University of Twente

Human-Computer Interaction

Summary: the books and the articles

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Part I

Lazar, Feng, Hochheiser - Research Methods in Human-Computer Interaction

Chapter 1

Introduction to HCI Research

1.1 Introduction

HCI research is fascinating and complex. HCI borrows research methods from a number of different fields, modifies them, and creates its own standards for acceptable research. The complexity arises from the complex nature of human beings.

It is generally agreed that the field of HCI was formally founded in 1982. In the late 1970s and early 1980s, the move away from large computers in secure rooms used only by highly trained people, to personal computers on desktops and in home dens used by nontechnical people in much greater numbers, created the need for the field of HCI.

1.2 Types of HCI Research Contributions

Wobbrock and Kientz discuss seven types of research contributions:

- **Empirical contributions** - qualitative or quantitative data collected through any of the methods described in the book.
- **Artifact contributions** - the design and development of new artifacts.
- **Methodological contributions** - new approaches that influence processes in rearch or practice.
- **Theoretical contributions** - predictive or descriptive concepts and models which are vehicles for thought.
- **Dataset contributions** - a contribution which provides a corpus for the benefit of the research community.
- **Survey contributions** - a review and synthesis of work done in a specific area, to help identify trends and specific topics that need more work.
- **Opinion contributions** - writings which seek to persuade the readers to change their minds.

The book focuses on empirical research.

1.3 Changes in Topics of HCI Research Over Time

The focus of HCI research has shifted over time. Where we started with developing user interfaces for office software, and figuring out how to increase workspace efficiency, we now research whether people like an interface and want to use it, and in what environment they will be using the technology. And this will change over time as well.

1.4 Changes in HCI Research Methods Over Time

Research methods naturally evolve and change over time. Research tools become more widely available or decrease in cost.

Typically, HCI research has utilized smaller size datasets, because researchers need to recruit their own participants and collect their own datasets. Big data approaches enable HCI researchers to collect or use bigger datasets. A

downside to big data approaches is the loss of interaction with the research participants, making it more difficult to find out the meaning of the data.

Longitudinal studies in HCI are rare. This is a real shortcoming.

For HCI research, the nature of the users participating in the research is often very important. This makes the research complex and perhaps even expensive.

1.5 Understanding HCI Research Methods and Measurement

HCI research must be practical and relevant to people, organizations, or design. Not all HCI researchers agree on research methods.

Schneiderman has described the difference between micro-HCI and macro-HCI.

Not everything can be researched using traditional research methods. Thus, HCI employs research methods from other fields, like the social sciences, and other disciplines might frown upon them.

1.6 The Nature of Interdisciplinary Research in HCI

HCI research takes place in multiple disciplines, each with their own characteristics and preferences.

1.7 Who is the Audience for your Research?

Most HCI researchers target their research towards other researchers. However, there are more audiences, like the individuals who do systems development and interface design, as practitioners. This might introduce issues with disclosure and corporate secrecy. Another target for research is policy makers, who need data to inform their decisions related to HCI issues.

1.8 Understanding one Research Project in the Context of Related Research

There is nu such thing as a perfect data collection method or a perfect data collection effort.

We define triangulation as the phenomenon where replicated research results in the same general findings over time, providing evidence for the scientific truth of the finding.

1.9 Inherent Trade-Offs in HCI

This section gives some examples of current struggles and trade-offs in the field of HCI. There isn't really anything to summarize. Go read it yourself.

Chapter 2

Experimental Research

2.1 Types of Behavioral Research

We can broadly categorize empirical research in three groups:

Type of research	Focus	General Claims	Typical Methods
Descriptive	Describe a situation or a set of events	X is happening	Observations, field studies, focus groups, interviews
Relational	Identify relations between multiple variables	X is related to Y	Observations, field studies, surveys
Experimental	Identify causes of a situation or a set of events	X is responsible for Y	Controlled experiments

The three kinds of research methods are not totally independent, but highly intertwined. They all play a great role in the process of scientific discovery.

2.2 Research Hypotheses

A hypothesis is a precise problem statement that can be directly tested through an empirical investigation. In contrast, a theory generally covers a larger scope and requires a sequence of empirical studies.

2.2.1 Null Hypothesis and Alternative Hypothesis

An experiment normally has at least one null hypothesis and one alternative hypothesis. A null hypothesis typically states that there is no difference between experimental treatments. The alternative hypothesis is always a statement that is mutually exclusive with the null hypothesis. The goal of an experiment is to find statistical evidence to refute or nullify the null hypothesis in order to support the alternative hypothesis.

It is important to start with one or more good hypotheses, which satisfy the following criteria:

- is presented in precise, lucid language;
- is focused on a problem that is testable in one experiment;
- clearly states the control groups or conditions of the experiment;

2.2.2 Dependent and Independent Variables

Independent variables refer to the factors that the researchers are interested in studying or the possible "cause" of the change in the dependent variable. Dependent variables refer to the outcome or effect that the researchers are interested in.

2.2.3 Typical Independent Variables in HCI Research

In the HCI field, independent variables are usually related to technologies, users, and the context in which the technology is used.

2.2.4 Typical Dependent Variables in HCI Research

Dependent variables frequently measured can be categorized into five groups:

- efficiency
- accuracy
- subjective satisfaction
- ease of learning and retention rate
- physical or cognitive demand

2.3 Basics of Experimental Research

In a true experimental design, the investigator can fully control or manipulate the experimental conditions so that a direct comparison can be made between two or more conditions while other factors are, ideally, kept the same.

2.3.1 Components of an Experiment

The design of an experiment consists of three components:

- **Treatments**: the different techniques, devices, or procedures that we want to compare.
- **Units**: the objects to which we apply the experiment treatments.
- **Assignment method**: the way in which the experimental units are assigned different treatments

2.3.2 Randomization

The major reason why experimental research can uncover causal relations is because of complete randomization. In a totally randomized experiment, no one, including the investigators themselves, is able to predict the condition to which a participant is going to be assigned.

2.4 Significance Tests

N/A. Go study statistics.

2.5 Limitations of Experimental Research

Experimental research has notable limitations:

- It requires well-defined, testable hypotheses that consist of a limited number of dependent and independent variables.
- It requires strict control of factors that may influence the dependent variables.
- Lab-based experiments may not be a good representation of users' typical interaction behavior. This difference is called the Hawthorne effect.

The first two requirements are difficult to satisfy in HCI research, and thus form limitations in experimental research in the context of HCI.

Chapter 3

Experimental Design

We classify three groups of studies:

- Experiments: a study involves multiple groups or conditions and the participants are randomly assigned to each condition.
- Quasi-experiments: a study involves multiple groups or conditions but the participants are not randomly assigned to different conditions.
- Nonexperiments: there is only one observation group or only one condition involved.

True experiments possess the following characteristics:

- Based on at least one testable research hypothesis, which it aims to validate.
- There are usually at least two conditions or groups.
- The dependent variables are normally measured through quantitative measurements.
- The results are analyzed through various statistical significance tests.
- It should be designed and conducted with the goal of removing potential biases.
- It should be replicable with different participant samples, at different times, in different locations, and by different experimenters.

3.1 What Needs to be Considered When Designing Experiments?

Most successful experiments start with a clearly defined research hypothesis with a reasonable scope. The hypothesis shows the (in)dependent variables. It is important to consider how one can measure the dependent variables, and how one can control the independent variables to create the right experimental conditions.

3.2 Determining the Basic Design Structure

The basic structure of an experiment can be determined by answering two questions:

- How many independent variables do we want to investigate?

  If there is only one independent variable, we need a basic one-level design. Otherwise, we need a factorial design.

- How many different values does each independent variable have?

  We use the answer to this question to determine the number of conditions in the experiment.

Both designs allow for between-group or within-group design. The factorial design also allows for a split-plot design.

3.3 Investigating a Single Independent Variable

The number of conditions in an experiment with a single independent variable is determined by the possible values of the independent variable.

3.3.1 Between-Group Design and Within-Group Design

In between-group design, each participant is only exposed to one experimental condition. In within-group design, each participant is exposed to multiple experimental conditions.

Advantages and disadvantages of between-group design

+ Cleaner from a statistical perspective
+ Lower time per participant
– Also compares the performance of the groups.
– Subject to substantial impacts from individual differences.
– Harder to detect significant differences.
– Requires a large sample size: $m \times n$ participants for m participants per condition and n conditions.

Advantages and disadvantages of within-group design

+ Requires a much smaller sample size.
+ The impact of individual differences is isolated.
– May be impacted by learning effects.
– Might induce fatigue among participants.

3.3.2 Choosing the Appropriate Design Approach

Generally speaking, between-group design should be adopted when the experiment investigates:

- simple tasks with limited individual differences,
- tasks that would be greatly influenced by the learning effect, or,
- problems that cannot be investigated through a within-group design.

Generally speaking, within-group design should be adopted when the experiment:

- investigates tasks with large individual differences,
- investigates tasks that are less susceptible to the learning effect, or,
- when the target participant pool is very small.

Chapter 4

Statistical Analysis

4.1 Preparing Data for Statistical Analysis

There are several reasons to preprocess data before analyzing it:

- It may contain errors or it might be prestented in inconsistent formats.
- It may be too primitive, and higher level coding might be necessary to help identify underlying themes.
- The specific analysis method or software might require the data to be in a predefined layout or format.

4.1.1 Cleaning Up Data

The first step is to screen the data for possible errors. You can conduct a reasonableness check. In many cases, fixing errors in this stage is impossible, and the corresponding data items must be removed and treated as missing values.

4.1.2 Coding Data

Most statistical software cannot interpret categorical variables without coding them. This means we transform textual descriptions to numbers.

4.1.3 Organizing Data

Most statistical software has predefined requirements for how data should be laid out for specific statistical analysis. Thus, the data might have to be transformed or re-organized to adhere to these requirements.

4.2 Descriptive Statistics

N/A. Go read the statistics reader.

4.3 Comparing Means

Commonly used significance tests for comparing means and their application context:

Experiment Design	Independent Variables	Conditions for each IV	Types of Test
Between-group	1	2	Independent-samples t test
	1	3 or more	One-way ANOVA
	2 or more	2 or more	Factorial ANOVA
Within-group	1	2	Paired-samples t test
	1	3 or more	Repeated measures ANOVA
	2 or more	2 or more	Repeated measures ANOVA
Between and within	2 or more	2 or more	Spliy-plot ANOVA

4.4 t Tests

N/A. Go read the statistics reader.

4.5 Analysis of Variance

N/A. Go read the statistics reader.

4.6 Assumptions of t Tests and F Tests

N/A. Go read the statistics reader.

4.7 Identifying Relationships

4.7.1 Correlation

The most widely used statistical method for testing correlation is the Pearson's product moment correlation coefficient test. The test returns a correlation coefficient called Pearson's r with $-1 \leq r \leq 1$.

- When r is -1.00, a perfect negative linear relationship is suggested.
- When r is 0.00, there is no linear relationship.
- When r is 1.00, a perfect positive linear relationship is suggested.

By applying the test to all combinations of variables, we can identify relationships between variables.

Obviously, the test only identifies correlation, but not causation.

4.7.2 Regression

Regression analysis allows you to investigate the relationship among one dependent variable and a number of independent variables.

4.8 Nonparametric Statistical Tests

N/A. Go read the statistics reader.

Chapter 5

Surveys

5.1 Introduction

Surveys are one of the most commonly used research methods, across all fields of research, not just HCI. We use surveys to describe populations, explain behaviors and to explore uncharted waters. A survey is a well-defined and well-written set of questions to which an individual is asked to respond.

A questionnaire is not a survey. The questionnaire is the list of questions, and the survey is the complete methodological approach.

5.2 Benefits and Drawbacks of Surveys

Benefits of surveys:

- Easy data collection from a large number of people, at a relatively low cost
- Usable for many different research goals
- Useful for getting an overview, or a 'snapshot', or a user population
- Do not require advanced tools for development
- Most likely to get approval from an institutional review board or human subjects board
- Relatively unobtrusive

Drawbacks of surveys:

- Not very good for getting 'deep', detailed data
- Typically self-administered, so difficult to ask follow-up questions
- Sometimes lead to biased data

5.3 Goals and Targeted Users for Survey Research

Survey responses usually need to come from a specific population that is being studied. It is important to define inclusion criteria, which specify in great detail who qualifies to be included in a survey study.

5.4 Probabilistic Sampling

The classic use of a survey in sociology is to make estimates for populations. The most accurate way to do this is by running a census, where you attempt to get a survey respons from everybody in the population. This is very expensive and complex.

Often, instead of running a census, random sampling, or probability sampling, is used. A small number of participants that adhere to the inclusion criteria are selected to participate in the study.

Stratification is the practice of dividing the population in separate subpopulations. Data analysis can then be made for each subpopulation and can be combined for the entire population. Stratification ensures equal representation of the subpopulations.

There is no clear guideline or rule of thumb on the appropriate amount of responses for a survey. In general, a relatively (or sufficiently) large population has an upper limit on sample size where an increased sample size becomes irrelevant. And in a smaller population size, a smaller sample might be required.

Random sampling is subject to a number of potential errors and biases:

- **Sampling error** occurs when there are not enough responses from those surveyed to make accurate population estimates.
- **Coverage error** occurs when not all members of the population of interest have an equal change of being selected for the survey.
- **Measuring error** occurs when survey questions are poorly worded or biased, leading to data of questionable quality.
- **Nonresponse error** occurs when there are major differences (in demographics, such as age or gender) between the people who responsed to a survey and the people who were sampled.

5.5 Non-probabilistic Sampling

The assumption in probabilistic sampling is that we wish to achieve a population estimate. However, in HCI research, this is generally not the goal. Thus, HCI often uses survey without random sampling. This is considered valid and acceptable.

By asking respondents for demographic data, we can ensure that survey responses are valid and representative.

In non-probabilistic sampling, the number of responses becomes increasingly important. By estimating the total population of interest, we can estimate the validity of the research. When the number of responses is large in proportion to the estimated population size, we get what is known as oversampling.

For some populations, no previous research exists, no baseline data exists and we have no estimate on the population size. Then, the goal of a survey would be to establish the baseline data.

5.6 Developing Survey Questions

Most survey questions can be structured in one of three ways: as open-ended questions, closed-ended questions with ordered response categories, or closed-ended questions with unordered response categories.

Open-ended questions are useful in getting a better understanding of phenomena. The questions must be carefully worded. And it is difficult to analyze the data. It is important to think about the possible answers to open-ended questions, and to tailor them in such a way that it forces respondents to think about their answer.

Closed-ended questions are either ordered or unordered. Ordered questions typically require just one answer, while unordered questions might accept more than one answer.

Common problems with survey questions include:

- Double-barreled questions ask two separate things. They need to be split into two separate questions.
- Using negative words in questions can be confusing to respondents.
- Biased wording can lead to biased responses.
- *Hot-button* words can lead to biased repsonses.

5.7 Overall Survey Structure

The book gives some tips on how to structure a survey. I could copy-paste them, but the section is already a good summary on its own.

5.8 Existing Surveys

There exist a number of survey tools for common tasks such as usability testing and evaluation.

5.9 Paper or Online Surveys?

One can use paper surveys, online surveys or a combination thereof. Both have their benefits and drawbacks. The choice of survey method might introduce biases, because not everybody can fill in an online or paper survey.

5.10 Pilot Testing the Survey Tool

After a survey tool is developed, it is very important to do a pilot study to help ensure that the questions are clear and unambiguous.

5.11 Response Rate

One of the main challenges of survey research is ensuring a sufficient response rate. It is important to motivate people to respond to surveys.

5.12 Data Analysis

There are several ways to analyze survey data. The chosen analysis will depend, in large part, on:

- Whether it was a probabilistic or non-probabilistic survey,
- How many responses were received, and,
- Whether a majority of questions were open-ended or closed-ended questions.

Quantitative data is ready to be analyzed. Qualitative data first needs to be coded. Often, the goal of quantitative data analysis is to have a set of 'descriptive statistics', which provide a short, high-level summary of the data.

Chapter 8

Interviews and Focus Groups

8.1 Introduction

Unfortunately, surveys are somewhat limiting in asking users for direct feedback. They go broad, but not deep. With interviews, we can go deep (but not broad).

8.2 Pros and Cons of Interviews

Pros of interviews:

- The ability to "go deep"
- Extremely flexible
- Possible to observe behavior of interviewees

Cons of interviews:

- Challenging to manage potentially unbounded discussions
- Much more difficult to conduct than surveys
- Hard work
- Limited to a relatively small number of participants
- Challening to perform analysis

8.3 Applications of Interviews in HCI Research

We discern three applications of interviews:

- Initial exploration: understanding the users' goals and needs when starting work on a new project
- Requirements gathering: understanding what your novel idea should do to improve on the current situation
  - Contextual inquiry: in-depth interviews involving demonstrations of how participants complete key tasks
- Evaluation and subjective reactions: capturing the reactions and collecting feedback during the design process

8.4 Who to Interview

The obvious interview candidates are potential and current users. Sometimes, a broader pool of interviewees drawn from all categories of stakeholders might be more informative. And sometimes, key informants might appear: individuals who are repeatedly called upon to provide important insights, usually over an extended period of time.

8.5 Interview Strategies

Fully structured interviews use a rigid script to present questions in a well-defined order. They have the advantage of being easily analyzed. The downside is that you'll have to follow the script, even if you'd like to ask follow-up questions that are not in the script.

A semi-structured interview allows you to deviate from the script, by adding new questions on the fly or modifying the order of questions.

Finally, unstructured interviews take this to the logical extreme and do not follow a script.

8.6 Interviews vs Focus Groups

Focus groups, or group discussions, can be more efficient than interviews, as you can interview more people in the same amount of time. You should not rely on one focus group, but talk with two or more, as not every group will be responsive or representative.

Focus groups are generally semi-structured or unstructured.

8.7 Types of Questions

Structured, closed questions limit users to a small number of predefined choices. The answers are easy to analyze, but they might discourage elaboration and further comments.

Open-ended questions ask for responses, opinions or other feedback, without imposing any external constraints on the responses. They are more difficult to analyze, but give the respondent the freedom to answer in depth.

Interview questions should be as simple as possible, without any technical terms or jargon. They should be as unbiased and nonjudgmental as possible. The questions should be appropriate for the audience.

8.8 Conducting an Interview

Pilot-testing your interview, with research colleagues and participants, is always a good idea.

Proper preparation includes appropriate backups. Assume everything will fail.

It is probably too distracting to take notes while conducting an interview, and it's better to have a colleague take notes while you conduct the interview.

Written notes should be used not only for verbatim quotes, but also to record nonverbal cues or concerns.

8.9 Electronically Mediated Interviews and Focus Groups

Modern communication technologies present the attractive option of conducting interviews and focus groups electronically.

8.9.1 Telephone

Consider the following concerns when conducting phone interviews:

- There may be local or national laws dictating appropriate behavior for recording phone calls.
- The dynamics of a telephone interview are likely to be somewhat different from what they would be if you were talking to the same person face-to-face.
- The lack of direct face-to-face contact may, in some situations, prove advantageous.
- When you have multiple unfamiliar people on a call, it's hard to keep track of who is speaking.

8.9.2 Online

Computer-mediated interviews are generally conducted via email, instant-messaging, chat, or online conferencing tools. Recruiting challenges in online interviewing include the usual problems associated with online research: you may or may not know who you are talking with. Respondents can be anonymous, which may be useful if you are discussing illegal or otherwise undesirable activities.

Online interviews and focus groups are often easy to record.

Contextual feedback in email and chat interviews may be even more impoverished than with telephone interviews, as these text-only exchanges lack both the visual feedback of face-to-face meetings and the audio information generally available on telephone calls.

Pacing in online interviews is also a challenge.

Online focus groups also lessen the presence of moderators: the moderator is reduced to simply being another voice or line on the chat screen.

Online conferencing tools provide additional context that can narrow the gap between online and in-person interviews.

8.10 Analyzing Interview Data

Your goal in analyzing interview data is to generate an accurate representation of interviewee responses. You should try to analyze your data as soon as possible. Effective analysis works to avoid bias and reliance on preconceived notions.

8.10.1 What to Analyze

Fully structured interviews consisting only of closed questions are the easiest to analyze.

Analysis gets harder as your questions become more open-ended and the interview becomes less structured.

You'll have to choose whether you are going to analyze the recordings and/or written notes.

8.10.2 How to Analyze

Interview analyses usually rely heavily on qualitative methods for coding data, either through emergent or a priori codes. These methods attempt to find common structures and themes from qualitative data. In the case of interviews, your goal is to identify the important ideas that repeatedly arise during an interview.

Content analysis is examining the text of the interview for patterns of usage, including frequency of terms, co-occurrences, and other structural markers that may provide indications of the importance of various concepts and the relationships between them.

Discourse analysis goes beyond looking at discussions of words and contents to examine the structure of the conversation, in search of cues that might provide additional understanding.

Critical-incident analysis is examining interviews and focus groups for stories, responses or comments that are particularly insightful, interesting, or otherwise important.

8.10.3 Validity

Any single analysis may be influenced in subtle (or not-so-subtle) ways by the viewpoints and biases of the individual analyst.

8.10.4 Reporting Results

Your presentation of interview results should be as clear and specific as possible. Replace vague quantifiers with concrete counts. You can also use respondents' words to make your reporting more concrete.

Chapter 10

Usability Testing

10.1 Introduction

N/A

10.2 What is Usability Testing?

Usability testing, in general, involves representative users attempting representative tasks in representative environments, on early prototypes or working versions of computer interfaces.

The goal is to improve the quality of an interface by finding flaws: areas of the interface that need improvement. At the same time, we wish to find what is working well, so we can ensure it stays.

The scope of what defines a flaw is that which poses a problem for a majority of people.

Usability testing can take place on a spectrum ranging from true experimental research to letting users use an interface on a small scale and taking notes. The first end will more often be considered research, but the latter is way more practical due to obvious reasons.

10.3 How Does Usability Testing Relate to "Traditional" Research?

Usability testing is sometimes also called user research.

Similarities to "traditional" research:

- Similar approaches are used.
- Similar metrics are used.
- The participants have the same rights as in any other type of research.

However, usability testing has different end goals. It is often a question of improving a product while spending the least amount of money, time, and resources. Consequently, we give ourselves the liberty to, for example, use multiple research methods, let go of strict controls, or to modify the interface after every single user test.

The goal of usability testing means that companies are reluctant to publish their findings: it is considered valuable IP.

Finally, there exists some meta-research on usability testing, for example to verify what method of usability testing gives the best results.

10.4 Types of Usability Testing or Usability Inspections

10.4.1 Expert-Based Testing

Expert-based tests are essentially structured inspections by interface experts. Interface experts are experts in interfaces, but they are typically not experts in the tasks to be performed within a certain interface.

Interface experts first use a structured inspection to attempt to uncover some of the more obvious interface flaws. Ideally, these glaring issues should be fixed before moving on to user-based usability testing.

We consider four different types of expert reviews:

- Heuristic review: an expert compares a set of heuristics (rules of thumb) to the interface. Probably the best-known set of broad interface heuristics is Schneiderman's 8 Golden Rules of Interface Design:
  1. Strive for consistency
  2. Cater to universal usability
  3. Offer informative feedback
  4. Design dialogs to yield closure
  5. Prevent errors
  6. Permit easy reversal of actions
  7. Support internal locus of control
  8. Reduce short-term memory load
- Consistency inspection: reviewing a series of screens or web pages for issues of consistency in layout, color, terminology or language.
- Cognitive walkthrough: simulating users "walking through" a series of tasks.
- (Less popular) guideline review: compare a set of interfaces to a previously written set of interface guidelines. The major difference between the guideline review and the heuristic review is the amount of guidelines: usually 10 to 200 for guideline review, but less than 10 for heuristic review.

10.4.2 Automated Usability Testing

An automated usability test is a software application that inspects a series of interfaces to assess the level of usability. A major strength is that the application can often help in fixing the issue, or even fix the issue on its own. A major weakness is that many aspects of usability cannot be discovered by automatic means.

10.5 The Process of User-Based Testing

10.5.1 Formative and Summative Usability Testing

Usability testing that takes place early in development tends to be exploratory and to test early design concepts. This is also known as formative testing.

Usability testing that takes place when there is a more formal prototype ready, when high-level design choices have already been made, is known as a summative test.

Finally, a usability test sometimes takes place right before an interface is released to the general user population. In this type of test, known as a validation test, the new interface is compared to a set of benchmarks for other interfaces.

10.5.2 Stages of Usability Testing

Usability testing requires a lot of advance planning. Different authors on the topic describe different steps. Some steps (or stages) seem very similar to experimental design.

Often, a usability expert, taking the role of the usability moderator, manages the process. The moderator determines which users would be appropriate, representative participants to take part in the usability testing. The next goal is to try and recruit the users.

10.5.3 How Many Users are Sufficient?

A consensus has not emerged over time. Most people agree that five users are sufficient. The number of users depends on the requested accuracy and the amount of flaws in the interface that can be uncovered. Both factors are difficult to pinpoint. And of course, the amount of users also depends on the available time and resources.

10.5.4 Locations for Usability Testing

The most traditional setting for usability testing is a two-room setup. In one room, the user interacts with the interface, and in the other room, the test moderators and other stakeholders sit and watch what the user is doing during the test.

A fixed usability testing room is not required - you can also visit users for usability testing. This comes with its own obvious strengths and weaknesses.

10.5.5 Task Lists

Creating the task list can be one of the most challenging parts of creating a usability test. A task list should:

- Require no further elaboration aside from an initial scenario,
- Typically have one clear answer or solution per task, indicating the completion of the task,
- Have tasks that relate to the key features of the interface, and,
- Require actually using the interface to complete the tasks.

10.5.6 Measurement

We commonly take three quantitative measurements:

- Task performance
- Time performance
- User satisfaction

Many more measurements are available, like the number of errors, error recovery time, time spent using the help feature, number of visits to the search feature or index, ...

10.5.7 The Usability Testing Session

Remember that participants have the same rights as in traditional research.

Remind users that you are not testing them. Rather, the interface is being tested. They are experts and their feedback and findings are valuable.

10.5.8 Making Sense of the Data

Analyzing data from usability testing is similar to analyzing data from any other type of research. However, the goal of the analysis is different.

The usability testing report (or presentation) should be oriented towards the goal of improving the specific interface and to those who will read it: interface designers, software engineers, project managers, and other managers involved in software development.

The report should identify all flaws discovered during usability testing, but also prioritize which ones are most important to fix.

10.6 Other Variations on Usability Testing

Technology probes involve putting a technology into a real-world setting. A technology is installed in a real-world setting to see how it is used and then reflection on these experiences gives feedback on who the users are and what types of technology could be successfully used in these settings by these users.

A Wizard-of-Oz method is essentially a simulation of functionality that does not exist yet in an interface application. The user perceives that they are interacting with the actual interface and system. In reality, the user is interacting with another human being that is providing the responses to the user.

Chapter 11

Analyzing Qualitative Data

11.1 Goals and Stages of Qualitative Analysis

The goal of qualitative analysis is to turn the unstructured data found in texts and other artifacts into a detailed description about the important aspects of the situation or problem under consideration.

Qualitative data analysis consists of three stages:

1. We start with a data set containing information about our problem of interests. Via analysis, we hope to identify major themes and ideas that describe the context, activities, and other perspectives that define the problem.
2. In the second stage, we drill down into each component to find relevant descriptive properties and dimensions.
3. In the third stage, we use the knowledge we gained from studying each individual component to better understand the original substance and make inferences about that substance.

11.2 Content Analysis

Content analysis refers to the process of developing a representative description of text or other unstructured input. It not only applies to textual information, but also to multimedia materials. Content analysis is normally in-depth analysis that searches for theoretical interpretations that may generate new knowledge.

11.2.1 What is Content?

The target of content analysis usually covers two categories: media content and audience content.

Media content can be any material in printed publications, broadcast programs, websites, or any other types of recording.

Audience content is feedback directly or indirectly collected from an audience group.

11.2.2 Questions to Consider Before Content Analysis

Consider several questions before analyzing data:

1. You need to have a clear definition for the data set that is going to be analyzed.
2. You should study the data closely and remove any data that do not meet the criteria of the definition.
3. You should also clearly define the population from which the data set is drawn.
4. You need to know the specific context of the data.

11.3 Analyzing Text Content

11.3.1 Coding Schemes

Analyzing text content involves assigning categories and descriptors to blocks of text, a process called "coding."

Solid qualitative analysis depends on accurately identified concepts that later serve as categories for which data are sought and in which data are grouped. The concepts and categories are also a means of establishing relations between different entities.

There are two different approaches to analyzing the data: emergent coding and a priori coding. Emergent coding refers to the qualitative analyses conducted without any theory or model that might guide your analysis. A priori coding involves the use of an established theory or hypothesis to guide the selection of coding categories.

Grounded Theory and Emergent Coding

When you are not able to find established theories that allow you to develop the coding categories in advance, the emergent coding approach, based on the notion of grounded theory, is appropriate. Grounded theory starts from a set of empirical observations or data and we aim to develop a well-grounded theory from the data.

Grounded theory consists of four stages:

1. Open coding
2. Development of concepts
3. Grouping concepts into categories
4. Formation of a theory

A Priori Coding and Theoretical Frameworks

Theoretical frameworks, or taxonomies, are commonly used in multiple stages of qualitative research. In both emergent coding and a priori coding, different coding techniques may be adopted depending on the nature of the data and the study context.

Building a Code Structure

After the key coding items are identified, they can be organized and presented in a code list, or nomenclature or codebook. For studies using theoretical frameworks, the codes will come from the categories and concepts identified by the theory. Emergent coding, however, means that the codes are not identified in advance.

11.3.2 Coding the Text

When the data set is not large, it is recommended to read the text from beginning to end before starting to do any coding.

The following steps are recommended:

1. Look for specific items
2. Ask questions constantly about the data
3. Make comparisons constantly at various levels

11.3.3 Ensuring High-Quality Analysis

Qualitative data analysis is not objective.

Validity

There are three primary approaches to validity:

- Face validity (or content validity): a subjective validity criterion that requires a human researcher to examine the content of the data to assess whether on its "face" it appears to be related to what the researcher intends to measure.

- Criterion validity tries to assess how accurate a new measure can predict a previously validated concept or criterion.
- Construct or factorial validity is usually adopted when a researcher believes that no valid criterion is available for the research topic under investigation. It is a validity test of a theoretical construct and examines "What constructs account for variance in test performance?"

Reliability

Reliability checks span two dimensions: stability and reproducibility.

Stability is also called intracoder reliability. It examines whether the same coder rates the data in the same way throughout the coding process.

One of the commonly used reliability measures is the percentage of agreement among coders, calculated according to the following equation:

$$\%_{\text{agreement}} = \frac{\text{the number of cases coded the same way by multiple coders}}{\text{the total number of cases}}$$

You can adopt other measures such as Cohen's Kappa, which rates interrater reliability on a scale from 0 to 1, with 0 meaning that the cases that are coded the same are completely by chance and 1 meaning perfect reliability. Kappa is calculated by the following equation:

$$K = \frac{P_a - P_c}{1 - P_c}$$

11.4 Analyzing Multimedia Content

In order to find interesting patterns in the interactions, the image, audio, and video data need to be coded for specific instances (i.e., a specific gesture, event, or sound). The basic guidelines for analyzing text content also apply to multimedia content.

Chapter 15

Working with Human Subjects

15.1 Introduction

N/A

15.2 Identifying Potential Participants

15.2.1 Which Subjects?

In selecting participants, you should strive to find people with personal attributes and goals appropriate for your study.

15.2.2 How Many Subjects?

Determining the number of participants to involve in a research study is a trade-off between the information gained in the study and the cost of conducting it.

Controlled experiments or empirical studies require a sample group of participants large enough to produce statistically significant results.

The nature of the participants required for your study often plays a role in the amount of participants. Another important factor is the time required for each participant.

15.2.3 Recruiting Participants

Once you have determined who your participants are and how many you need, you must find them and convince them to participate. The characteristics of your desired participants play an important role in determining how you will go about finding them.

Incentives can often motivate people to participate. Although financial and other incentives are routinely used to encourage participation in research studies, it is certainly appropriate to consider the potential impact that prospects of financial gain might have on participant behavior. Compensation should be commensurate with the amount of time requested and the type of participants involved.

Some studies may have additional requirements that require screening of interested participants to determine whether or not they meet important criteria.

15.3 Care and Handling of Research Participants

15.3.1 Risks and Concerns of Research Participants

Researchers must allow participants to make judgments and must provide the information necessary for making those judgments. Special consideration must be given in cases of illness or disability that may limit an individual's ability to make independent decisions. This is the basis of informed consent.

15.3.2 Protecting Privacy

Participants should also be assured that their privacy will be protected.

The use of photography and video or audio recording presents special challenges regarding the privacy of participants.

Data storage and backup choices should also consider participant privacy.

15.3.3 Institutional Review Boards

Universities, hospitals, corporations, and other organizations that conduct research often have standing committees that review and approve projects involving human subjects. Researchers and institutions benefit from the knowledge that the proposed research has been reviewed for issues that may cause embarrassment or legal liability. Although this review is certainly not foolproof, it generally works well in practice.

15.3.4 Informed Consent

The notion of informed consent has two parts.

"Informed" means that study participants must understand the reason for conducting the study, the procedures that are involved, potential risks, and how they can get more information about the study.

The second, equally important notion is "consent": participation in research studies should be entirely voluntary and free from any implied or implicit coercion.

In most cases, researchers provide participants with an informed consent document that contains several sections:

- Institution and Researcher Identification
- Contact Information
- Title and Purpose
- Description of Procedures
- Duration
- Risks
- Benefits
- Alternatives to Participation
- Confidentiality
- Costs/Additional Expenses
- Participant's rights:
  - Participation is voluntary.
  - Participants can choose to stop participating at any time, without penalty.
  - Participants have the right to be informed of any new information that will affect their participation in the study.
- Supplemental Information
- Signature, accompanied by a statemenet that the participant:
  - has volunteered to participate;
  - has been informed about the tasks and procedures;
  - has had a chance to ask questions and had questions answered;
  - is aware that he/she can withdraw at any time;
  - consented prior to participation in the sutdy.

15.3.5 Respecting Participants

Before conducting a study, you might ask how you might feel if asked to participate, or, you later found that your actions might have been part of the study without your knowledge. If you decide that you might not be comfortable, others might have the same reaction, and you might consider revising your study design.

15.3.6 Additional Concerns

Although it might seem as if withholding key details from research participants might be somewhat less than fully honest, complete transparency might not be appropriate in some cases, particularly if knowledge of the goals of the study might influence participant behavior.

15.3.7 International Concerns

N/A

15.4 Human Subjects Research and the Public Trust

N/A

Chapter 16

Working with Research Participants with Disabilities

16.1 Introduction

As the number of research projects involving users with disabilities grows, it is important also to examine the specific concepts, issues, and challenges of doing human-computer interaction (HCI) research involving users with various disabilities.

16.2 Participants

16.2.1 Inclusion Criteria

The population with disabilities is not monolithic, nor is the population with a certain disability. You must be very clear on the criteria for inclusion in the research study. We discern the following inclusion criteria:

- Technology
- Education
- Employment
- Disability
- Communication

16.2.2 Differing Levels of Ability

Ability levels may vary widely among users with a specific disability. Impairments are not binary. This impacts task completion speeds.

There are generally two approaches for developing interfaces for users with disabilities:

- Try to make an interface that works well for a majority of users, both with and without disabilities.
- Design an interface that is optimized for a specific user group.

16.2.3 Recruitment of Participants With Disabilities

Finding enough participants that fit the inclusion criteria is rare. Simulating impairments is not a valid solution to this problem and should not be done.

16.2.4 Communicating With People Who are Deaf or Hard of Hearing

It is important to ascertain whether the participants will need sign language interpretation. Simply communicating via written text is insulting and rude.

16.2.5 Communicating With People With Moderate to Severe Speech Impairments

Some of these people may be using an Augmentative and Alternative Communication (AAC) device. Such a device helps them communicate by using selection devices and computer-synthesized speech output.

Having challenges with speaking or expressive language skills does not imply having challenges with understanding spoken language or receptive language skills.

16.2.6 Proxy Users

Proxy users, simulating a disability, are not encouraged for any type of research. Actual users with disabilities learn to compensate by becoming more reliant on other senses or body parts; proxy users do not.

There are some exceptions:

- Using people who are familiar with the users and impairments, to represent the users themselves.
- Using proxy users in limited stages and limited circumstances for preliminary evaluation, although it is not ideal.

You should never use proxy users simply because you do not 'speak the language' of the actual users.

16.3 Methodological Considerations

In general, the research methods described in other chapters of the book can be utilized in any research involving people with disabilities. There are a few issues you should consider.

16.3.1 Small Sample Sizes

For research focusing on users with disabilities, it is generally acceptable to have 5–10 users with a specific disability take part in a study.

16.3.2 Distributed Research

If not enough participants with disabilities, who meet the inclusion criteria, are available in a local area, another approach is to do distributed research, where the users do the research in their own home or office, without researchers present, and data is collected via time diaries, surveys, keystroke logging, or another method.

It has its drawbacks:

- It lowers the control that the researchers have over the study.
- Generally, the amount of and richness of data collection will not be comparable to a research study done in-person.
- It may not be possible to ascertain much detail about the specific technical environment utilized by the participant, when the data is collected remotely.

16.3.3 In-Depth Case Studies

Another approach is to do in-depth case studies, in which fewer users take part in a more intensive way.

16.3.4 Consistent Technical Environment or Best Case Scenario?

If your research study involves having people with disabilities interacting with a software application, operating system, or web site, one of the important methodological considerations is whether to use a standard technical configuration for all participants taking part, or to allow them to utilize their own technical setup.

16.3.5 Interventions

When there is an interface barrier that users are presented with, which does not allow the user to continue in the interface, this barrier is often an accessibility barrier. An intervention is when a researcher helps the participant move forward by providing advice.

16.4 Logistics

16.4.1 Communicating With Potential Participants

When recruiting potential participants, it is important to understand their preferred method of communication and any related challenges.

16.4.2 Pilot Studies

Due to the complex logistics involved in research involving participants with disabilities, it is a good idea, when possible, to do pilot studies before beginning any real data collection. One or two participants in the pilot study are generally enough, just to confirm that you are on the right track and that there are no major problems with logistics.

16.4.3 Scheduling Data Collection Involving Users With Disabilities

Transportation may be an issue for some users with disabilities.

Rather than asking participants to come to a university or remote location, it may be preferable for researchers to offer to go to a home or workplace location. The major drawback of visiting users in their work or home environment is that you tend to have less control over the environment.

It is important for researchers to understand that the variety of users and the various levels of severity of the disability (see previous sections in this chapter) mean that the time involved for a user to take part in a research study might be relatively unpredictable.

16.4.4 Involving Participants With Cognitive Disabilities / Intellectual Impairments

There's a concreteness that people with cognitive disabilities often need for participating in research.

16.4.5 Documentation for Users With Disabilities

In traditional paper format, the documents required for participation in a research study may pose a problem for users who have what are known as *print disabilities*: people that have trouble seeing print, handling print or cognitively processing print.

16.4.6 Bringing Extra Computer Parts

Users with disabilities tend not to replace or even buy computer parts they cannot use due to their disability. Sometimes you as a researcher need such a part (working), so bring your own.

16.4.7 Payment

Pay attention to the practicality of gifts or payments to the users of your research.

Part II

Preece, Sharp, Rogers - Interaction Design

Chapter 2

The Process of Interaction Design

2.1 Introduction

This chapter discusses the process of interaction design, that is, how to design an interactive product.

The chapter presents the double-diamond of design, with four iterated phases:

- Discove
- Define
- Develop
- Deliver

2.2 What Is Involved in Interaction Design?

Interaction design has specific activities focused on discovering requirements for the product, designing something to fulfill those requirements, and producing prototypes that are then evaluated. In addition, interaction design focuses attention on users and their goals.

Design is also about trade-offs—about balancing conflicting requirements.

Generating alternatives is a key principle in most design disciplines and one that is also central to interaction design.

Involving users and others in the design process means that the designs and potential solutions will need to be communicated to people other than the original designer.

2.2.1 Understanding the Problem Space

The first phase in the double diamond is deciding what to design.

2.2.2 The Importance of Involving Users

Involving users in development is important, because it's the best way to ensure that the end product is usable and that it indeed will be used.

Expectation management is the process of making sure that the users' expectations of the new product are realistic. Involving users throughout development helps with expectation management, because they can see the product's capabilities from an early stage.

2.2.3 Degrees of User Involvement

Different degrees of user involvement are possible.

Participatory design, also sometimes referred to as cooperative design or co-design, is an overarching design philosophy that places those for whom systems, technologies, and services are being designed, as central actors in creation activities.

2.2.4 What Is a User-Centered Approach?

A well-designed system will make the most of human skill and judgment, will be directly relevant to the activity in hand, and will support rather than constrain the user.

Three principles are generally accepted as the basis for a user-centered approach:

1. Early focus on users and tasks.
   (a) Users' tasks and goals are the driving force behind the development.
   (b) Users' behavior and context of use are studied, and the system is designed to support them.
   (c) Users' characteristics are captured and designed for.
   (d) Users are consulted throughout development from earliest phases to the latest.
   (e) . All design decisions are taken within the context of the users, their activities, and their environment.
2. Empirical measurement.
3. Iterative design.

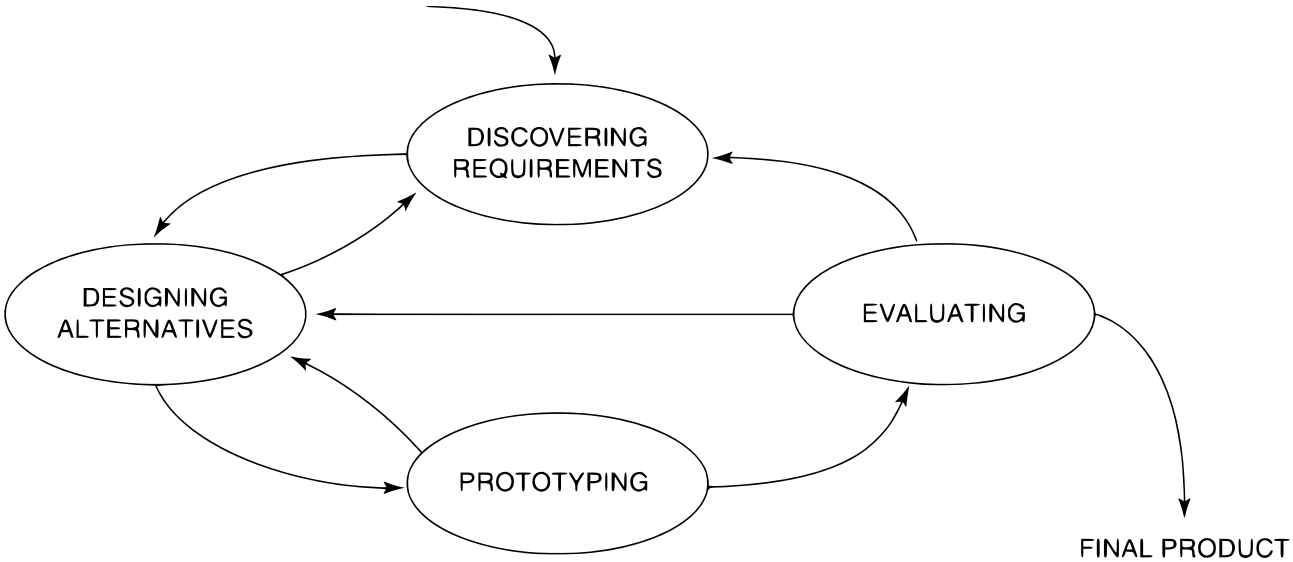
2.2.5 Four Basic Activities of Interaction Design

Well:

1. Discovering requirements for the interactive product.
2. Designing alternatives that meet those requirements.
3. Prototyping the alternative designs so that they can be communicated and assessed.
4. Evaluating the product and the user experience it offers throughout the process.

2.2.6 A Simple Lifecycle Model for Interaction Design

The term lifecycle model (or process model) is used to represent a model that captures a set of activities and how they are related. The book presents a simple lifecycle model:



2.3 Some Practical Issues

Well:

1. Who are the users?
2. What are the users' needs?

3. How to generate alternative designs?
4. How to choose among alternatives?
5. How to integrate interaction design activities with other lifecycle models?

Chapter 12

Design, Prototyping and Construction

12.1 Introduction

Design, prototyping, and construction fall within the Develop phase of the double diamond of design, introduced in chapter 2, "The Process of Interaction Design," in which solutions or concepts are created, prototyped, tested, and iterated.

12.2 Prototyping

Prototyping provides a concrete manifestation of an idea which allows designers to communicate their ideas and users to try them out.

12.2.1 What Is a Prototype?

A prototype is one manifestation of a design that allows stakeholders to interact with it and to explore its suitability.

12.2.2 Why Prototype?

Prototypes are useful when discussing or evaluating ideas with stakeholders; they are a communication device among team members and an effective way for designers to explore design ideas.

Prototypes answer questions and support designers in choosing between alternatives.

12.2.3 Low-Fidelity Prototyping

A low-fidelity prototype does not look very much like the final product, nor does it provide the same functionality.

Low-fidelity prototypes are useful because they tend to be simple, cheap, and quick to produce. Low-fidelity prototypes are not meant to be kept and integrated into the final product.

12.2.4 High-Fidelity Prototyping

A high-fidelity prototype looks more like the final product and usually provides more functionality than a low-fidelity prototype. High-fidelity prototypes can be developed by modifying and integrating existing components.

12.2.5 Compromises in Prototyping

By their very nature, prototypes involve compromises: the intention is to produce something quickly to test an aspect of the product. Two common properties that are often traded off against each other are breadth of functionality versus depth: horizontal versus vertical prototyping. Another common compromise is level of robustness versus degree of changeability.

One of the consequences of high-fidelity prototypes is that the prototype can appear to be good enough to be the final product, and users may be less prepared to critique something if they perceive it as a finished product. Another consequence is that fewer alternatives are considered because the prototype works and users like it.

12.3 Conceptual Design

Conceptual design is concerned with developing a conceptual model. A conceptual model is an outline of what people can do with a product and which concepts are needed for the user to understand how to interact with it.

12.3.1 Developing an Initial Conceptual Model

Interface metaphors combine familiar knowledge with new knowledge in a way that will help users understand the product.

We discern five different types of interaction: instructing, conversing, manipulating, exploring, and responding. Which type of interaction is best suited to the current design depends on the application domain and the kind of product being developed. Most conceptual models will include a combination of interaction types, and different parts of the interaction will be associated with different types.

What (candidate) interface types to choose depends on the product constraints that arise from the requirements.

12.3.2 Expanding the Initial Conceptual Model

Ask the following questions:

- What functions will the product perform?
- How are the functions related to each other?
- What information is needed?

12.4 Concrete Design

Conceptual design and concrete design are closely related. During design, conceptual issues will sometimes be highlighted, and at other times, concrete detail will be stressed. Designers need to balance the range of environmental, user, data, usability, and user experience requirements with functional requirements.

12.5 Generating Prototypes

12.5.1 Generating Storyboards

A storyboard represents a sequence of actions or events that the user and the product go through to achieve a goal. A scenario is one story about how a product may be used to achieve that goal.

12.5.2 Generating Card-Based Prototypes

Card-based prototypes are commonly used to capture and explore elements of an interaction, such as dialog exchanges between the user and the product.

12.6 Construction

As prototyping and building alternatives progresses, development will focus more on putting together components and developing the final product.

12.6.1 Physical Computing

Physical computing is concerned with how to build and code prototypes and devices using electronics.

12.6.2 SDKs: Software Development Kit

A software development kit (SDK) is a package of programming tools and components that supports the development of applications for a specific platform.

Part III

Other reading materials

Appendix A

Beth - Scenario Based Design

1 The Basic Idea

Scenario-based design is a family of techniques in which the *use* of a future system is concretely described at an early point in the development process. SBD changes the focus of design work from defining system operations (i.e. functional specification) to describing how people will use a system to accomplish work tasks and other activities.

2 A Simple Example

A scenario is a story, consisting of a setting, or situation state, one or more actors with personal motivations, knowledge and capabilities, and various tools and objects that the actors encounter and manipulate. The scenario describes a sequence of actions and events that lead to an outcome. These actions and events are related in a usage context that includes the goals, plans, and reactions of the people taking part in the episode.

Scenarios can help to make envisioned possibilities more concrete. Such scenarios serve the following purposes:

- They help with brainstorming and developing further alternatives.
- They raise questions about the assumptions behind the scenarios.
- They can be used to analyze software requirements, to partially specify a functionality, and to guide the design of user interface layouts and controls.
- They can be used to identify and plan evaluation tasks that will be performed by usability test participants.

3 Why Scenario-Based Design?

Scenarios are easy to write. It takes only a little more effort to enrich scenarios with a rough sketch or storyboard. And they are easily digestible, so they can be used to enable rapid communication among many different stakeholders. Scenarios support quick iteration of new ideas and designs.

The design of an interactive system tends to evoke a problem-solving strategy named *solution-first*. Here, we use a candidate solution as a means to clarify the problem, the allowable moves, and the goal.

This approach has well-known hazards: designers move to the solution too fast and become afraid to let go of an idea when it is no longer appropriate.

3.1 Scenarios are Concrete but Rough

The world of design is constantly evolving, because requirements always change and refinements in software technology and new perceived opportunities and requirements propel a new generation of designs every 2-3 years. Scenarios align with this property, because while they are concrete enough such that they support analyzing a design, they are rough enough that we can easily change them.

3.2 Scenarios maintain an orientation to people and their needs

Designers need constraints, otherwise there are too many things that might be designed. Designers are likely to be biased toward familiar technologies, even when they are aware of the shortcomings.

Scenarios address the *representational bias* in human cognition: we overestimate the relevance of things familiar to us. Scenarios describing unusual but critical circumstances can provide new perspectives.

Scenarios become even more effective when users are directly invloved in creating them.

3.3 Scenarios are Evocative, Raising Questions at Many Levels

Scenarios help designers to reflect about their ideas in the context of doing design. They promote reflection and analysis in part because the human mind is adept at overloading meaning in narrative structures.

Scenarios often include implicit information about design consequences. The implication (and not explicit mention) of them is important to keep scenarios rough.

However, sometimes, we do wish to make the consequences more visible by analyzing the difference between scenarios. For example, by listing the design features of the scenarios, and then expanding them to consider possible positive and negative consequences for users in the source scenario or closely-related alternatives.

Each analyzed feature with its consequences is called a *claim*.

4 A Framework for Scenario-Based Design

The paper offers a programmatic framework for employing scenarios of use in interactive system design.

The framework employs scenario-based analysis and design into all phases of system development. The aim of the framework is to develop a rich understanding of the current activities and work practices, and to use this understanding as a basis for activity transformation.

The SBD begins with an initial vision, where the current situation is communicated in problem scenarios and claims. The scenarios describe prototypical stakeholders engaging in meaningful activities, while the claims enumerate features of the current situation that are understood to have important consequences for the actors.

Then, the problem scenarios are transformed and elaborated through several phases of iterative design. Each set of scenarios is complemented by claims, the analysis of which helps designers to reflect on the usage implications of their design ideas while the designs are being developed. Design scenarios are also evaluated more thoroughly through empirical usability studies.

4.1 Requirements Analysis

SBD starts with a root concept, which contains the following features:

- A high-level vision
- The basic rationale behind the vision
- A list of major stakeholders
- Starting assumptions: nonfunctional concerns which will constrain development

The root concept lays the groundwork for analyzing the current activities. The key result here is a set of problem scenarios and claims. One might find these through field work, but also by describing a set of hypothetical stakeholders (according to Cooper's concept of personas).

The themes and relationships implicit in the scenarios can be made more explicit and open for discussion by analyzing them in claims. A claim is a feature of interest, together with the hypothesized positive and negative consequences.

This collection of scenarios and associated claims build requirements to the rest of the design process, *not* to the end product. The design process should address the negative consequences, but try to uphold the positive consequences.

4.2 Activity Design

In SBD, the initial step towards specifying a design solution is made by envisioning how current activities might be enhanced, or even completely transformed, by available technologies. We keep activities and basic goals and motivations in mind; we do *not* give much attention to the concrete steps of user interaction at this point.

We can analyze metaphors and available information technology to further reason about activities. Metaphors help us think outside of the box, while a technology-oriented analysis helps us find familiar software and devices which already exist.

New scenarios can then be developed by starting with the same persona with the same goal, but introducing new solution ideas. Of course, the goal is still to keep the claims in mind. These new scenarios can then again be analyzed using claims.

4.3 Information Design

After choosing a candidate activity scenario, we can elaborate it with information and interaction details (the user interface). Ideas are discussed by trying them out in the activity design scenarios, paying attention to the claims analyzed in earlier phases, but also introducing new claims to help compare the alternatives.

4.4 Interaction Design

After comparing various alternatives with different information and interaction details, we can start describing scenarios where the concrete exchanges between the user(s) and the system are specified. And again, these scenarios are analyzed using claims.

4.5 Usability Evaluation

After detailed user interaction scenarios have been developed starts a phase of usability evaluation. Here, we formally test the usability of the system, by measuring the efficiency of users for representative tasks on early operational prototypes.

However, usability evaluation can take place earlier in the design process, for example by including users in the discussion and envisioning of activity scenarios.

4.6 Scenario-Based Iterative Design

The SBD framework is highly iterative.

5 Scenarios throughout the System Life Cycle

Scenarios can be used in much more places than those described in the framework.

6 Current Challenges

Scenarios are not a replacement for hard work.

Appendix B

Friedman - Value Sensitive Design

1 Introduction

N/A

2 What is Value Sensitive Design?

Value Sensitive Design is a theoretically grounded approach to the design of technology that accounts for human values in a principled and comprehensive manner throughout the design process.

2.1 What is a Value?

A value refers to what a person or group of people consider important in life.

2.2 Related Approaches to Values and System Design

Supporting human values through system design has recently emerged within at least four important approaches:

- Computer Ethics
- Social Informatics
- Computer Supported Cooperative Work
- Participatory Design

3 The Tripartite Methodology: Conceptual, Empirical and Technical Investigations

Value Sensitive Design builds on an iterative methodology that integrates conceptual, empirical, and technical investigations.

3.1 Conceptual Investigations

Value Sensitive Design takes up the following questions under the rubric of conceptual investigations:

- Who are the direct and indirect stakeholders affected by the design at hand?
- How are both classes of stakeholders affected?
- What values are implicated?
- How should we engage in trade-offs among competing values in the design, implementation, and use of information systems (e.g., autonomy vs. security, or anonymity vs. trust)?

- Should moral values (e.g., a right to privacy) have greater weight than, or even trump, non-moral values (e.g., aesthetic preferences)?

3.2 Empirical Investigations

Depending on the questions at hand, many analyses will need to be informed by empirical investigations of the human context in which the technical artifact is situated. Empirical investigations are also often needed to evaluate the success of a particular design.

3.3 Technical Investigations

Value Sensitive Design adopts the position that technologies in general, and information and computer technologies in particular, provide value suitabilities that follow from properties of the technology.

4 Value Sensitive Design in Practice: Three Case Studies

N/A

5 Value Sensitive Design's Constellation of Features

Value Sensitive Design brings forward a unique constellation of eight features:

1. It seeks to be proactive: to influence the design of technology early in and throughout the design process.
2. It enlarges the arena in which values arise to include not only the work place, but also education, the home, commerce, online communities, and public life.
3. It contributes a unique methodology that employs conceptual, empirical, and technical investigations, applied iteratively and integratively.
4. It enlarges the scope of human values beyond those of cooperation and participation and democracy to include all values, especially those with moral import.
5. It distinguishes between usability and human values with ethical import.
6. It identifies and takes seriously two classes of stakeholders: direct and indirect.
7. It is an interactional theory.
8. It builds from the psychological proposition that certain values are universally held, although how such values play out in a particular culture at a particular point in time can vary considerably.