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# Next Generation User Interfaces

## *Requirements Analysis, Prototyping and Evaluation*

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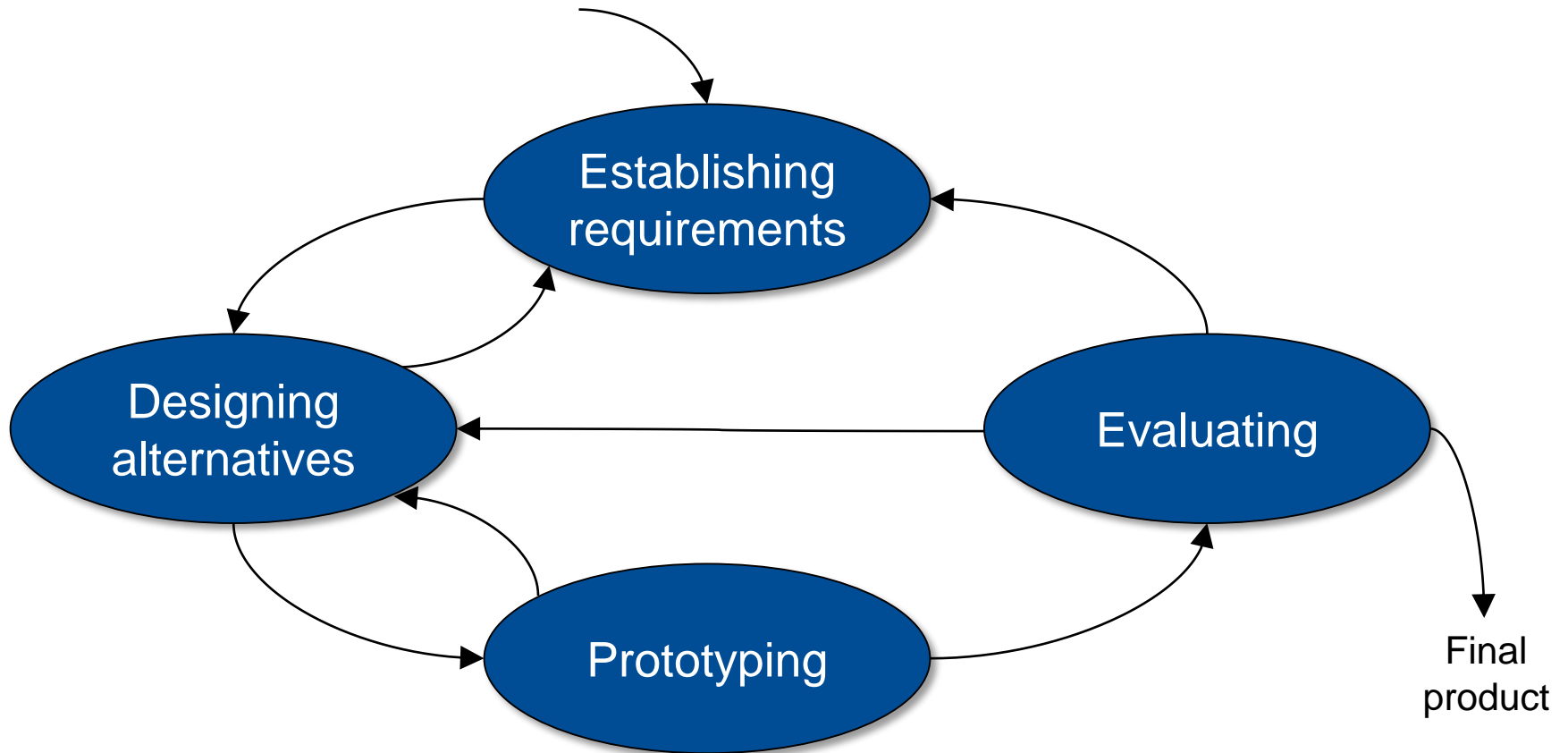
# Requirements Analysis



- Update/replace an *existing system* or develop a totally *innovative product*
  - initial set of requirements or requirements produced from scratch
- We have to understand
  - users and their capabilities (*who*)
  - user tasks and goals (*how*)
  - conditions (context) under which the product will be used (*where*)
- Requirements analysis is often intertwined (*iterative activity*) with design activities and evaluation activities
- Produce a *set of stable requirements* forming a sound basis to start with the design



# Interaction Design Lifecycle Model





# Types of Requirements

- *Functional requirements*
  - what should the product do (fundamental)
- *Data requirements*
  - type of data
  - amount of data
  - data accuracy
  - ...
- *Environmental requirements (context of use)*
  - physical environment
    - lighting, noise, movement, dust, ...
  - social environment
    - synchronous or asynchronous sharing of data, co-located or distributed, ...



# Types of Requirements ...

- *Environmental requirements (context of use) ...*
  - organisational environment
    - user support, resources for training, how hierarchical is the management, ...
  - technical environment
    - technologies the product will run on, compatibility, technological limitations, ...
- *User characteristics*
  - key attributes of intended user group
    - abilities and skills
    - nationality and educational background
    - preferences
    - physical or mental disabilities
    - level of expertise (novice, expert, casual user, frequent user, ...)
  - *user profile* consists of a collection of attributes for a typical user



# Types of Requirements ...

- *Usability goals*
  - define measures for agreed usability goals
    - *objective measure* of a user's performance
    - measuring a *user's perceptions* of the interaction
- *User experience goals*



# Exercise: Types of Requirements



- Interactive product to pay for food (by credit card) in a university's self-service cafeteria
- Interactive product to control the functioning of a nuclear power plant



# Data Gathering for Requirements

- Different forms of data gathering to get information about tasks and associated goals as well as the context of use
  - interviews
  - focus groups
  - questionnaires
  - direct observation
  - indirect observation
  - studying documentation
  - researching similar products





# Interviews



- *Open-ended* or *unstructured* interview
  - good to get first impressions (exploratory)
  - rich data with deep understanding of the topic
  - time consuming to analyse
- *Structured* interview
  - closed questions with predefined set of alternative answers
  - questions should be worded the same and asked in the same order for each participant
- *Semi-structured* interview
  - combination of closed and open questions
  - e.g. start with a closed question followed by open question(s)



# Focus Groups



- Trained facilitator interviews groups of 3-10 people
- Can be conducted in special requirements workshops
- Individuals develop opinions within a social context by talking to each other
- Investigates *community issues* rather than individual experiences



# Questionnaires



- Can ask closed as well as open questions
- Might be used for initial responses that can then be used for selecting people to be interviewed
- Different formats of questions and responses
  - checkboxes
    - e.g. **male** or **female**
  - ranges
    - e.g. age: **0-17**, **18-29**, **30-39**, **40-49** and **over 50**
    - avoid any overlaps
  - rating
    - Likert scale
      - how many points on the scale? even or odd number of points?
      - place positive end of the scale first (e.g. **strongly agree**) and the negative end last



# Questionnaires ...



- rating ...
  - semantic differential scale
    - user is asked to place a cross in a number of positions between two extremes
    - extremes represented by two adjectives (e.g. **attractive** vs. **ugly**)
- Usually small number of participants in interaction design questionnaires (fewer than 20 users) with high return rates
- Online questionnaires
  - email or web-based questionnaires



# Direct and Indirect Observation



- Direct observation (field study) of participants in their natural setting (e.g. via *ethnographic studies*)
  - understand the nature of the tasks and the context in which they are performed
- Indirect observation of users
  - diaries
  - interaction logging
    - e.g. for evolving products



# Studying Documentation and Products

- Studying of manuals and other documentation
  - good for background information on the user's work
- Researching of similar products might help to trigger some requirements
  - e.g. investigate desktop image editing software when designing an image editor for mobile devices



# Data Gathering Guidelines for Requirements

- Focus on identifying the stakeholders' needs
- Involve *all* the stakeholder groups
- Involve more than one representative from each stakeholder group
- Support the *iterative requirements activity* with descriptions and prototypes



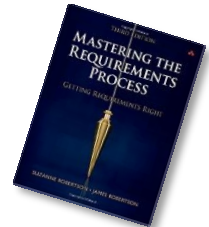
# Data Analysis, Interpretation and Presentation

- Formats such as the Volere *requirements shell* highlight the information to look for
  - good first step in data analysis for requirements
- Functional requirements
  - class diagrams
  - state charts
  - sequence diagrams
  - ...
- Data requirements
  - entity-relationship (ER) diagrams,
  - ...





# Volere Requirements Shell



**Requirement #:** Unique id    **Requirement Type:** The type from the template    **Event/use case #:** List of events / use cases that need this requirement

**Description:** A one sentence statement of the intention of the requirement

**Rationale:** A justification of the requirement

**Source:** Who raised this requirement?

**Fit Criterion:** A measurement of the requirement such that it is possible to test if the solution matches the original requirement

**Customer Satisfaction:** Degree of stakeholder happiness if this requirement is successfully implemented. Scale from 1 = uninterested to 5 = extremely pleased.

**Customer Dissatisfaction:** Measure of stakeholder unhappiness if this requirement is not part of the final product. Scale from 1 = hardly matters to 5 = extremely displeased.

**Dependencies:** A list of other requirements that have some dependency on this one

**Conflicts:** Other requirements that cannot be implemented if this one is

**Supporting Materials:** Pointer to documents that illustrate and explain this requirement

**History:** Creation, changes, deletions, etc.

**Volere**  
Copyright © Atlantic Systems Guild

**Requirement #:** 75    **Requirement Type:** 9    **Event/use case #:** 7, 9

**Description:** The product shall record all the roads that have been treated

**Rationale:** To be able to schedule untreated roads and highlight potential danger

**Source:** Arnold Snow - Chief Engineer

**Fit Criterion:** The recorded treated roads shall agree with the drivers' road treatment logs and shall be up to date within 30 minutes of the completion of the road's treatment

**Customer Satisfaction:** 3    **Customer Dissatisfaction:** 5

**Dependencies:** All requirements using road and scheduling data    **Conflicts:** 105

**Supporting Materials:** Work context diagram, terms definitions in section 5

**History:** Created February 29, 2000

**Volere**  
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# Task Description

- More recently task descriptions are used *throughout the development*
  - from early requirements activities, through prototyping and evaluation
- Techniques with a user-centred focus to describe users' goals and tasks
  - scenarios
  - use cases
  - essential use cases
  - ...



# Scenarios

- Informal narrative description (stories)
- Construction of scenarios by stakeholders often the first step in establishing requirements
  - level of detail varies depending on where in the development process a scenario is being used
  - emphasise the *tasks*, *context* as well as *usability* and *user experience goals* during the requirements activity
- Often generated during workshops, interviews or brainstorming sessions
  - not intended to capture full set of requirements (one perspective)
  - can also be used to describe situations envisioned in the future

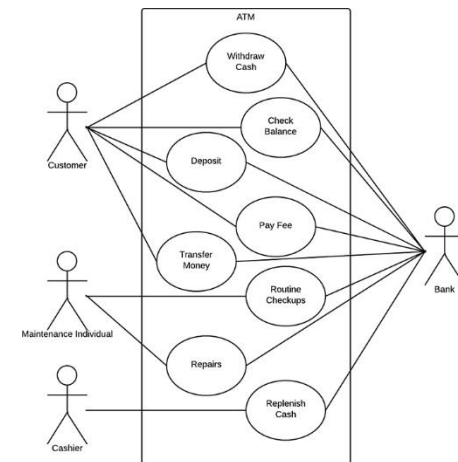


# Use Cases

- Focus on user goals (like scenario) but emphasis is on *user-system interaction* rather than on the user's task itself
- A use case diagram consists of actors and the use cases these actors are associated with
  - use case consists of a textual description of a *normal course* as well as some *alternative courses*

## Withdraw Cash

1. System asks the user to enter their card
  2. User enters the card
  3. System displays options
  4. User chooses the option to withdraw money
  5. ...
- 
3. If the card is invalid:
    - 3.1. System displays an error message
    - 3.2. System returns the card
    - 3.3. System returns to step 1





# Essential Use Cases

- More general case than in a scenario (abstraction) but tries to avoid the assumptions of a traditional use case (e.g. that there is a piece of technology to interact with)
  - no commitment to a particular interaction design when creating an essential use case

retrieveVisa

USER INTENTION

find visa requirements

supply required information

obtain a personal copy of visa information

choose suitable format

SYSTEM RESPONSIBILITY

request destination and nationality

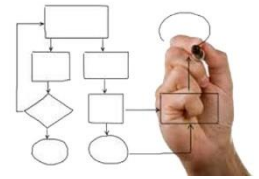
obtain appropriate visa information

offer information in different formats

provide information in chosen format



# Conceptual Design




- Transforms requirements into a *conceptual model*
  - *what can people do with a product?*
    - emerges from functional requirements
  - *what concepts are needed to understand how to interact with the product?*
    - depends on a variety of issues
      - who will be the users and what kind of interface will be used
      - terminology and application domain
      - ...
- Key guiding principles of conceptual design
  - keep an open mind but never forget the users and their context
  - discuss ideas with other stakeholders as much as possible
  - use low-fidelity prototyping to get rapid feedback
  - iterate, iterate and iterate

# Personas

- Descriptions (conceptual model) of typical users
  - brings user profiles to life
  - consists of a name and often a photo
  - unique *set of goals* related to the product
  - user's skills, attitudes, tasks and environment
- Details help designers to see personas as real potential users

**EZ-Write primary persona: the main user type**



**Fred Fish: Corporate Chef**  
*"Get me out of the office & into the kitchen."*

*Employer: Boise Controls*  
*Background: Masters from Johnson & Wales University*  
*Computer skills: Novice*

Quick take on Fred	
Computer skills	Novice Expert
Job situation	Employee Director Manager Vice president
Computer type	Netbook Laptop Desktop
Computer tools	Advanced features Coding tools Email Web browsing Word processing
Background	Business Engineering Marketing Management Other: cooking

Photo from Flickr, some rights reserved

**Key goals**  
 Fred doesn't get his hands dirty the way he used to (literally). He stops in at all six Boise Controls sites as often as possible to stay in touch with cooks and cooking. He wants to learn computer tools, but not at the expense of managing his kitchens.

**A day in the life**  
 Once a month, he meets with the head chefs and to plan the menu. When they're done, he sends it to his staff and his manager.  
 He's not a computer whiz. On a good day, he can drag in some clip art and do some formatting with fonts. Once in awhile, he'll format menus with the new editor they on his MacBook Pro.  
 He's figured out a lot, but not everything. He always had a problem sending a message without the attachment, or an attachment with no message. That's annoying and embarrassing and used to keep him away from computers.

The new EZ-Write system seems to have some features to help with that. Anytime he writes something like "...see the attached menu..." the program prompts him if he doesn't attach something. If there were a Nobel Prize for software, he'd nominate the people who designed this.

**Chefs are different from other users**  
 Computers are just tools for a chef. Fred would rather use a cutting board than a keyboard.



# Developing an Initial Conceptual Model

- Define an initial conceptual model by considering
  - which *interface metaphors* are suitable to help users understand the product?
  - which *interaction type(s)* do best support the users' activities?
- Three-step process for choosing a good *interface metaphor*
  - understand what the system will do (functional requirements)
  - understand which parts (tasks or subtasks) of the product are likely to cause users problems, are complicated or critical
  - choose metaphor to support those critical aspects





# Developing an Initial Conceptual Model ...

- *Interaction type* depends on the application domain and the kind of product that is developed
  - e.g. manipulating type most likely suited for a game
  - conceptual model can include combination of interaction types
    - different parts of the interaction associated with different types
- Consideration of different *interface types* at this stage might lead to different design alternatives



# Brainstorming for Innovation



- Generate ideas for alternative designs and for suggesting innovative and better products
- Factors for requirements brainstorming
  - *participants should know the user's goals to be supported*
  - *no ideas should be criticised or debated*
  - include participants from a wide range of disciplines
  - do not ban silly stuff (can often turn into useful requirements)
  - use catalysts (e.g. earlier ideas) for further inspiration
  - keep records and possibly number the ideas (for reference)
  - user warm-up exercises
    - e.g. IDEO's TechBox idea mentioned in previous lecture



# Physical Design

- Considers details of the product including
  - visual appearance including colour and graphics or sounds
  - icon design, button design, menu design, interface layout
  - choice of interaction devices
- No rigid border between conceptual and physical design
  - *iterative process* where conceptual design decisions might have to be revisited during physical design
- User characteristics have a significant impact on physical design
  - accessibility
    - good design for all products to include accessibility features
  - national culture
    - *cross-cultural design* includes the use of appropriate language(s), colours, ...



# Using Scenarios in Design

- Scenarios play different roles in the design process
  - as basis for the overall design
    - basis for storyboard creation
    - script for prototype evaluation
  - for the technical implementation
  - as a means of cooperation within design teams
  - as a means of cooperation across professions boundaries
    - basis of communication in a multidisciplinary team
- The most positive and negative consequences of a particular proposed design might be captured by *plus* and *minus scenarios*



# Prototyping



- *“It is often said that users can’t tell you what they want, but when they see something and get to use it, they soon know what they don’t want.”*
- A prototype is a manifestation of design that allows stakeholders to interact with it and explore its suitability
  - paper-based storyboard or outline of a screen
  - electronic picture or video simulation of a task
  - 3D cardboard mockup or object printed with a 3D printer
  - piece of software
  - ...
- Prototypes help to choose between design alternatives
- Building a prototype encourages *reflection in design*



# Low-Fidelity Prototyping

- Low-fidelity prototypes often do not look very much like final products
  - different materials
- Simple, cheap and quick to modify
  - support exploration of alternative designs
- *Storyboarding*
  - often used in combination with a scenario



PalmPilot prototype, Jeff Hawkin, 1995



# Low-Fidelity Prototyping ...



- *Sketching*
  - hand-drawn sketches containing computer components, icons, dialogue boxes, ...
- *Prototyping with index cards*
  - each card represents one screen or one element of a task
- *Wizard of Oz experiment*
  - assumes that one has a software-based prototype
  - human operator (wizard) simulates the software's response to the user
- *PowerPoint*
  - balances the provisionality of paper with the polished appearance of software prototypes
    - characteristics of low and high fidelity



# High-Fidelity Prototyping



- Prototypes look much more like final product
- Growing interest in modifying and integrating existing components
  - tinkering (hardware)
  - component-based software engineering (software)



## Advantages

- look and feel of final product
- often fully interactive



## Disadvantages

- expensive and time-consuming to develop
- users comment on superficial aspects
- developers are reluctant to change something





# Compromises in Prototyping



- Often the breadth of functionality is traded against the depth of functionality
  - *horizontal prototyping*
    - provides a wide range of functions but with little detail
  - *vertical prototyping*
    - provides a lot of details for only a few functions
- *Throwaway prototyping*
  - final product is built from scratch
  - no testing necessary along the way
- *Evolutionary prototyping*
  - prototype evolves into the final product
  - rigorous testing necessary along the way



# Support for Design



- There exist various pattern collections, libraries and catalogues for interaction design
  - <http://ui-patterns.com>
  - <http://www.welie.com>
  - <http://j.mp/pattern-libraries>
- Hardware toolkits for physical prototyping
  - Phidgets hardware building blocks
  - Arduino open source electronics platform
  - ...



# Evaluation

- Evaluation is an integral part of the design process
  - *usability* of the system
  - *user experience*
- Observe participants and measure their performance
  - usability testing
  - experiments
  - field studies



Developer watching videotape of usability test.



# Why, What, Where and When to Evaluate

## ■ *Why* evaluate

- investigate user requirements
- ensure that users can use the product and they like it

*“User experience encompasses all aspects of the end-user’s interaction ... the first requirement for an exemplary user experience is to meet the exact needs of the customer, without fuss or bother. Next come simplicity and elegance, which produces products that are a joy to own, a joy to use.”*

Nielsen Norman Group

## ■ *What* to evaluate

- conceptual models
- early low-fidelity prototypes
- more complete high-fidelity prototypes



# Why, What, Where and When to Evaluate ...

- *Where* to evaluate
  - laboratory
  - natural setting (in-the-wild studies)
  - living labs
- *When* to evaluate
  - *formative evaluations*
    - throughout the design process
    - *what and how to redesign?*
  - *summative evaluations*
    - assess the final product
    - *how well did we do?*



Aware Home, Georgia Tech



# Three Types of Evaluation

- *Controlled settings* involving users
  - laboratories or living labs
  - methods: usability testing and experiments
  - test hypotheses and measure or observe certain behaviour under controlled conditions
    - reduce outside influences and distractions
    - same instructions for all participants and results can be generalised
- *Natural settings* involving users
  - public places and online communities
  - methods: direct observation (field study), interviews and logging
    - identify opportunities for new technology
    - establish requirements for a new design
    - decide how to best introduce new technology



# Three Types of Evaluation ...

- *Natural settings* involving users ...
  - investigate how product is used in the real world with little or no control of users' activities
    - due to lack of control it might be difficult to anticipate what is going to happen
    - might get unexpected data and new insights
  - should be unobtrusive but some methods might influence how people behave
- *Any setting not involving users*
  - consultants and researchers critique, predict and model parts of the interfaces in order to identify obvious usability problems
  - methods: heuristics, walkthroughs, analytics and models
- Often a *combination of methods* is used across these three categories in a single study



# DECIDE Evaluation Framework

- *DECIDE* framework provides a checklist (guide) to plan an evaluation study and remind about important issues
  - *D*etermine the goals
  - *E*xplore the questions
  - *C*hoose the evaluation methods
  - *I*dentify the practical issues
  - *D*ecide how to deal with the ethical issues
  - *E*valuate, analyse, interpret and present the data





# Determine the Goals



- What are the high-level goals of the evaluation?
- Who wants the evaluation and why?
- Goals influence the methods used for the study
- Possible goals
  - check that user requirements are met
  - improve the usability of the product
  - identify the best metaphor for the design
  - check for consistency
  - investigate how a product affects working practices
  - ...



# Explore the Questions



- Questions help to guide the evaluation
- The goal of finding out why some customers prefer to buy paper airline tickets (rather than e-tickets) can for example be broken down into specific sub-questions
  - what are customers' attitudes to e-tickets?
  - are customers concerned about security?
  - is the interface to obtain the e-tickets poor?
    - is the system difficult to navigate?
    - is the response time too slow?
    - is the terminology confusing (inconsistent)?



# Choose the Evaluation Methods



- Evaluation method influences how data is collected, analysed and presented
- For example, field studies
  - involve observations and interviews
  - observe users in natural settings
  - do not involve controlled tests
  - produce mainly qualitative data
  - ...



# Identify the Practical Issues

- Selection of users
  - people with particular level of expertise
  - gender distribution
  - age
- Find evaluators
- Selection of equipment
  - will participants be disturbed by cameras?
- Stay within the budget
- Respect the schedule
- Should a pilot study be organised?



# Decide How to Deal with the Ethical Issues

- Develop an *informed consent form*
- Information for participants
  - goals of the study
  - what happens with the findings
    - anonymity when quoting them
  - confidentiality of personal information (coding)
  - offer draft of final report
- Participants are *free to stop at any time*

## Consent Form: Interactions

I state that I am 18 years of age or older and wish to participate in a program of research being conducted by Dr. Charles Stangor at the University of Maryland, College Park, Department of Psychology.

The purpose of the research is to study how individuals get to know each other. In the remainder of the study I will be having a short conversation with another person. This interaction will be videotaped. At the end of the interaction, I will be asked to complete some questionnaires about how I felt during and what I remember about the interaction. The entire experiment will take about 45 minutes.

I furthermore consent to allow the videotape that has been made of me and my partner to be used in the research. I understand that the videotape will be used for research purposes only, and no one else except the present experimenter and one other person who will help code the tape will ever view it.

I understand that code numbers will be used to identify the videotapes and that all written material that I contribute will be kept separate from the videos. As a result, it will not be possible to connect my name to my videotape.

I understand that both my partner and I have the right to withdraw the tape from the study at any point.

I understand that the experiment is not designed to help me personally but that the researchers hope to learn more about interpersonal interactions.

I understand that I am free to ask questions or to withdraw from participation at any time without penalty.

Dr. Charles Stangor  
Department of Psychology



# Evaluate, Interpret and Present the Data

- Evaluation method influences how data is collected, analysed and presented
- The following needs to be considered
  - Reliability
    - can the study be replicated by another evaluator or researcher?
  - Validity
    - does the method measure what we expect?
  - Ecological validity
    - does the environment influence the findings
    - are participants aware of being studied (Hawthorne effect)?
  - Biases
    - is the process creating biases (e.g. preferences of evaluators)?
  - Scope
    - can the findings be generalised



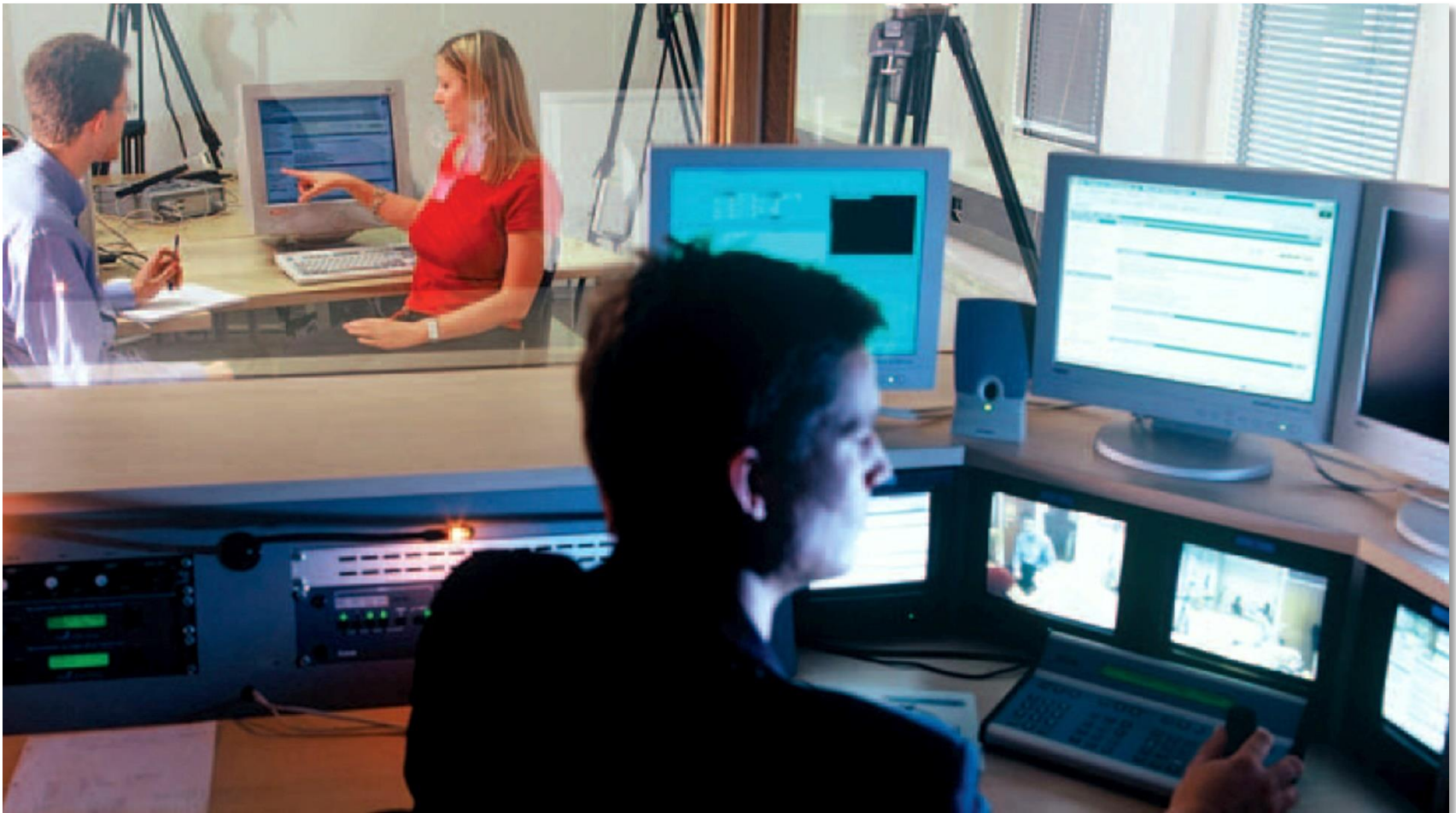
# Usability Testing

- Record the performance (quantitative data) of typical users doing typical tasks in a *controlled setting*
- Participants are observed and timed
- Data is recorded on video and interactions (e.g. key presses) are logged
  - users might be asked to think aloud while carrying out tasks
- Data is used to calculate the *time to complete a task* and to identify the *number* and *type of errors*
- User satisfaction and opinion is evaluated based on questionnaires and interviews
- Field observations may provide contextual understanding





# Usability Lab with User and Assistant







# Testing Conditions

- Usability lab or other controlled space
  - *usability-in-a-box* and *remote usability testing* as more affordable and mobile alternatives to a usability lab
- Emphasis on
  - selecting representative users
  - defining representative tasks
- 5-12 participants and tasks no longer than 30 minutes
  - number of participants depends on schedule, availability and cost of running tests
  - some experts argue that testing should continue until no new insights are gained
- Same test conditions for every participant



# Experiments



- Test hypothesis to discover *new knowledge* by investigating the relationship between two or more *variables*
- *Independent variable* is manipulated by the investigator
  - e.g. cascaded menus vs. context menus
- *Dependent variable* depends on the independent variable
  - e.g. time to select and option from the menu
- We further define a *null hypothesis* (e.g. there is no difference in selection time) and an *alternative hypothesis* (e.g. there is a difference between the two menus on selection time)



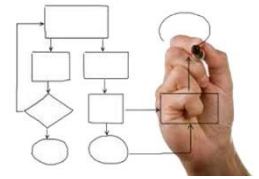
# Experiments ...



- Statistical analysis of the data can be used to contradict the null hypothesis
- Experimenter has to set up the conditions and find ways to keep other variables constant (*experimental design*)



# Experimental Design



- We have to decide which participants to use for which conditions in an experiment
  - *different participants (between-subjects design)*
    - single group of participants is allocated randomly to the experimental conditions
      - 👍 no order or training effects
      - 👎 large number of participants is needed (to minimise individual differences)
  - *same participants (within subjects design)*
    - all participants appear in both conditions
      - 👍 less participants needed
      - 👎 need counter-balancing to avoid order effect
  - *matched participants (pair-wise design)*
    - participants are matched in pairs (e.g. based on expertise, gender etc.)
    - same as *different participants* but individual differences reduced



# Usability Testing vs. Research

## Usability Testing

- improve products
- a few participants
- results inform design
- usually not completely replicable
- conditions controlled as much as possible
- procedure planned
- results reported to developers

## Experiments for Research

- discover knowledge
- many participants
- results validated statistically
- must be completely replicable
- strongly controlled conditions
- experimental design
- scientific report to scientific community



# Field Studies



- Field studies are done in natural settings
- “*in-the-wild studies*” is a term for prototypes being used freely in natural settings
- Aim to understand what users do naturally and how technology impacts them
- Field studies are used in product design to
  - identify opportunities for new technology
  - establish requirements for a new design
  - decide how to best introduce new technology
  - evaluate technology in use
- Findings of field studies can sometimes be unexpected



# Inspections, Analytics and Models

- Understand users through knowledge codified in heuristics, remotely collected data or model that predict users' performance
  - user does not have to be present during the evaluation
- *Inspection*
  - heuristic evaluation and walkthroughs
  - expert plays role of a user and analyses aspect of the interface
- *Analytics*
  - based on user interaction logging (often done remotely)
- *Predictive models*
  - analysing and quantifying physical and mental operations needed for a task



# Inspections



- Experts use their knowledge of users and technology to review the usability of a product
- Expert critiques can be formal or informal reports
- *Heuristic evaluation* is a review guided by a set of heuristics
- *Walkthroughs* involve stepping through a pre-planned scenario noting down potential problems





# Heuristic Evaluation

- Developed by Jacob Nielsen and his colleagues in the early 1990s
- Based on heuristics distilled from an empirical analysis of 249 usability problems
- Over time the original heuristics have been revised for current technology
- Heuristics being developed for mobile devices, wearables, virtual worlds, ...
- Design guidelines form a basis for developing heuristics



Jacob Nielsen



# Nielsen's Original Heuristics

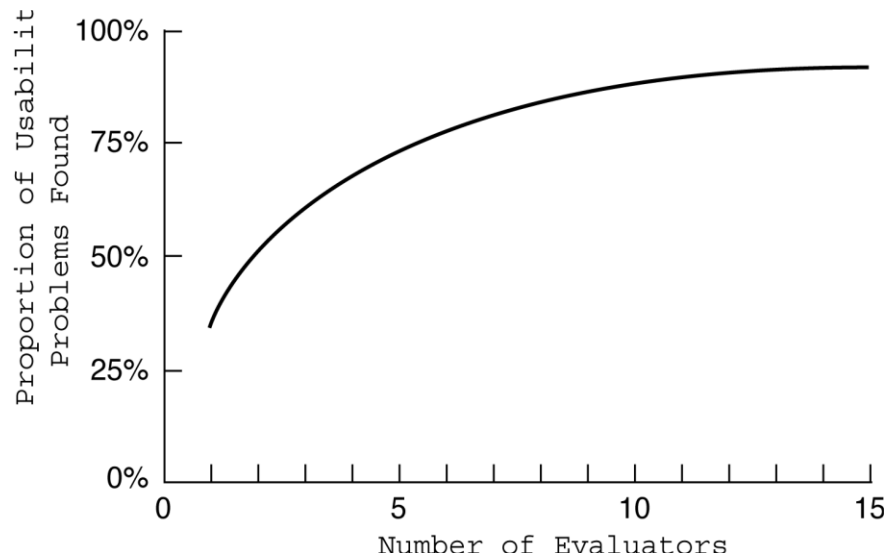
- Visibility of system status
- Match between system and the real world
- User control and freedom
- Consistency and standards
- Error prevention
- Recognition rather than recall
- Flexibility and efficiency of use
- Aesthetic and minimalistic design
- Help users recognise, diagnose and recover from errors
- Help and documentation



# Discount Evaluation



- Heuristic evaluation is referred to as discount evaluation when 3-5 evaluators are used
- Empirical evidence suggests that on average 5 evaluators identify 75-80% of the usability problems





# Three Stages of Heuristic Evaluation

- *Briefing session* to tell experts what to do
- *Evaluation* period of 1-2 hours in which
  - each expert works separately
  - each expert takes one pass to get a feel for the product
  - each expert takes a second pass to focus on specific features
- *Debriefing session* in which experts work together in order to *prioritise the problems*



# Advantages and Problems

- Few ethical and practical issues to consider because no users are involved
- Can be difficult (and expensive) to find experts
- Only best experts have knowledge of the application domain and the users
- Important problems might get missed
- Many trivial problems and often also problems that are no problems (false alarms) are identified
- Experts have biases



# Cognitive Walkthroughs

- Focus on ease of learning
- Designer presents an aspect of the design together with usage scenarios (*focused evaluation* of small parts)
- Expert is told the assumptions about the user population, the context of use and the task details
- One or more experts walk through the design prototype with the scenario and guided by the following 3 questions
  - will the correct action be sufficiently evident to the user?
  - will the user notice that the correct action is available?
  - will the user associate and interpret the response from the action correctly?
- As experts work through the scenario they note problems



# Pluralistic Walkthrough

- Variation of the cognitive walkthrough
- Performed by a carefully managed team
- Panel of experts begins by working separately
- Then there is managed discussion that leads to agreed decisions

# Analytics

- Method for evaluating user traffic through a system or parts of a system
- Analysing various logged parameters of user interactions
- Google Analytics is an example for the analytics of web-based solutions
  - times of day, visitor IP address, time on page, exit pages, ...







# Predictive Models

- Predictive models provide a way of evaluation products or designs *without direct user involvement*
- Less expensive than user testing
- Usefulness is limited to solutions with predictable tasks
  - e.g. telephone answering system, mobile phones, ...
- Based on expert error-free behaviour



# GOMS Model

- **Goals**
  - what does the user want to achieve
    - e.g. find a website
- **Operators**
  - cognitive processes and physical actions needed to attain goals
    - e.g. decide which search engine to use
- **Methods**
  - procedure to accomplish the goals
    - e.g. drag mouse over input field, type in keywords and press the 'go' button
- **Selection rules**
  - decide which method to select when there is more than one
    - e.g. press the 'go' button or the 'Enter' key on the keyboard



# Keystroke Level Model

- GOMS model has been further developed into the quantitative *keystroke level model*
- Predicts how long it takes an expert user to perform a task by summing up the necessary operations

Operator	Description	Time (sec)
K	Pressing a single key or button	
	Average skilled typist (55 wpm)	0.22
	Average non-skilled typist (40 wpm)	0.28
	Pressing shift or control key	0.08
	Typist unfamiliar with the keyboard	1.20
P	Pointing with a mouse or other device on a display to select an object. This value is derived from Fitts' Law which is discussed below.	0.40
P1	Clicking the mouse or similar device	0.20
H	Bring 'home' hands on the keyboard or other device	0.40
M	Mentally prepare/respond	1.35
R(t)	The response time is counted only if it causes the user to wait.	t



# Fitts's Law (1954)

- Fitts's Law predicts that the time to point at an object using a device is a function of the distance from the target object and the object's size

$$T = k \log_2(D/S + 1.0)$$

$T$  = time to move the pointer to the target

$D$  = distance between the pointer and the target

$S$  = size of the target       $k$  = constant



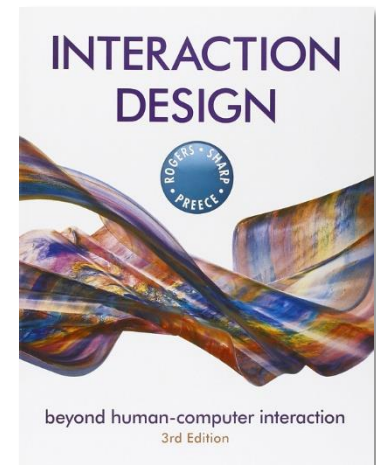
Paul Fitts

- The further away and the smaller the object the longer the time to locate it and point to it
  - useful for evaluating systems for which the time to locate an object is important (e.g. smartphone and handheld devices)



# Further Reading

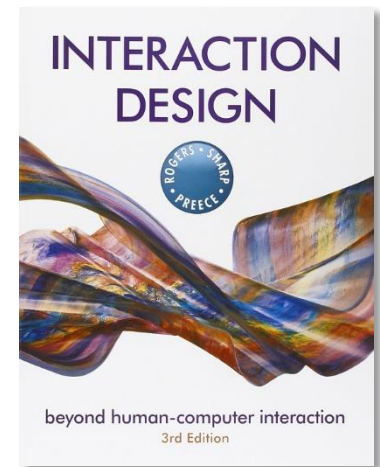
- Parts of this lecture are based on the *Interaction Design: Beyond Human-Computer Interaction* book
  - chapter 7
    - Data Gathering
  - chapter 10
    - Establishing Requirements
  - chapter 11
    - Design, Prototyping and Construction
  - chapter 12
    - Introducing Evaluation
  - chapter 13
    - An Evaluation Framework





# Further Reading ...

- Parts of this lecture are based on the *Interaction Design: Beyond Human-Computer Interaction* book
  - chapter 14
    - Evaluation Studies: From Controlled to Natural Settings
  - chapter 15
    - Evaluation: Inspections, Analytics and Models





# References



- *UI Patterns*
  - <http://ui-patterns.com>
- *A Pattern Library for Interaction Design*
  - <http://www.welie.com>
- *Yahoo Design Pattern Library*
  - <http://j.mp/pattern-libraries>
- *Phidgets Inc.*
  - <http://www.phidgets.com>
- *Arduino*
  - <http://www.arduino.cc>



## References ...



- *The Psychology of Human-Computer Interaction*, Card, S.K., Moran, T.P. and Newell, A., Lawrence Earlbaum Associates, Hillsdale, NJ, 1983
- *The Information Capacity of the Human Motor System in Controlling Amplitude of Movement*, Fitts, P.M., Journal of Experimental Psychology 47, 381-391, 1954





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# Next Lecture

## *Information Architectures*

