UNIVERSITÄT
BERN

Introduction to Software Engineering

8. User Interface Design

Roadmap

- Interface design models
- Design principles
- GUI characteristics
- Usability Testing

Literature

Sources

- *Software Engineering*, I. Sommerville, 7th Edn., 2004.
- *Software Engineering — A Practitioner's Approach*, R. Pressman, Mc-Graw Hill, 5th Edn., 2001.

Recommended reading

- Mary Beth Rosson, John M. Carroll, *Usability Engineering*, 2002
- Jakob Nielsen, *Usability Engineering*, Morgan Kaufmann, 1999.
- Alan Cooper, *About Face — The Essentials of User Interface Design*, Hungry Minds, 1995.
- Alan Cooper, *The Inmates are running the Asylum*, SAMS, 1999.
- Jef Raskin, *The Humane Interface*, Addison Wesley, 2000.
- Jeff Johnson, GUI Bloopers, Morgan Kaufmann, 2000.
- *The Interface Hall of Shame*, http://homepage.mac.com/bradster/iarchitect/shame.htm

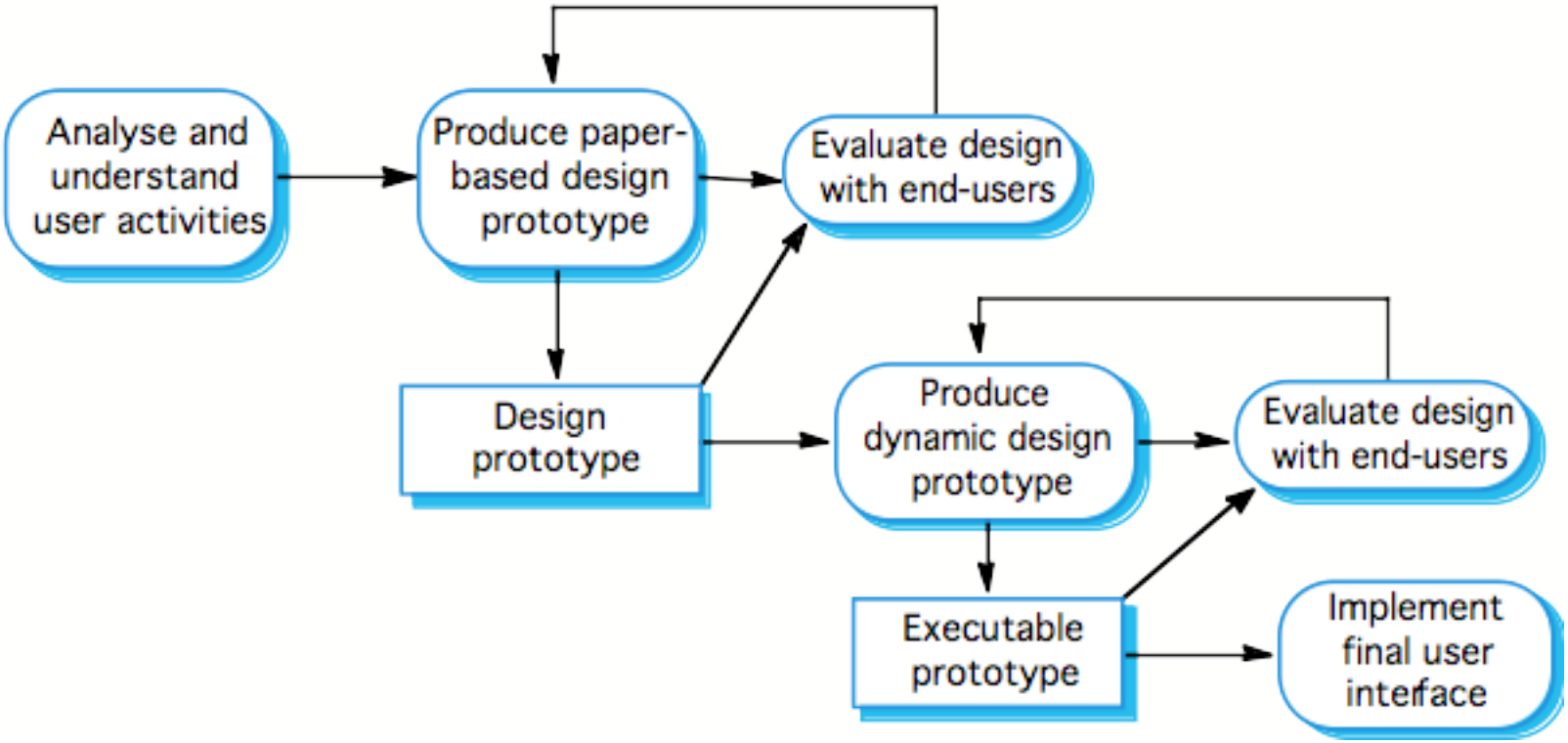
Roadmap

- **Interface design models**
- Design principles
- GUI characteristics
- Usability Testing

The UI design process

- UI design is an *iterative process* involving close liaisons between users and designers.
- The 3 core activities in this process are:
  - *User analysis*. Understand what the users will do with the system;
  - *System prototyping*. Develop a series of prototypes for experiment;
  - *Interface evaluation*. Experiment with these prototypes with users.

The design process



Interface Design Models

Four different models occur in HCI design:

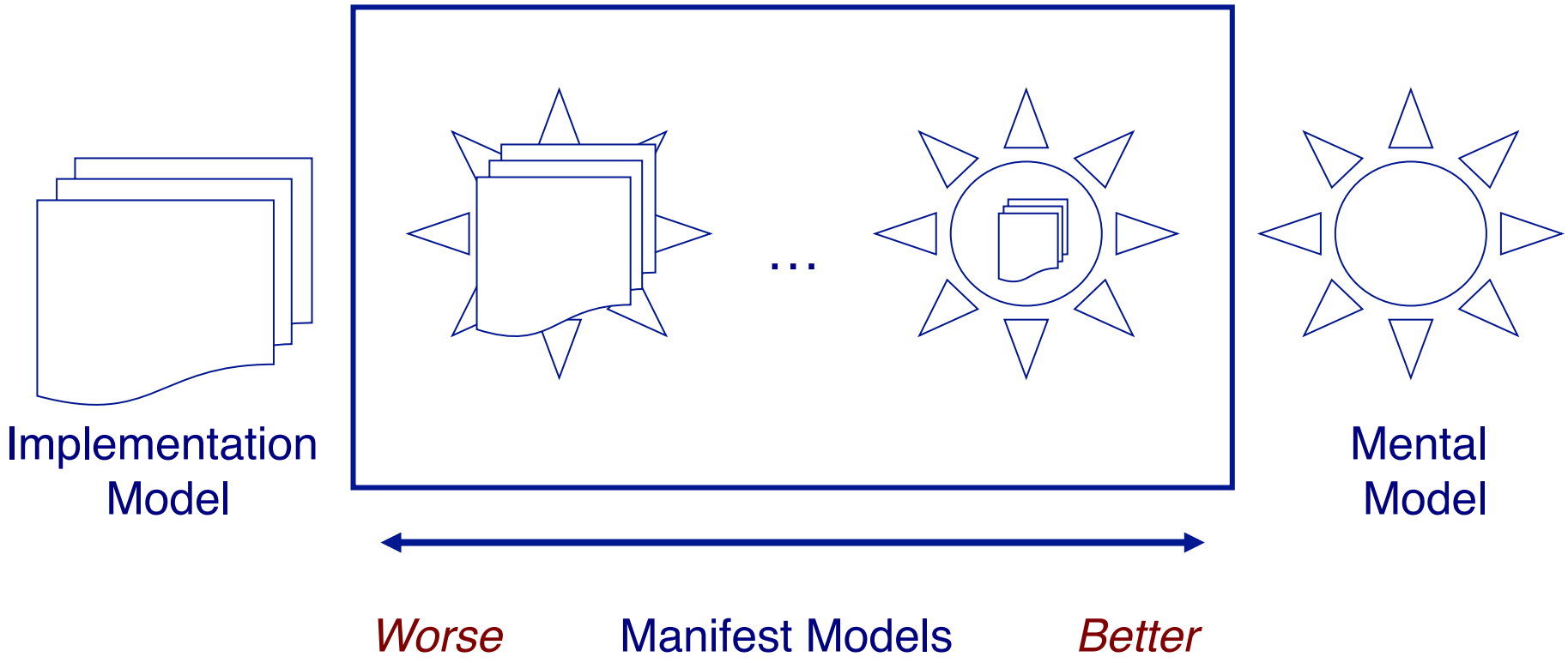
1. The design model expresses the *software design*.

2. The user model describes the *profile of the end users*. (i.e., novices vs. experts, cultural background, etc.)

3. The user's model is the end users' *perception of the system.*

4. The system image is the *external manifestation* of the system (look and feel + documentation etc.)

UI Models



Alan Cooper, *About Face*, 1995

Roadmap

- Interface design models
- **Design principles**
- GUI characteristics
- Usability Testing

User Interface Design Principles

Principle	*Description*
User familiarity	Use terms and concepts *familiar* to the user.
Consistency	Comparable operations should be activated in the *same way*. Commands and menus should have the same format, etc.
Minimal surprise	If a command operates in a known way, the user should be able to *predict* the operation of comparable commands.
Feedback	Provide the user with visual and auditory feedback, maintaining *two-way communication*.

Principle	Description
Memory load	Reduce the amount of information that must be remembered between actions. *Minimize* the memory load.
Efficiency	Seek efficiency in dialogue, motion and thought. *Minimize keystrokes and mouse movements*.
Recoverability	Allow users to *recover from their errors*. Include undo facilities, confirmation of destructive actions, 'soft' deletes, etc.
User guidance	Incorporate some form of *context-sensitive user guidance* and assistance.

Roadmap

- Interface design models
- Design principles
- **GUI characteristics**
- Usability Testing

GUI Characteristics

Characteristic	*Description*
Windows	Multiple windows allow *different information to be displayed simultaneously* on the user's screen.
Icons	Usually icons represent *files* (including folders and applications), but they may also stand for *processes* (e.g., printer drivers).
Menus	Menus bundle and organize *commands* (eliminating the need for a command language).
Pointing	A pointing device such as a mouse is used for *command choices* from a menu or indicating items of interest in a window.
Graphics	Graphical elements can be *commands* on the same display.

GUIs

Advantages

- They are *easy to learn* and use.
  - Users without experience can learn to use the system quickly.
- The user may *switch attention* between tasks and applications.
- *Fast, full-screen interaction* is possible with immediate access to the entire screen

Problems

- A GUI is not automatically a good interface
  - Many software systems are *never used* due to poor UI design
  - A poorly designed UI can cause a user to make *catastrophic errors*

Direct Manipulation

Advantages

- Users *feel in control* and are less likely to be intimidated by the system
- User *learning time* is relatively short
- Users get *immediate feedback* on their actions
- mistakes can be quickly detected and corrected

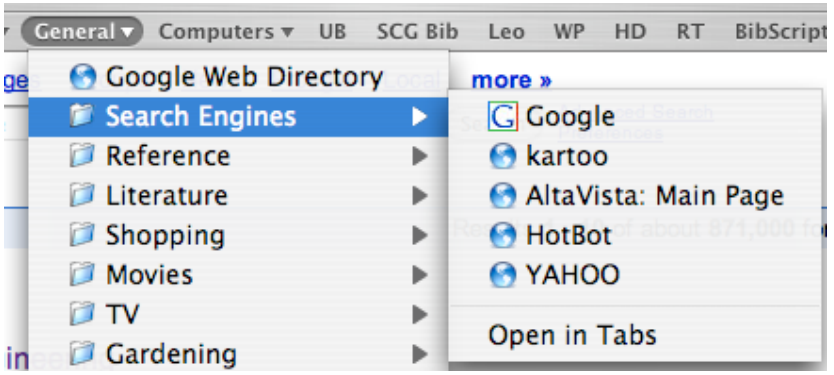
Problems

- Finding the right user *metaphor* may be difficult
- It can be *hard to navigate* efficiently in a large information space.
- It can be *complex to program* and demanding to execute

Menu Systems

Advantages

- Users don't need to remember command names
- Typing effort is minimal
- User errors are trapped by the interface
- Context-dependent help can be provided (based on the current menu selection)



Problems

- Actions involving *logical conjunction* (and) or disjunction (or) are *awkward* to represent
- If there are many choices, some *menu structuring* facility must be used
- *Experienced users find menus slower* than command language

Menu Structuring

Scrolling menus

> The menu can be scrolled to reveal additional choices
> Not practical if there is a very large number of choices

Hierarchical menus

> Selecting a menu item causes the menu to be replaced by a sub-menu

Walking menus

> A menu selection causes another menu to be revealed

Associated control panels

> When a menu item is selected, a control panel pops-up with further options

Command Interfaces

With a command language, the user types commands to give instructions to the system

- May be implemented using *cheap terminals*
- *Easy to process* using compiler techniques
- Commands of *arbitrary complexity* can be created by command combination
- *Concise interfaces* requiring minimal typing can be created

Command Interfaces

Advantages

- Allow experienced users to *interact quickly* with the system
- Commands can be *scripted* (!)

Problems

- Users have to *learn and remember* a command language
- Not suitable for *occasional* or inexperienced users
- An *error detection* and recovery system is required
- *Typing ability* is required (!)

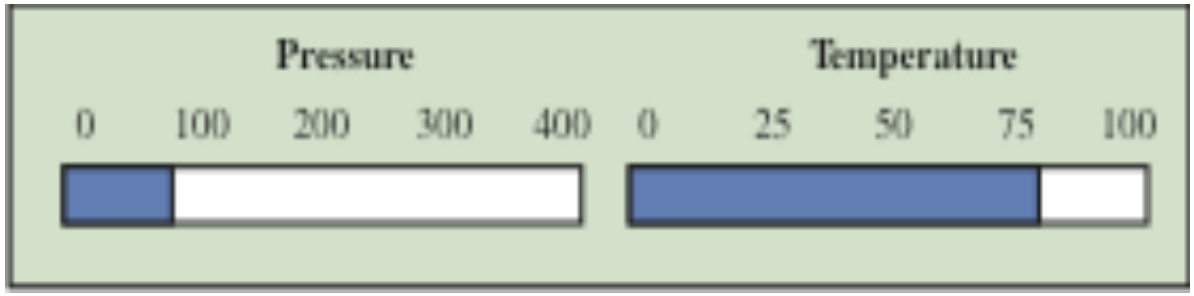
Analogue vs. Digital Presentation

Digital presentation

- *Compact* — takes up little screen space
- *Precise values* can be communicated

Analogue presentation

- Easier to get an 'at a glance' *impression* of a value
- Possible to show *relative values*
- Easier to see *exceptional* data values



Colour Use Guidelines

Colour can help the user *understand complex information structures.*

- Don’t use (only) colour to *communicate meaning*!
  - Open to *misinterpretation* (colour-blindness, cultural differences ...)
  - *Design for monochrome then add colour*
- Use colour coding to support user tasks
  - highlight exceptional events
  - allow users to control colour coding
- Use *colour change* to show *status change*
- Don't use too many colours
  - Avoid colour pairings which clash
- Use colour coding *consistently*

Roadmap

- Interface design models
- Design principles
- GUI characteristics
- **Usability Testing**

Usability Testing

- Observe a group of test subjects performing a pre-defined scenario
  - Which test subjects?
  - How many test subjects?
  - Which scenarios?
  - What to observe?

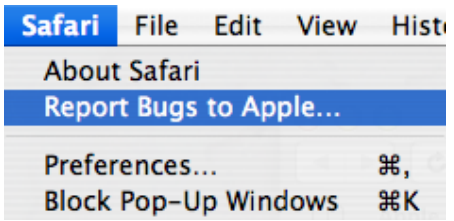
Jakob Nielsen, *Usability Engineering*

User interface evaluation

- Some evaluation of a user interface design should be carried out to assess its *usability*.
- Full scale evaluation is very *expensive* and *impractical* for most systems.
- Ideally, an interface should be evaluated against a *usability specification*. However, it is rare for such specifications to be produced.

Simple evaluation techniques

- *Questionnaires* for user feedback.
- *Video recording* of system use and subsequent tape evaluation.
- *Instrumentation* of code to collect information about facility use and user errors.
- The provision of code in the software to collect *on-line user feedback*.



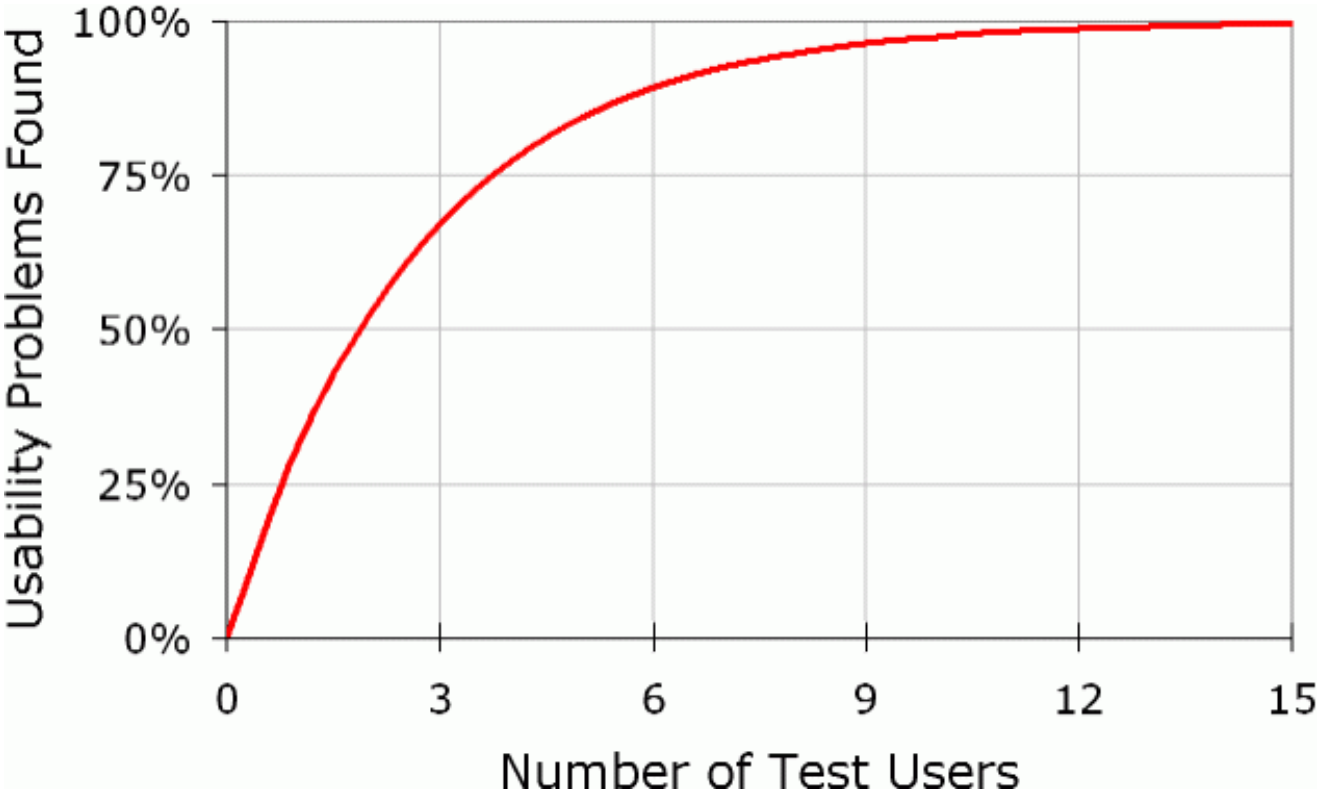
Hints

- Establish concrete goals — what do you want to achieve?
  - What criteria will you use to establish “success”?
  - What data will you collect?
  - Choose representative test tasks.
- Carry out a pilot test first.
- Test users should truly represent the intended users.
- Use experienced experimenters. (Get trained!)
  - Make the test subjects feel comfortable.
  - Don’t bias the results.

Usability Attributes

Attribute	*Description*
Learnability	How long does it take a new user to become *productive* with the system?
Speed of operation	How well does the system *response* match the user's work *practice*?
Robustness	How *tolerant* is the system of user error?
Recoverability	How good is the system at *recovering* from user errors?
Adaptability	How closely is the system tied to a *single model* of work?

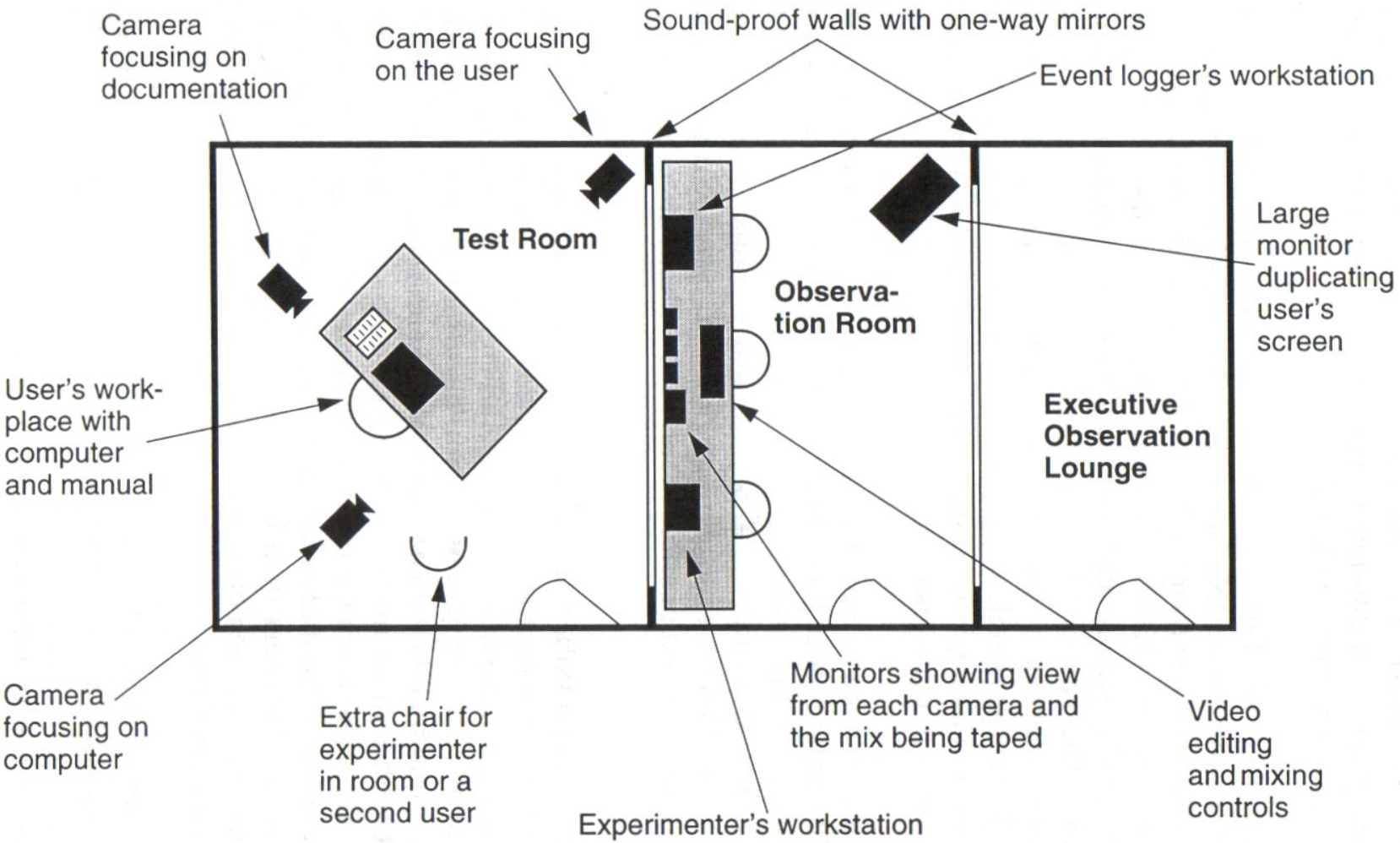
Why you only need to test with 5 users



http://www.useit.com/alertbox/20000319.html

Nielsen, Jakob, and Landauer, Thomas K.: "A mathematical model of the finding of usability problems," *Proceedings of ACM INTERCHI'93 Conference* (Amsterdam, The Netherlands, 24-29 April 1993), pp. 206-213.

Usability laboratories (!)



Jakob Nielsen, *Usability Engineering*

Key points

- The user interface design process involves *user analysis*, *system prototyping* and *prototype evaluation*.
- *User interface design principles* should help guide the design of user interfaces.
- *Interaction styles* include direct manipulation, menu systems form fill-in, command languages and natural language.
- *Graphical displays* should be used to present trends and approximate values. *Digital displays* when precision is required.
- *Colour* should be used *sparingly and consistently*.
- The goals of *UI evaluation* are to *obtain feedback* on how to improve the interface design and to assess if the interface meets its *usability requirements*.

What you should know!

- What models are important to keep in mind in UI design?
- What is the principle of minimal surprise?
- What problems arise in designing a good direct manipulation interface?
- What are the trade-offs between menu systems and command languages?
- How can you use colour to improve a UI?
- In what way can a help system be context sensitive?

Can you answer the following questions?

- Why is it important to offer “keyboard short-cuts” for equivalent mouse actions?
- How would you present the current load on the system? Over time?
- What is the worst UI you every used? Which design principles did it violate?
- What’s the worst web site you’ve used recently? How would you fix it?
- What’s good or bad about the MS-Word help system?

License