

User-Centered Design and Development

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- These slides are a revised version of the originals provided with the book “Interaction Design” by Jennifer Preece, Yvonne Rogers, and Helen Sharp, Wiley, 2002.
- I added some material, made some minor modifications, and created a custom show to select a subset.
 - Slides added or modified by me are marked with my initials and the year (e.g. FJK 2009), unless I forgot it ...

Chapter 1

Overview of User-Centered Design and Human-Computer Interaction

Chapter Overview

- Good vs. bad design
- Interaction design
- Interaction design process
- Goals of interaction design
- Design and usability practices

Motivation

- More and more products and systems have become highly complex, posing challenges to users.
- As much as possible products should be designed to accommodate their users, not vice versa.
- Computer-based products can be extremely versatile, but their interaction with the user can also be adapted relatively easily.

Objectives

- To become familiar with the main concepts and terms in the area of user-centered design (UCD) and human-computer interaction (HCI).
- To understand the contributing factors to good and poor design.
- To know about important principles for good interaction design.

What is Interaction Design?



What is interaction design?

- Designing interactive products to support people in their everyday and working lives
 - Sharp, Rogers and Preece (2002)
- The design of spaces for human communication and interaction
 - Winograd (1997)

Goals of interaction design

- Develop usable products
 - Usability means easy to learn, effective to use and provide an enjoyable experience
- Involve users in the design process

Example of bad and good design

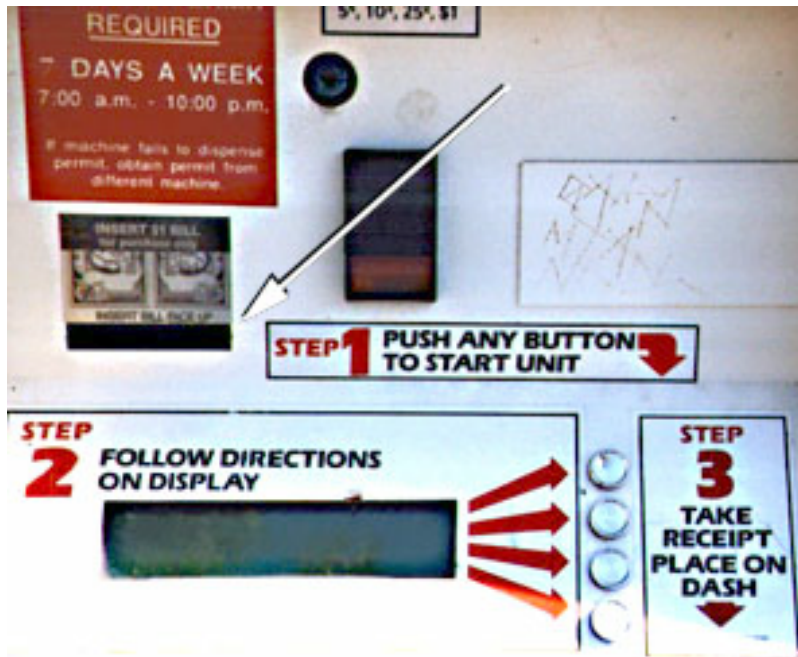
- Elevator controls and labels on the bottom row all look the same, so it is easy to push a label by mistake instead of a control button



- People do not make same mistake for the labels and buttons on the top row. Why not?

From: www.baddesigns.com

Why is this vending machine so bad?



- Need to **push button first** to activate reader
- Normally **insert bill** first before making selection
- Contravenes well known convention

From: www.baddesigns.com

What to design

- Need to take into account:
 - Who the users are
 - What activities are being carried out
 - Where the interaction is taking place
- Need to optimise the interactions users have with a product
 - Such that they match the users activities and needs

Understanding users' needs

- Need to take into account what people are good and bad at
- Consider what might help people in the way they currently do things
- Listen to what people want and get them involved
- Use tried and tested user-based methods

Activity

- How does making a call differ when using a:
 - Cell phone
 - Public phone box?
- Consider the kinds of user, type of activity and context of use



What is an interface?

?

Evolution of HCI 'interfaces'

- **50s** - Interface at the hardware level for engineers - switch panels
- **60-70s** - interface at the programming level - COBOL, FORTRAN
- **70-90s** - Interface at the terminal level - command languages
- **80s** - Interface at the interaction dialogue level - GUIs, multimedia
- **90s** - Interface at the work setting - networked systems, groupware
- **00s** - Interface becomes pervasive
 - RF tags, Bluetooth technology, mobile devices, consumer electronics, interactive screens, embedded technology

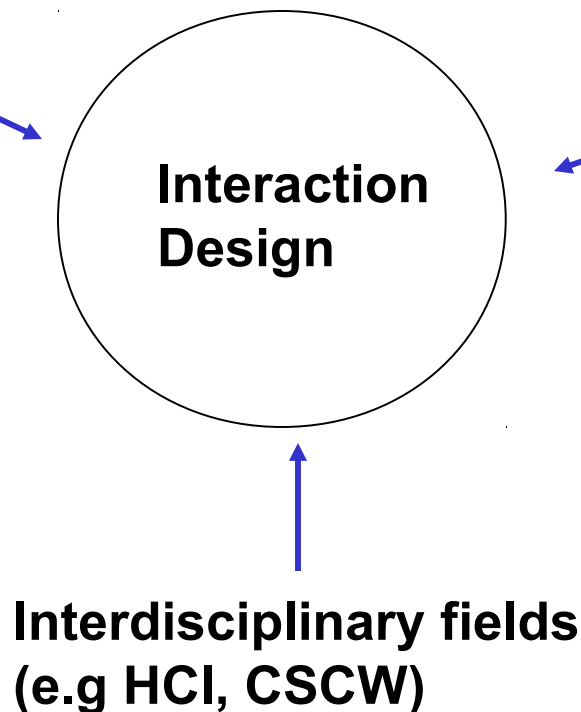
From HCI to Interaction Design

- **Human-computer interaction (HCI)** is:
“concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them” (ACM SIGCHI, 1992, p.6)
- **Interaction design (ID)** is:
“the design of spaces for human communication and interaction”
 - Winograd (1997)
- Increasingly, more application areas, more technologies and more issues to consider when designing ‘interfaces’

Relationship between ID, HCI and other fields

**Academic disciplines
(e.g. computer science, psychology)**

**Design practices
(e.g. graphic design)**



Relationship between ID, HCI and other fields

- Academic disciplines contributing to ID:
 - Psychology
 - Social Sciences
 - Computing Sciences
 - Engineering
 - Ergonomics
 - Informatics

Relationship between ID, HCI and other fields

- Design practices contributing to ID:
 - Graphic design
 - Product design
 - Artist-design
 - Industrial design
 - Film industry

Relationship between ID, HCI and other fields

- Interdisciplinary fields that 'do' interaction design:
 - HCI
 - Human Factors
 - Cognitive Engineering
 - Cognitive Ergonomics
 - Computer Supported Co-operative Work
 - Information Systems

How easy is it to work in multidisciplinary teams?

- More people involved in doing interaction design the more ideas and designs generated...but...
- The more difficult it can be to communicate and progress forwards the designs being created

Interaction design in business

- Increasing number of ID consultancies, examples of well known ones include:
 - **Nielsen Norman Group:** “help companies enter the age of the consumer, designing human-centered products and services”
 - **Swim:** “provides a wide range of design services, in each case targeted to address the product development needs at hand”
 - **IDEO:** “creates products, services and environments for companies pioneering new ways to provide value to their customers”



What do professionals do in the ID business?

- **interaction designers** - people involved in the design of all the interactive aspects of a product
- **usability engineers** - people who focus on evaluating products, using usability methods and principles
- **web designers** - people who develop and create the visual design of websites, such as layouts
- **information architects** - people who come up with ideas of how to plan and structure interactive products
- **user experience designers** - people who do all the above but who may also carry out field studies to inform the design of products

What is involved in the process of interaction design

- Identify needs and establish requirements
- Develop alternative designs
- Build interactive prototypes that can be communicated and assessed
- Evaluate what is being built throughout the process

Core characteristics of interaction design

- users should be involved through the development of the project
- specific usability and user experience goals need to be identified, clearly documented and agreed at the beginning of the project
- iteration is needed through the core activities

Usability goals

- Effective to use
- Efficient to use
- Safe to use
- Have good utility
- Easy to learn
- Easy to remember how to use

Activity on usability

- How long should it take and how long does it actually take to:
 - use a VCR to play a video?
 - use a VCR to pre-record two programs?
 - use an authoring tool to create a website?



User experience goals

- Satisfying - rewarding
- Fun - support creativity
- Enjoyable - emotionally fulfilling
- Entertaining ...and more
- Helpful
- Motivating
- Aesthetically pleasing
- Motivating

Usability and user experience goals

- How do usability goals differ from user experience goals?
- Are there trade-offs between the two kinds of goals?
 - e.g. can a product be both fun and safe?
- How easy is it to measure usability versus user experience goals?

Design principles

- Generalizable abstractions for thinking about different aspects of design
- The do's and don'ts of interaction design
- What to provide and what not to provide at the interface
- Derived from a mix of theory-based knowledge, experience and common-sense

Visibility



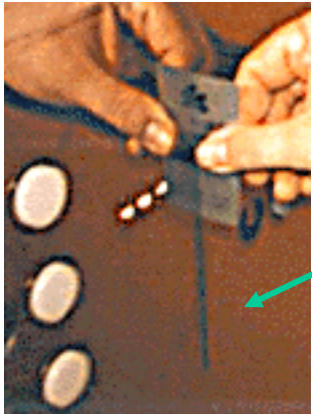
- This is a control panel for an elevator.
- How does it work?
- Push a button for the floor you want?
- Nothing happens. Push any other button? Still nothing. What do you need to do?

From:

www.baddesigns.com

It is not visible as to what to do!

Visibility




...you need to insert your room card in the slot by the buttons to get the elevator to work!



How would you make this action more **visible**?

- make the card reader more obvious
 - provide an auditory message, that says what to do (which language?)
 - provide a big label next to the card reader that flashes when someone enters
-
- make relevant parts visible
 - make what has to be done obvious

Feedback

- Sending information back to the user about what has been done
- Includes sound, highlighting, animation and combinations of these
 - e.g. when screen button clicked on provides sound or red highlight feedback:

 → “ccclichhk”

 → 

Constraints

- Restricting the possible actions that can be performed
- Helps prevent user from selecting incorrect options
- Three main types (Norman, 1999)
 - physical
 - cultural
 - logical

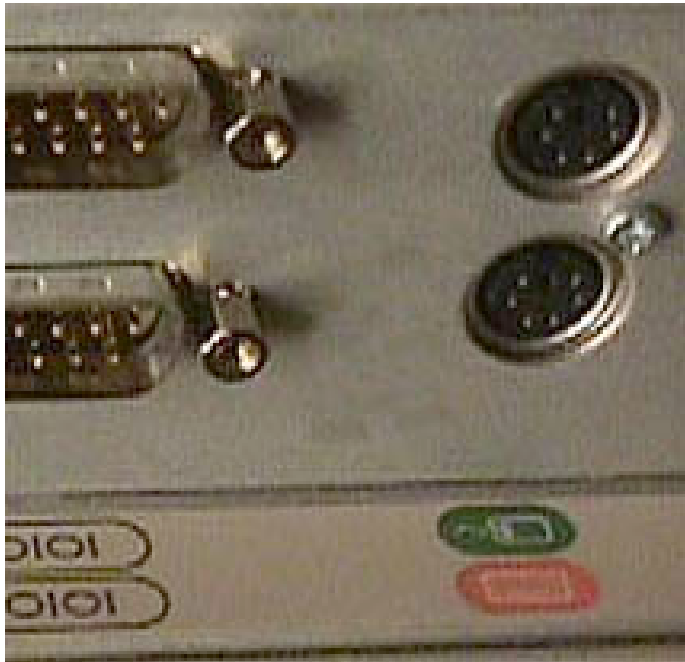
Physical constraints

- Refer to the way physical objects restrict the movement of things
 - E.g. only one way you can insert a key into a lock
- How many ways can you insert a CD or DVD disk into a computer?
- How physically constraining is this action?
- How does it differ from the insertion of a floppy disk into a computer?

Logical constraints

- Exploits people's everyday common sense reasoning about the way the world works
- An example is the logical relationship between physical layout of a device and the way it works as the next slide illustrates

Logical or ambiguous design?



- Where do you plug the mouse?
- Where do you plug the keyboard?
- top or bottom connector?
- Do the color coded icons help?

From: www.baddesigns.com

How to design them more logically



(i) A provides direct adjacent mapping between icon and connector



(ii) B provides color coding to associate the connectors with the labels

From: www.baddesigns.com

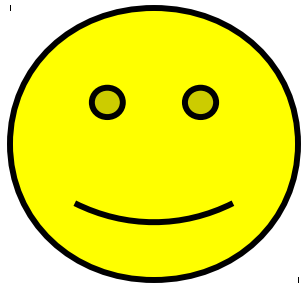
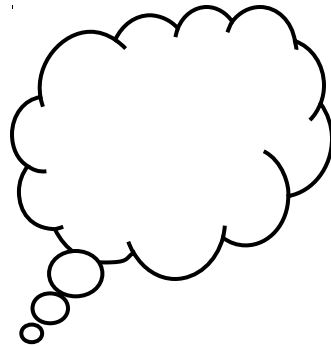
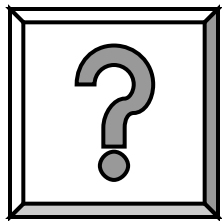
Cultural constraints

- Learned arbitrary conventions like red triangles for warning



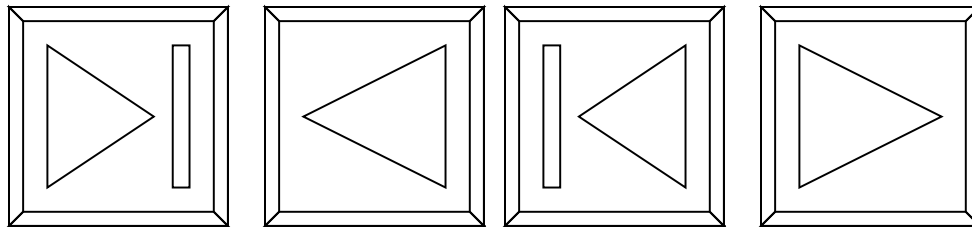
- Can be universal or culturally specific

Which are universal and which are culturally-specific?



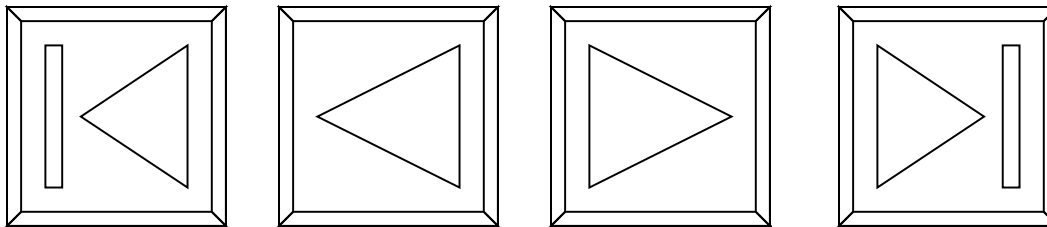
Mapping

- Relationship between controls and their movements and the results in the world
- Why is this a poor mapping of control buttons?



Mapping

- Why is this a better mapping?



- The control buttons are mapped better onto the sequence of actions of fast rewind, rewind, play and fast forward

Activity on mappings

- Which controls go with which rings (burners)?



A



B



C



D

Why is this a better design?



Consistency

- Design interfaces to have similar operations and use similar elements for similar tasks
- For example:
 - always use ctrl key plus first initial of the command for an operation – ctrl+C, ctrl+S, ctrl+O
- Main benefit is consistent interfaces are easier to learn and use

When consistency breaks down

- What happens if there is more than one command starting with the same letter?
 - e.g. save, spelling, select, style
- Have to find other initials or combinations of keys, thereby breaking the consistency rule
 - E.g. ctrl+S, ctrl+Sp, ctrl+shift+L
- Increases learning burden on user, making them more prone to errors

Internal and external consistency

- Internal consistency refers to designing operations to behave the same within an application
 - Difficult to achieve with complex interfaces
- External consistency refers to designing operations, interfaces, etc., to be the same across applications and devices
 - Very rarely the case, based on different designer's preference

Keypad numbers layout

- A case of external inconsistency

(a) phones, remote controls

1	2	3
4	5	6
7	8	9
	0	

(b) calculators, computer keypads

7	8	9
4	5	6
1	2	3
0		

Affordances: to give a clue

- Refers to an attribute of an object that allows people to know how to use it
 - e.g. a mouse button invites pushing, a door handle affords pulling
- Norman (1988) used the term to discuss the design of everyday objects
- Since has been much popularised in interaction design to discuss how to design interface objects
 - e.g. scrollbars to afford moving up and down, icons to afford clicking on

What does 'affordance' have to offer interaction design?

- Interfaces are virtual and do not have affordances like physical objects
- Norman argues it does not make sense to talk about interfaces in terms of 'real' affordances
- Instead interfaces are better conceptualised as 'perceived' affordances
 - Learned conventions of arbitrary mappings between action and effect at the interface
 - Some mappings are better than others

Activity

- Physical affordances:

How do the following physical objects afford? Are they



Activity: Affordance Discovery

- Take an object or product that is unfamiliar to the test subject, and ask them to find the affordances.
 - Ideally, the product should perform a pleasant activity once the affordance has been identified and used.

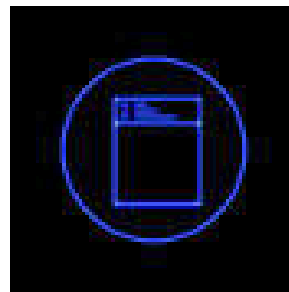
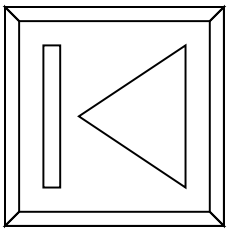
Activity

- Virtual affordances

How do the following screen objects afford?

What if you were a novice user?

Would you know what to do with them?



Up Arrow →

Elevator Button

Down Arrow →

Challenge

- Sketch or describe some key affordances for the following product ideas:
 - A visual interface for a “file unification system.”
 - An auditory interface for stock brokers.
 - An auditory interface for software debugging.
 - A tactile interface for pedestrian navigation.

File Unification System

- Visual interface for merging computer file systems (e.g. desktop/laptop)
 - Files that are close in one system should be close together in the unified system
 - Files with similar contents should be close together
 - Different versions of the same file should be grouped together
 - Different file types should be easy to distinguish visually.

Note: You are not asked to design a system that *performs* this task, but only the *interface* (affordances) for it.

Auditory Interface for Stock Brokers

- Stock brokers need to digest and react to a large quantity of data in a short time. With multiple computer monitors, their visual channels are often overloaded, but their auditory channel is often underutilized.
- Design audible affordances that help stockbrokers keep track of market developments and make quick decisions when appropriate.

Auditory Interface for Software Debugging

- Debugging software can be very tedious and challenging, especially for complex systems.
- Design audible affordances that help software testers identify errors and unusual system behaviors.
 - It might be useful to concentrate on a manageable set of errors and problems.

Tactile Interface for Pedestrian Navigation

- Imagine that you have to traverse an unknown environment with no or very little visible information (e.g. at night, in fog, a visually impaired person).
 - Use the Cal Poly campus as test case.
- Design tactile affordances that help a pedestrian navigate in such an environment.
 - You may assume that computer-based information about the environment is available.

Usability principles

- Similar to design principles, except more prescriptive
- Used mainly as the basis for evaluating systems
- Provide a framework for heuristic evaluation

Usability principles (Nielsen 2001)

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

Key points

- ID is concerned with designing interactive products to support people in their everyday and working lives
- ID is multidisciplinary, involving many inputs from wide-reaching disciplines and fields
- ID is big business even after the dot.com crash!

Key points

- ID involves taking into account a number of interdependent factors including context of use, type of task and kind of user
- Need to strive for usability and user experience goals
- Design and usability principles are useful heuristics for analyzing and evaluating interactive products