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Human Computer Interaction

Design Principles

1

Core characteristics of interaction design: Recap

- Users should be involved through the whole development of the product
- Specific usability and user experience goals need to be identified, clearly documented and agreed at the beginning of the project
- *Iteration* is needed throughout the core activities

Usability Goals: Recap

- Effective to use (**effectiveness**)
- Efficient to use (**efficiency**)
- Safe to use (**safety**)
- Have a good utility (**utility**)
- Easy to learn (**learnability**)
- Easy to remember how to use (**memorability**)

Principles of Interaction Design

- How do we create *elegant solutions* to complex interaction problems?
- How do interaction designers succeed at creating great designs that are powerful and aesthetically appealing?

Principles of Interaction Design



Interaction design principles

- A way of conceptualizing usability in terms of design principles.
 - e.g. feedback
- Design principles are derived from a mix of theory-based knowledge, experience, and common sense.
 - the do's and don'ts of interaction design
 - intended to help designers explain and improve the design
 - not intended to specify how to design an actual interface

Principles of Interaction Design

MAXIM

Design principles can be used to guide design decisions

- Design principles do not prescribe specific outcomes; they function within the context of a particular design project.
- Design principles guide interaction designers and help them make decisions that are based on established criteria

1-7

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Gulfs and Principles

- Design principle can be used to determine if there are gulfs of execution or evaluation
- Gulfs of execution relate to the effectiveness principles
- Gulfs of evaluation relate to the efficiency principles

1-8

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Interaction Design Principles

Don Norman (1988) – the Design of Everyday Things

1. Visibility—don't hide buttons e.g. bank web site
 2. Feedback— so you don't re-hit buttons
 3. Constraints— grey-out options in different modes
 4. Mapping—between controls and effects
 5. Consistency—right mouse click always behaves same
 6. Affordances—give a clue as to the use eg pushing a button
- Similar to Nielson's 10 usability principles (2001).

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Visibility

- The more visible functions are, the more likely users will be able to know what to do next.
- When functions are "out of sight", it makes them more difficult to find and know how to use.
- Norman's example: controls of a car

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Visibility-- Hidden controls examples

from www.baddesigns.com/elcard.html
the control panel in the elevator
of a nice hotel in Los Angeles

when you push a button
and the elevator doesn't
move. How does it work?



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Visibility—Hidden controls examples (2)

Insert your card on
the control panel.

How could this interface
be improved?



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Feedback

- Send information back to the user about what has to be done
- Include sound, highlighting, animation, and combinations of these
- Deciding which combinations are appropriate for different kinds of activities and interactivities is central.
- Using feedback in the right way can also provide the necessary visibility for user interaction.

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Feedback

- What everyday life would be like without feedback?

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Feedback

- PowerPoint: Hide Slide

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Constraints

- Restrict the possible actions that can be performed
 - USB
- Helps prevent user from selecting incorrect options
 - Deactivating certain menu options by shading them

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Constraints

- Three main types (Norman 1999)
 1. Physical—the way physical objects restrict the movement of things. eg inserting a CD, door hinges
 2. Logical— rely on people's understanding of the way the world works. eg disabling menu options in certain modes; colour coding wires/sockets to connect to appliances
 3. Cultural—rely on learned conventions
e.g. red for danger
Once learned and accepted by a cultural group, they become universally accepted conventions.
the use of windowing for displaying information
the use of icons on the desktop to represent operations and documents

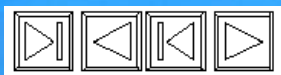
Mapping

- Relationship between controls and their effects in the real world
- Nearly all artifacts need some kind of mapping



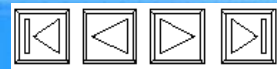
Mapping

- Why is this a poor mapping of control buttons for a CD player?



Mapping (2)

- Why is this a better mapping?



- More natural mapping between fast rewind, rewind, play, and fast forward on a CD player.

Consistency

- Interfaces should use similar elements for similar tasks; Easier to learn and use
- E.g. always use ctrl key plus first initial of the command for an operation :-
- ctrl +S for Save, ctrl+O for Open
– (note powerpoint uses ctrl + M to insert a new slide!)
- Difficult to maintain across different applications eg Office, Excel, Word.

Affordance

- An Affordance is an action that an individual can potentially perform in their environment. However, the more exact meaning depends on whether the word is used to refer to **any such action possibility** or only to **those which the actor is aware of**, both of which are common uses.

Affordance

- example: Scissors

1) First the user goal needs to be considered. To an angry user, the scissor might afford throw weapon, rather than a paper cutter.

2) Affordance will simply by observation, remind the user of similar items in size and form.

User will from conventions know that the sharp edges are not to be touched, and that they are to be used on the paper. Instead the holes size and form will seem to fit his fingers. Physical constraints limit the options of usage further. Only a limited number of fingers will fit into each hole. And the distance between the holes will make sure the correct fingers are used, and that the scissor can be operated at all.

Affordance

- Affordance can be misinterpreted, if the user does not have the conventional knowledge, or even worse, if he has a conventional behaviour that makes him want to touch the sharp edges.

Therefore it is important for the designer, to study the user and take into consideration if the user differs from the designer himself. Norman also points out **the need for user interaction in the design process**, where tests and feedback from the user should be used to improve the product.

Affordances: to give a clue

- An attribute of an object that allows people to know how to use it
- Originally used for physical objects—buttons, door handles etc.
- Used now as “perceived” affordances
 - scrollbars to afford moving up and down,
 - icons to afford clicking on.
- These are more like learned conventions.

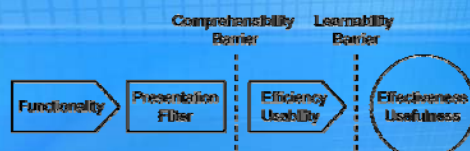
Activity—physical affordances

- Study an object from the classroom.

Write down the answer to these questions:

- What does the object do? How do you know?
- Would you know what to do if you had never encountered this device before?
- How does the object afford?
- Are controls visible?
- Is there feedback?
- What constraints are there?

Framework for Design Principles



Framework for Design Principles

The framework has the following components:

- Usability Goals**
 - There are two main usability goals in the framework; comprehensibility and learnability.
- Design Principle Categories**
 - The framework also divides the design principles into two main groups; efficiency principles and effectiveness principles.
- Format to Describe Design Principles**
 - The framework uses the format “serves the principle of ... which promotes ...” to describe the different principles.
 - Familiarity* serves the principle of *memorability*, which promotes *usability*.

Framework for Design Principles



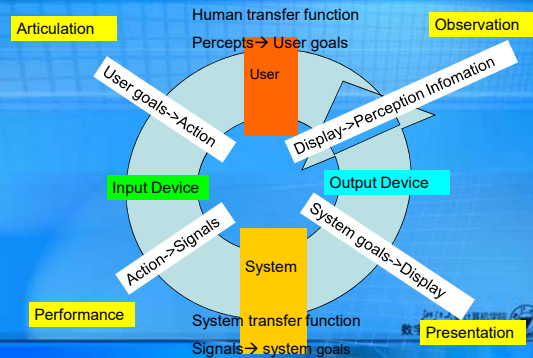
Functionality - The system must have adequate functionality for a particular task.

Presentation Filter - The functionality must be made accessible through the presentation filter (interface).

1-31

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Interaction Framework: Recap



Framework for Design Principles



Comprehensibility Barrier - If the presentation is comprehensible, the comprehensibility barrier will be superseded. This depends on the degree of efficiency/usability in the interface design.

Learnability Barrier - If the interface is comprehensible it will be learnable, there is a direct relationship.

Effectiveness/Usefulness - If the user can learn the interface he can take advantage of the functionality and the interface will, therefore, be useful.

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Comprehensibility

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An interface design that is easy to comprehend will be efficient and effective

- If a user does not understand the interface it will be useless
- A design's comprehensibility is highly dependent on the way in which the interface communicates its functionality to the user

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Learnability

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An interface with high usability will be easier to learn

- The learnability of a design is based on comprehensibility: if you can't understand it, you can't learn it

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Comprehensibility Learnability

- Learnability and comprehensibility are recursive: we start with comprehensibility which affects learnability, which will in turn increase comprehensibility.



Comprehensibility/Learnability Feedback Loop

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Principles of Interaction Design

- Effectiveness/Usefulness
 - Utility
 - Safety
 - Flexibility
 - Stability
- Efficiency/Usability
 - Simplicity
 - Memorability
 - Predictability
 - Visibility

1-37

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Design Principle Categories

- Effectiveness/Usefulness

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Effectiveness describes the usefulness of a design

- The effectiveness goal stipulates(规定) that a design must fulfill the user's needs by affording the required functionality

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Effectiveness/Usefulness

- **Utility** - The principle of utility relates to what the user can do with the system.

1-39

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Effectiveness/Usefulness

- **Safety** - If a design has a high degree of safety, it will prove more useful than a design that involves a high degree of risk.
 - **Recovery** - can be implemented in interaction designs by incorporating appropriate undo functionality and robust error recovery routines.

A computer shall not harm your work or, through inaction, allow your work to come to harm.

(Raskin, 2000)

1-40

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Effectiveness/Usefulness

- **Safety**



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1-42

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Effectiveness/Usefulness

- **Flexibility** - A tool that is flexible can be used in multiple environments and may address diverse needs
 - **Customization** - A tool would have greater flexibility if people were able to customize the interface according to their personal preferences
- **Stability** - A stable system is a robust system.
 - A system that functions consistently well will be more useful than a system that crashes frequently

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Efficiency/Usability

MAXIM

Efficiency describes the usability of a design

- The efficiency goal stipulates that a design should enable a user to accomplish tasks in the easiest and quickest way possible without having to do overly complex or extraneous procedures.

A computer shall not waste your time or require you to do more work than is strictly necessary. (Raskin, 2000)

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Efficiency/Usability

- **Simplicity** - If things are simple they will be easy to understand and, therefore, easy to learn and remember.
 - **Ockham's Razor** - Pluralitas non est ponenda sine necessitate
 - pluralities should not be posited without necessity
 - Ockham: 1285-1349, medieval English philosopher and Franciscan monk
 - **80/20 Rule**
 - **Pareto's rule**
 - 80% of an application's usage involves 20% of its functionality
 - **Satisficing**
 - **Satisfying + Sufficing**
 - Combines the conflicting needs of finding the optimal solution that satisfies all the requirements and the need to settle on a solution that will be sufficient to proceed with the design

1-45

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Efficiency/Usability

• Simplicity

- **Progressive Disclosure** - Show the user only what is necessary



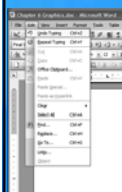
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Efficiency/Usability

• Simplicity

- **Constraints** - Involves limiting the actions that can be performed in a particular design



1-47

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Efficiency/Usability

• Simplicity

- **Constraints**

- Psychological
 - **Conventions** - exploit learned behavior to influence a user's actions
 - **Mapping** - can influence the way in which people perceive relationships between controls and effects
 - **Symbols** - can influence the way in which we interact with an interface by defining meaning and constraining our possible interpretations of interface elements

1-48

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Efficiency/Usability

- **Memorability** - Interfaces that have high memorability will be easier to learn and use
 - Many different parameters affect memorability:
 - Location
 - Logical Grouping
 - Conventions
 - Redundancy

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Efficiency/Usability

- **Predictability** - Predictability involves a person's expectations and his ability to determine the results of his actions ahead of time.
 - **Consistency-Correctness**
 - Consistency reinforces our associations and, therefore, increases our ability to remember and predict outcomes and processes.
 - Before we strive to be consistent, we must make sure we are correct

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Efficiency/Usability

- **Predictability**
 - **Generalizability**: can help us use the knowledge we gathered from previous experience and apply it to similar situations
 - **Conventions**: allow us to use our intuitions
 - **Familiarity**: familiar menu names and options help users locate objects and functions more easily
 - **Location, Location, Location**: Not all areas on the screen are created equal

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Efficiency/Usability

- **Predictability**
 - **Modes**: Modes create instability in mental models because they change the way objects function

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Efficiency/Usability

- **Visibility** - The principle of visibility involves making the user aware of the system's components and processes, including all possible functionality and feedback from user actions.

*Show everything at once, and the result is chaos.
Don't show everything, and then stuff gets lost.*
(Norman, 1998, 74)

1-53

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Efficiency/Usability

MAXIM

The principles of progressive disclosure and simplicity should be used in conjunction with the principle of visibility to avoid overload

- **Visibility**
 - **Overload**: Following the principle of visibility without also applying progressive disclosure can lead to visual overload
 - **Feedback**: Direct Manipulation interfaces provide immediate visual feedback about user actions. It is the task of the interaction designer to decide what form that feedback takes

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Efficiency/Usability

• Visibility

- **Recognition/Recall:** The principle of visibility is based on the fact that we are better at recognition than we are at recall
- **Orientation:** People need to be able to orient themselves, especially in complex information spaces

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Grouping

- **Low-level principles** - used to make decisions about specific screen controls, menus and layouts

MAXIM

Use visual cues to support the logical structure of the interface

• Gestalt Principles of Perception

- Gestalt psychology strives to explain the factors involved in the way we group things
- At the heart of Gestalt psychology is the idea that we strive to find the simplest solutions to incomplete visual information

1-56

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Usability Goals – Principles - Guidelines

• Usability Goal—Easy to use

- Most people are interested in completing their tasks and do not enjoy struggling with the tools they need to use. One of the most important goals of user-centered design is to make things easy to use.

• Design Principle—Simplicity

- Simple things require little effort and can often be accomplished without much thought. If interaction designs are guided by the principle of simplicity, they will be easier to use.

1-57

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10 Usability Principles (Nielsen 2001)

1. Visibility of system status
2. Match between system and real
3. User control and freedom
4. Consistency and standards
5. Help users recognize, diagnose and recover from errors
6. Error prevention
7. Recognition rather than recall
8. Flexibility and efficiency
9. Aesthetic and minimalist design
10. Help and documentation

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10 Usability Principles (Nielsen 2001)

1. Visibility of system status: always keep users informed about what is going on, through providing appropriate feedback within reasonable time
2. Match between system and real world: speak the user's language, using words, phrases and concepts familiar to the user, rather than system-oriented terms
3. User control and freedom – provide ways of allowing users to easily escape from places they unexpectedly find themselves, by using clearly marked 'emergency exits'
4. Consistency and standards: avoid making users wonder whether different words, situations, or actions mean the same thing

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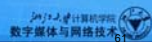
10 Usability Principles (Nielsen 2001)

5. Help users recognize, diagnose and recover from errors: use plain language to describe the nature of the problem and suggest a way of solving it
6. Error prevention: where possible prevent errors occurring in the first place
7. Recognition rather than recall: make objects, actions, and options visible

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10 Usability Principles (Nielsen 2001)

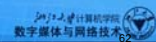
8. Flexibility and efficiency: provide accelerators that are invisible to novice users, but allow more experienced users to carry out tasks more quickly
9. Aesthetic and minimalist design: avoid using information that is irrelevant or rarely needed
10. Help and documentation: provide information that can be easily searched and provides help in a set of concrete steps that can easily be followed



Usability Summary

You should now be able to...

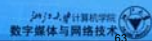
- Define HCI and interaction design
- Identify important usability and user experience goals for a product
- Critically evaluate an interface design



What do professionals do in the Interaction Design business?

Jobs are Interdisciplinary.

- Interaction designers: involved in the design of *all* the interactive aspects of a product
- Usability engineers: focus on *evaluating products*, using usability methods and principles
- Web designers: develop and create the *visual design* of websites such as layouts
- Information architects: how to plan and structure interactive products, especially websites
- User-experience designers: do all the above + field studies



Thank you.

