3 Basic HCI Principles and Models

3.1 Predictive Models for Interaction: Fitts’ / Steering Law
3.2 Descriptive Models for Interaction: GOMS / KLM
3.3 Users and Developers
3.4 3 Usability Principles by Dix et al.
3.5 3 Usability Principles by Shneiderman
3.6 Background: The Psychology of Everyday Action
This is a first (and not yet very deeply discussed) approach to design for usability.
What the User Sees

• Users see only what is openly visible!
What the Developer Knows

• Users have little idea about:
  – architecture,
  – state transitions,
  – dependencies
  – application context
  – system restrictions
  – …

• And users often do not want to know about it.
A Computer Screen and its Interpretation

- What do we see?
- What is shown?
- What is the meaning?
Answers from Skilled Computer Users

- Win2000 desktop
- Text and figures
- Icons and toolbars
- Overlapping windows
- Scroll bars and menus
- Task bar and status information
- Representations of documents
Basic (Naive) Technical Answers

- 2-D surface
- Controllable pixels
- Image with a resolution of 1400x1050 pixels
- For each pixel the colour can be set
- The change of colour can be controlled rapidly
Perfect User’s Answers

- My work environment
- Meeting notes
- Budget for next year
- Request to write a technical article
- Background information on a psychological phenomenon
Metaphor Example 1 – Overlaying Windows

• What is the meaning of the fact that a window is behind another window?

• What is real? What is illusion?

• What does iconizing do?

• Models? Conceptual… Implementation… Represented…
Metaphor Example 2 – Scrollbar vs. Hand

- Moving *up* the hand
  Moves *up* the document

- What happens in reality?
  What do we imagine?
  What is the metaphor?
Metaphor Example 2 – Scrollbar vs. Hand

- Moving *up* the scroll bar moves *down* the document

- What happens in reality? What do we imagine? What is the metaphor?
Metaphor Example 2 - Scrollbar vs. Hand

- Adequacy of interaction mechanism depends on content displayed
Types of Design Rules

- **Principles**
  - abstract design rules

- **Golden rules and heuristics**
  - more concrete than principles

- **Standards**
  - (very) detailed design rules

- **Design pattern**
  - generic solution for a specific problem

- **Style guides**
  - provided for devices, operating systems, widget libraries

- **Authority**: whether or not a rule must be followed or whether it is just suggested

- **Generality**: applied to many design situations or focused on specific application situation.
Usability 101 (by Jakob Nielson)

• “Usability is a quality attribute that assesses how easy user interfaces are to use. The word ‘usability’ also refers to methods for improving ease-of-use during the design process.”

• Usability has five quality components:
  – Learnability: How easy is it for users to accomplish basic tasks the first time they encounter the design?
  – Efficiency: Once users have learned the design, how quickly can they perform tasks?
  – Memorability: When users return to the design after a period of not using it, how easily can they reestablish proficiency?
  – Errors: How many errors do users make, how severe are these errors, and how easily can they recover from the errors?
  – Satisfaction: How pleasant is it to use the design?
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Principles to Support Usability

• Learnability
  – the ease with which new users can begin effective interaction and achieve maximal performance

• Flexibility
  – the multiplicity of ways the user and system exchange information

• Robustness
  – the level of support provided to the user in determining successful achievement and assessment of goal-directed behavior

Principles of Learnability (1 / 2)

• **Predictability**
  – determining effect of future actions based on past interaction history
  – operation visibility

• **Synthesizability**
  – ability of the user to assess the effect of past operations on the current state
  – the user should see the changes of an operation
  – immediate vs. eventual feedback

1. ![Image 1](image1)
2. ![Image 2](image2)
3. ![Image 3](image3)
Principles of Learnability (2 / 2)

• Familiarity
  – how prior knowledge applies to new system
  – affordance (guessability)

• Generalizability
  – extending specific interaction knowledge to new situations

• Consistency
  – likeness in input/output behavior arising from similar situations or task objectives
Principles of Flexibility (1 / 6)

• Ways in which the user and the system exchange information
• Dialogue initiative
  – freedom from system imposed constraints on input dialogue
  – user preemptiveness: user initiates dialog
  – system preemptiveness: system initiates dialog
Principles of Flexibility (2 / 6)

• Multithreading
  – ability of system to support user interaction for several tasks at a time
  – concurrent multimodality: simultaneous communication of information pertaining to separate tasks
    » multi-model dialog
    » editing text and beep (incoming mail) at the same time
  – interleaving multimodality: permits temporal overlap between separate tasks, dialog is restricted to a single task
    » window system, window = task
    » modal dialogs
    » interaction with just one window at a given time
Principles of Flexibility (3 / 6)

• Task migratability
  – passing responsibility for task execution between user and system
  – example: spell checking
Principles of Flexibility (4 / 6)

• Substitutivity
  – allowing equivalent values of input and output to be substituted for each other
  – representation multiplicity
  – equal opportunity: blurs the distinction between input and output
Principles of Flexibility (5 / 6)

- Customizability
  - modifiability of the user interface by the user (adaptability) or system (adaptivity)
  - **adaptability**: users ability to adjust the form of input and output
  - adaptivity: automatic customization of the user interface by the system
Principles of Flexibility (6 / 6)

- Customizability
  - modifiability of the user interface by the user (adaptability) or system (adaptivity)
  - adaptability: users ability to adjust the form of input and output
  - adaptivity: automatic customization of the user interface by the system
Principles of Robustness (1 / 2)

→ Level of support provided to the user in determining successful achievement and assessment of goal-directed behavior

• Observability
  – ability of the user to evaluate the internal state of the system from its perceivable representation

• Recoverability
  – ability of the user to correct a recognized error
  – reachability (states): forward (redo) / backward (undo) recovery
  – commensurate effort (more effort / steps for deleting a file than for moving it)
Principles of Robustness (2 / 2)

• Task conformance
  – degree to which system services support all of the user's tasks
  – task completeness; task adequacy

• Responsiveness
  – how the user perceives the rate of communication with the system
  – preferred: short durations and instantaneous responses (< 100ms)
  – stability and indication of response time
3 Usability Principles by Dix

• Learnability
  – Predictability
  – Synthesizability
  – Familiarity
  – Generalizability
  – Consistency

• Flexibility
  – Dialogue initiative
  – Multithreading
  – Task migratability
  – Substitutivity
  – Customizability

• Robustness
  – Observability
  – Recoverability
  – Responsiveness
  – Task conformance

[Section 7.2 in Dix. “Human Computer Interaction”]
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