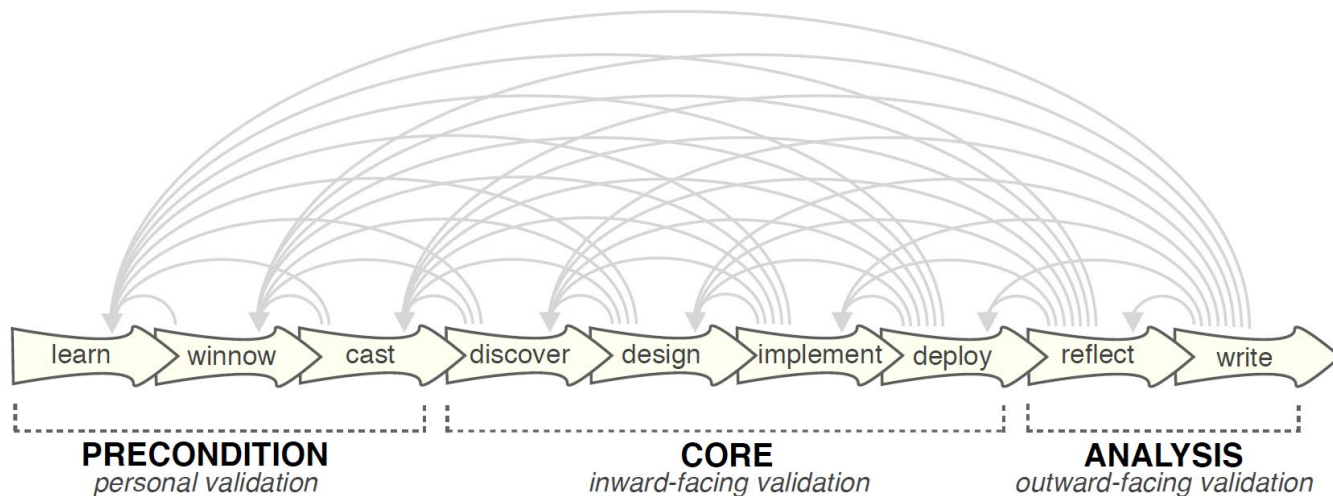


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EXECUTION AND EVALUATION OF VDA APPLICATIONS

EXECUTION AND EVALUATION OF VDA APPLICATIONS

A design study is a project in which visualization researchers analyse a specific real-world problem faced by domain experts, design a visualization system that supports solving this problem, validate the design, and reflect about lessons learned in order to refine visualization design guidelines
(Sedlmair, Meyer, Munzner, 2012)



EXECUTION AND EVALUATION OF VDA APPLICATIONS

Precondition:

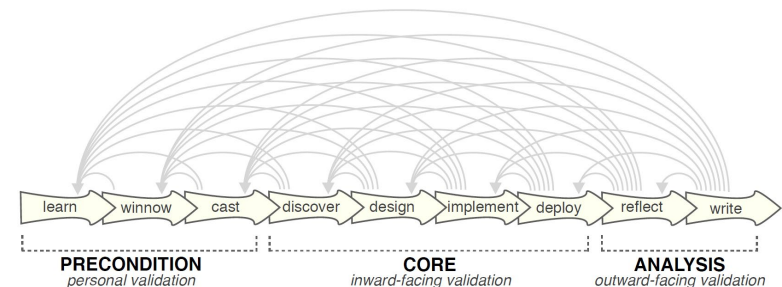
- Knowledge of visualization & interaction techniques (including visual encodings), design guidelines and evaluation methods
- Identify collaborators, such as domain experts and roles within the project
- Does real data exist, is it enough, and can I have it?

Core:

- Learn about the target domain the practices, needs, problems and requirements of the domain experts to discover if and how visualization can enable insight and discovery
- Design visualization solutions, preferably through parallel prototyping
- Create prototypes, start simple, ideally with paper prototypes, close feedback loops, investigate its use in the wild and evaluate

Analysis:

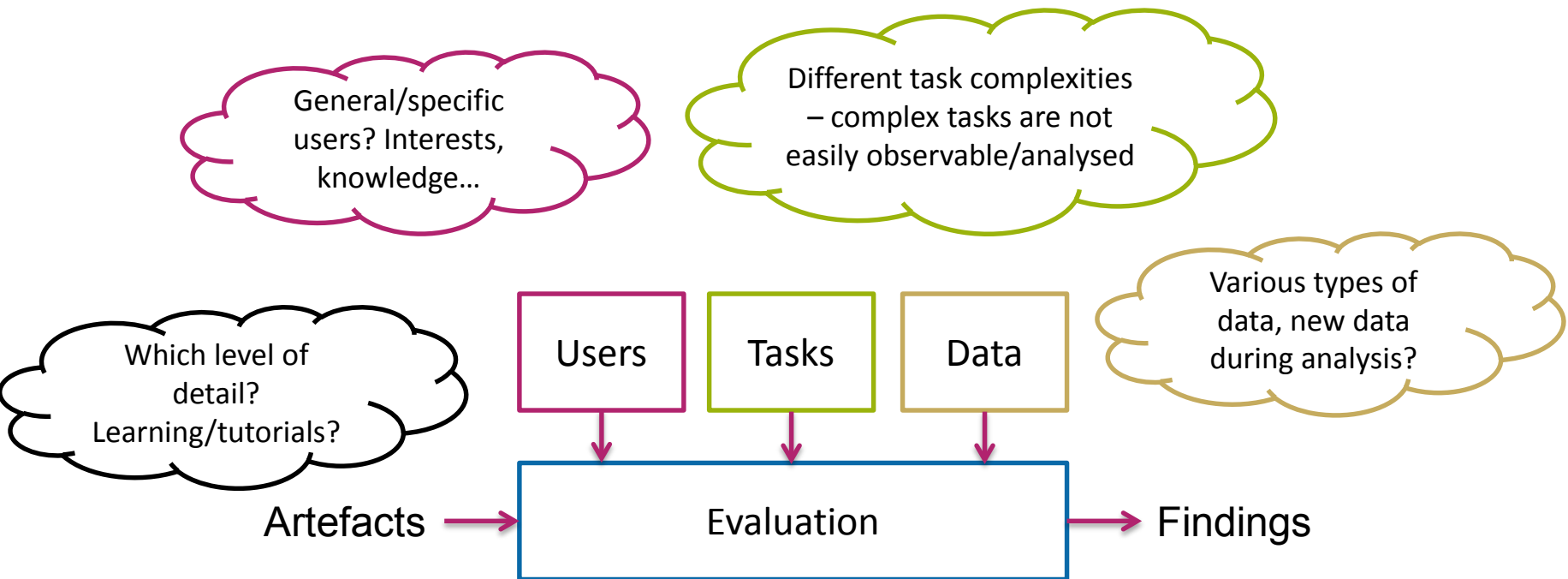
- Reflect upon the work carried out and write down lessons learned



EVALUATION OF VDA

Proper evaluation of VDA is not easy

- It encompasses many different aspects and disciplines
- Humans play a central role
- Evaluation leads to findings on the quality of artefacts. Such findings are never absolute, but depend on users, tasks and data.



COMMON EVALUATION APPROACHES FOR VDA

A range of evaluation methods exist for examining interactive techniques:

- Quantitative methods
- Qualitative methods
- Mixed method approaches
- Usability studies
-



COMMON EVALUATION APPROACHES FOR VDA

Two commonly used evaluation approaches for VDA are

Program understanding and software visualization

- already implemented VDA tools are evaluated together with analysts
- difficult to create “real” situations
- difficult to discard (close to) finished designs

Contests

- present a problem to the community and challenge researchers and developers to show that their solution is the best
- The “Visual Analytics Science and Technology” (VAST) Challenge
 - <https://vast-challenge.github.io/2019/>
 - <https://vast-challenge.github.io/2020/>

LECTURE SUMMARY

HCI

- How to design, evaluate and implement artefacts with the user in mind?
- How to design for usability?
 - Users, goals, contexts
- Usability: learnability, efficiency, memorability, errors, satisfaction
- Nielsen's usability heuristics
- User-centred design
- How to perform usability tests?

Evaluation of VDA applications

- Design studies
- Artefacts, data, users, tasks
- Mix of methods often required





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LECTURES - RECAP

RECAP



Lecture 1: General info of VDA and course design

Lecture 2 & 4: Information visualization 1 + 2

- Visualizations to amplify our cognition and communicate our knowledge and ideas
→ using vision to think
- Expressiveness and effectiveness of the visualization
- Interaction concepts – Overview first, zoom and filter, then details on demand
- The most common vis techniques for data scientists



RECAP



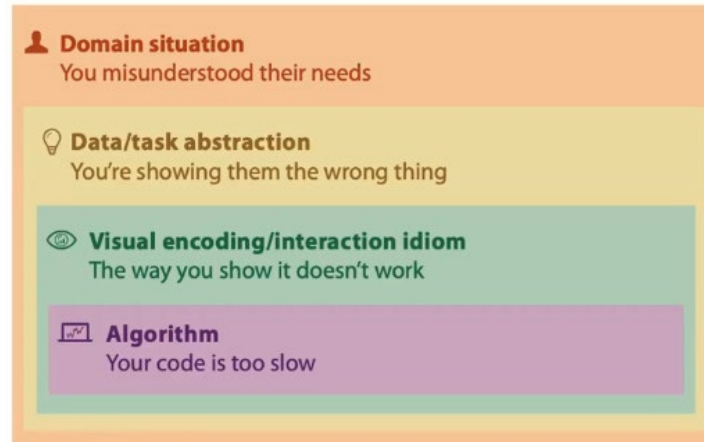
Lecture 3: Human perception and cognition

- Enable/support both our top-down and bottom-up processes
- Don't make the user remember everything!
- Design for visual queries
 - pop-out effects
 - colour, contrast, colour semantics
 - object relationships, depth

(Lecture 5: Guest lecture: Spotfire)

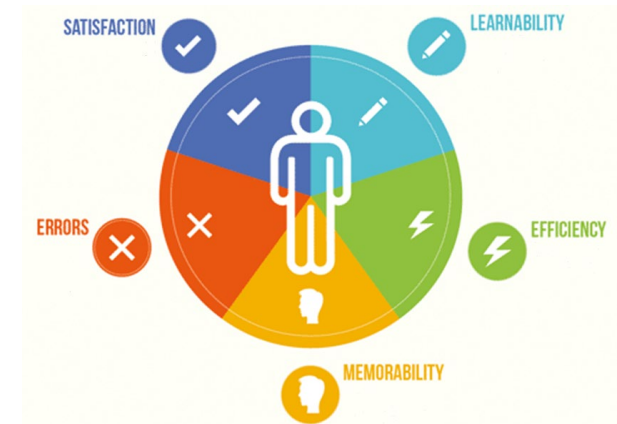


RECAP



Lecture 6: HCI and evaluation

- Try to achieve a good usability
- Usability: learnability, efficiency, memorability, errors, satisfaction
- Nielsen's usability heuristics
- How to perform usability tests?
- Design studies
- Evaluation and analysis of artefacts, data, users, tasks
- Mix of evaluation methods often required



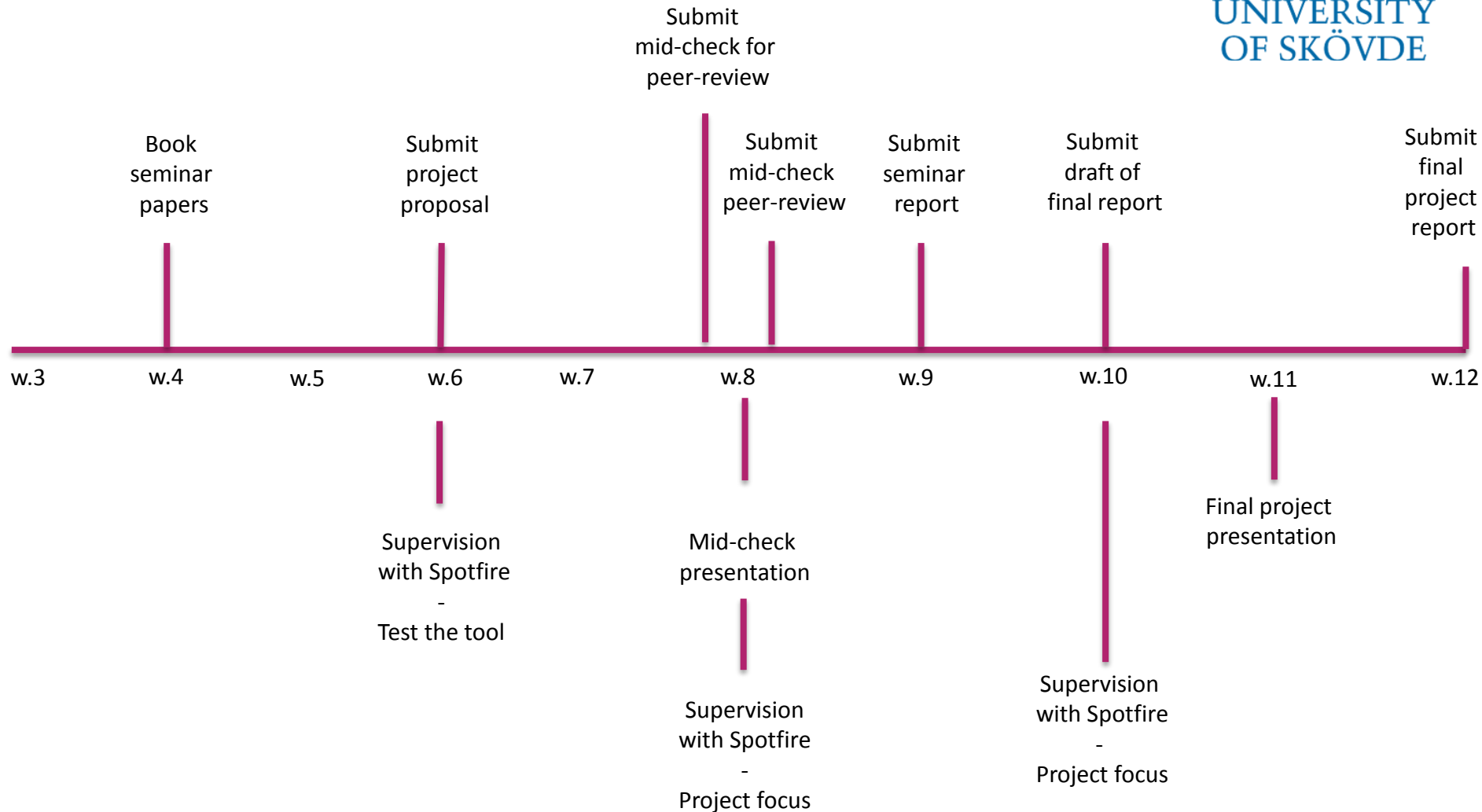


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QUESTIONS?

COURSE TIMELINE

DEADLINES AND PRESENTATIONS



WHAT IS LEFT?



= Hand-in



= Teaching activity

