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 (FJK), unless I forgot it …

484-W09 Quarter

- The slides I use in class are in the Custom Show “484-W09”. It is a subset of the whole collection in this file.
  - To view them, select “Slide Show => Custom Shows”, then the quarter, then “Show”

Chapter 2

Understanding User Interaction

Chapter Overview

- Problem space
- Conceptual models
- Interface metaphors
- Interaction paradigms
- Conceptual models and physical design

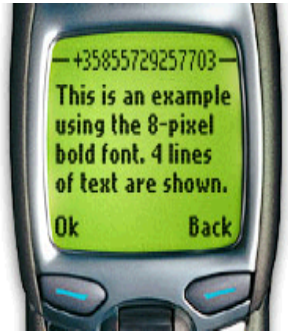
Motivation

- Good intentions are not sufficient to develop good user interfaces.
- It is important to understand the background, tasks, mind set, and experiences of users.
- Carefully considering the interactions of the user with the system before they are committed to code offers the flexibility to discard ideas and approaches that don’t work.

Objectives

- Understand the terms *problem space* and *conceptual model*.
- Use them to develop abstract descriptions of interactions.
- Identify mappings between the abstract descriptions and the methods and techniques available for implementation.
- Evaluate advantages and problems of various approaches to such mappings.

Understanding and conceptualizing interaction



Recap

- HCI has moved beyond designing interfaces for desktop machines
- About extending and supporting all manner of human activities in all manner of places
- Facilitating user experiences through designing interactions
    - Make work effective, efficient and safer
    - Improve and enhance learning and training
    - Provide enjoyable and exciting entertainment
    - Enhance communication and understanding
    - Support new forms of creativity and expression

Understanding the problem space

- What do you want to create?
- What are your assumptions?
- Will it achieve what you hope it will?

A framework for analysing the problem space

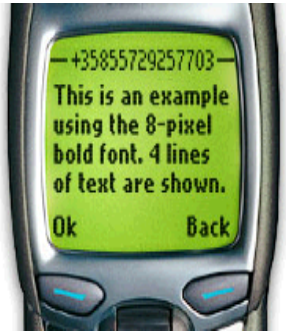
- Are there problems with an existing product?
- Why do you think there are problems?
- Why do you think your proposed ideas might be useful?
- How would you see people using it with their current way of doing things?
- How will it support people in their activities?
- Will it really help them?

Activity Theme: TV Gourmet

- Only watch shows you are really interested in
- Critical user needs
  - aspects that are important to all or most users
- Constraints
  - conceptual
  - technological
  - environment

An example

- What were the assumptions made by cell phone companies when developing WAP services?
- Was it a solution looking for a problem?



Assumptions: realistic or wish-list?

- People want to be kept informed of up-to-date news wherever they are - reasonable
- People want to interact with information on the move - reasonable
- People are happy using a very small display and using an extremely restricted interface - not reasonable
- People will be happy doing things on a cell phone that they normally do on their PCs (e.g. surf the web, read email, shop, bet, play video games) - reasonable only for a very select bunch of users

From problem space to design space

- Having a good understanding of the problem space can help inform the design space
  - e.g. what kind of interface, behavior, functionality to provide
- But before deciding upon these it is important to develop a conceptual model

Conceptual model

- How will the system appear to users?
  - Internalized understanding of how the system works.
  - May not correspond to the actual design of the system.
- A conceptual model is a high level description of:
  - "the proposed system in terms of a set of integrated ideas and concepts about what it should do, behave and look like, that will be understandable by the users in the manner intended"

Activity: Conceptual Model

- What is *your* conceptual model of a video recorder (*not* video player)?
  - Do you believe it is close to the actual design of such a system?
  - Do you know people who have an "interesting" conceptual model of a video recorder?

Activity: Mis-Conceptual Model

- Do you know examples of systems or devices for which some people have incorrect conceptual models?
  - This does not necessarily mean that those people are stupid!
  - Conceptual models should be largely independent of the actual technology used in the implementation of the system.

First steps in formulating a conceptual model

- What will the users be doing when carrying out their tasks?
- How will the system support these?
- What kind of interface metaphor, if any, will be appropriate?
- What kinds of interaction modes and styles to use?

  Always keep in mind when making design decisions how the user will understand the underlying conceptual model

Conceptual models

- Many kinds and ways of classifying them
- Here we describe them in terms of core activities and objects
- Also in terms of interface metaphors

Conceptual models based on activities

- Giving instructions
  - issuing commands using keyboard and function keys and selecting options via menus
- Conversing
  - interacting with the system as if having a conversation
- Manipulating and navigating
  - acting on objects and interacting with virtual objects
- Exploring and browsing
  - finding out and learning things

1. Giving instructions

- Where users instruct the system and tell it what to do
  - e.g. tell the time, print a file, save a file
- Very common conceptual model, underlying a diversity of devices and systems
  - e.g. CAD, word processors, VCRs, vending machines
- Main benefit is that instructing supports quick and efficient interaction
  - good for repetitive kinds of actions performed on multiple objects

2. Conversing

- Underlying model of having a conversation with another human
- Range from simple voice recognition menu-driven systems to more complex 'natural language' dialogues
- Examples include timetables, search engines, advice-giving systems, help systems
- Recently, much interest in *virtual agents*
  - Conversation with the user as interface,
  - e.g. Microsoft's Bob and Clippy, chatbots

Pros and cons of conversational model

- Allows users, especially novices and technophobes, to interact with the system in a way that is familiar
  - makes them feel comfortable, at ease and less scared

- Misunderstandings can arise when the system does not know how to parse what the user says
  - e.g. child types into a search engine, that uses natural language the question:

  "How many legs does a centipede have?" and the system responds:

You asked: How many legs does a centipede have?

Jeeves knows these answers:

Where can I find a definition for the math term **leg?** Ask!

Where can I find a concise encyclopedia article on **centipedes?** Ask!

Where can I see an image of the human **appendix?** Ask!

Why does my leg or other limb fall asleep? Ask!

Where can I find advice on controlling the garden pest **millipedes and centipedes?** Ask!

Where can I find resources from Britannica.com on **leg ?** Ask!

3. Manipulating and navigating

- Involves dragging, selecting, opening, closing and zooming actions on virtual objects
- Exploit's users' knowledge of how they move and manipulate in the physical world
- Exemplified by
  - what you see is what you get (WYSIWYG)
  - the **direct manipulation** approach (DM)
    - Shneiderman (1983) coined the term DM
    - came from his fascination with computer games at the time

Core principles of DM

- Continuous representation of objects and actions of interest
  - Objects don’t pop up and disappear frequently
- Physical actions and button pressing
  - instead of issuing commands with complex syntax
- Rapid reversible actions
  - immediate feedback on object of interest

Why are DM interfaces so enjoyable?

- Novices can learn the basic functionality quickly
- Experienced users can work extremely rapidly
  - carry out a wide range of tasks
  - defining new functions
- Intermittent users can retain operational concepts over time
- Error messages less rarely needed
- Users can immediately see if their actions are furthering their goals and if not do something else
- Users experience less anxiety
- Users gain confidence and mastery and feel in control

What are the disadvantages with DM?

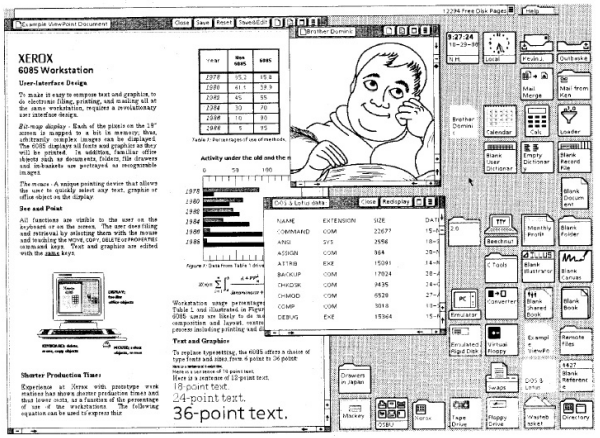
- Some people take the metaphor of direct manipulation too literally
- Not all tasks can be described by objects and not all actions can be done directly
- Some tasks are better achieved through delegating
  - e.g. spell checking
- Can become screen space 'gobblers'
- Moving a mouse around the screen can be slower than pressing function keys to do same actions
- Some tasks are more efficiently done in some other way

4. Exploring and browsing

- Similar to how people browse information with existing media
  - e.g. newspapers, magazines, libraries, pamphlets
- Information is structured for flexible search
  - multiple ways for a user to find information
  - e.g. multimedia, web

Conceptual models based on objects

- Usually based on an analogy with something in the physical world
  - Examples: books, tools, vehicles
- Classic: Xerox Star Interface based on office objects



Johnson et al (1989)

Lookahead: Metaphors

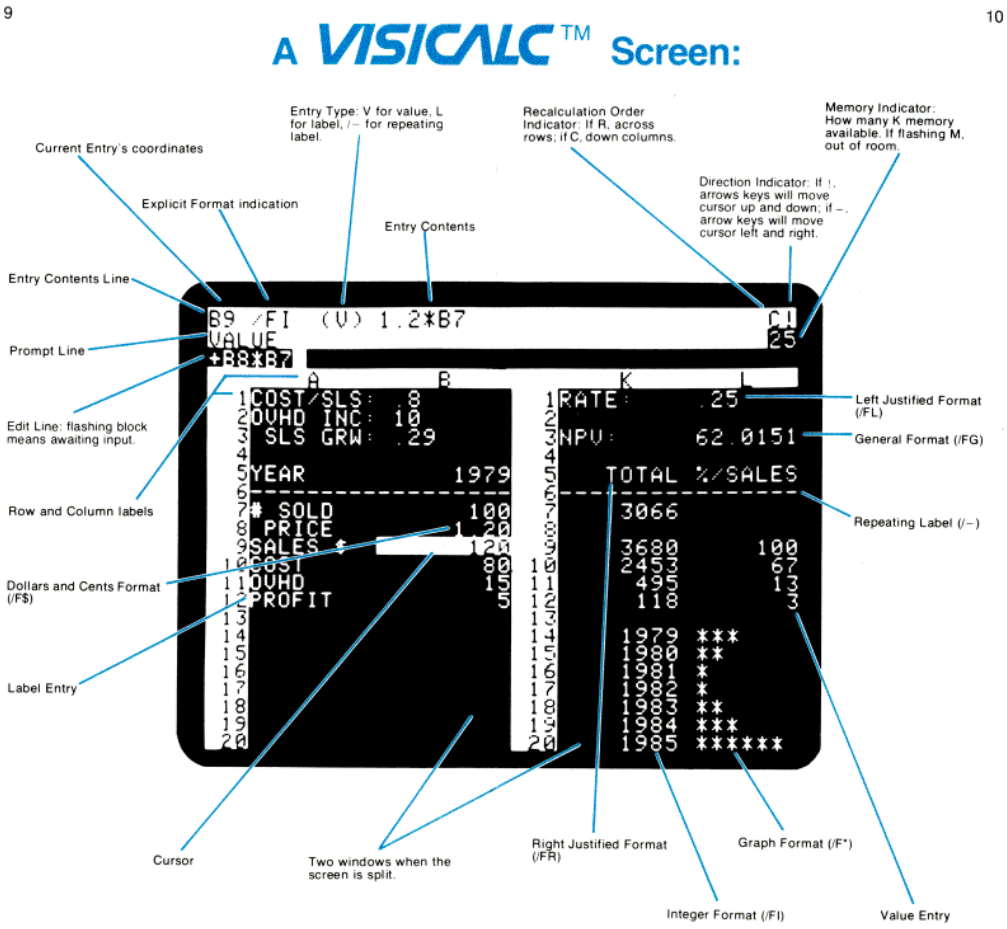
- What are commonly used metaphors associated with this type of computer interface?

Lookahead: Metaphors

- What are commonly used metaphors associated with this type of computer interface?
  - Desktop
  - Window
  - Folder
  - Garbage can

Another classic: the spreadsheet (Bricklin)

- Analogous to ledger sheet
- Interactive and computational
- Easy to understand
- Greatly extending what accountants and others could do



www.bricklin.com/history/refcards.htm

Which conceptual model is best?

- Direct manipulation
  - good for 'doing' types of tasks
    - designing, drawing, flying, driving, sizing windows
- Issuing instructions
  - good for repetitive tasks
    - spell-checking, file management
- Having a conversation
  - good for children, computer-phobic, disabled users and specialised applications
    - phone services

Hybrid conceptual models

- different ways of carrying out the same actions is supported at the interface
  - accommodates novices as well as experienced users
  - can take longer to learn
  - can be confusing
    - there may be subtle differences between the different ways of performing an action
    - may inhibit the formation of a conceptual model

Activity: Conceptual Model Showdown

- Compare different conceptual models for reading email
  - command-based
  - conversational
  - direct manipulation
  - user agent

Evaluation of Models

- Identify critical activities involved
- Formulate a set of scenarios
- Extract user needs, requirements
- Specify evaluation criteria
- Compare the different models

Interface metaphors

- Interface designed to be similar to a physical entity
  - e.g. desktop metaphor, web portals
  - the interface also has its own properties
- Can be based on activity, object or a combination of both
- Exploit user's familiar knowledge
  - helping them to understand 'the unfamiliar'
- Conjures up the essence of the unfamiliar activity
  - enabling users to to understand more aspects of the unfamiliar functionality

Benefits of interface metaphors

- Makes learning new systems easier
- Helps users understand the underlying conceptual model
- Can be very innovative
  - the realm of computers and their applications can become more accessible to a greater diversity of users

Problems with interface metaphors

- Break conventional and cultural rules
  - e.g. recycle bin placed on desktop
- Can constrain designers in the way they conceptualize a problem space
- Conflict with design principles
- Forces users to only understand the system in terms of the metaphor
- Designers can inadvertently use bad existing designs and transfer the bad parts over
- Limits designers' imagination in coming up with new conceptual models

Activity: Metaphors beyond the Desktop

- What are some metaphors unrelated to the “desktop” that are frequently used in computer interfaces?

Metaphors vs. Icons

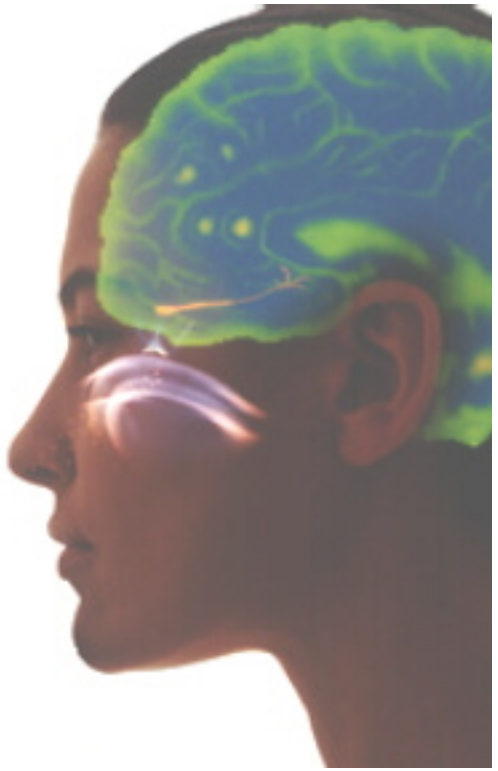
- What is the difference between *metaphors* and *icons*?
  - e.g. “trash can” as metaphor, vs. “trash can” icon

Conceptual models: from interaction mode to style

- Interaction mode:
  - what the user is doing when interacting with a system, e.g. instructing, talking, browsing or other
- Interaction style:
  - the kind of interface used to support the mode, e.g. speech, menu-based, gesture

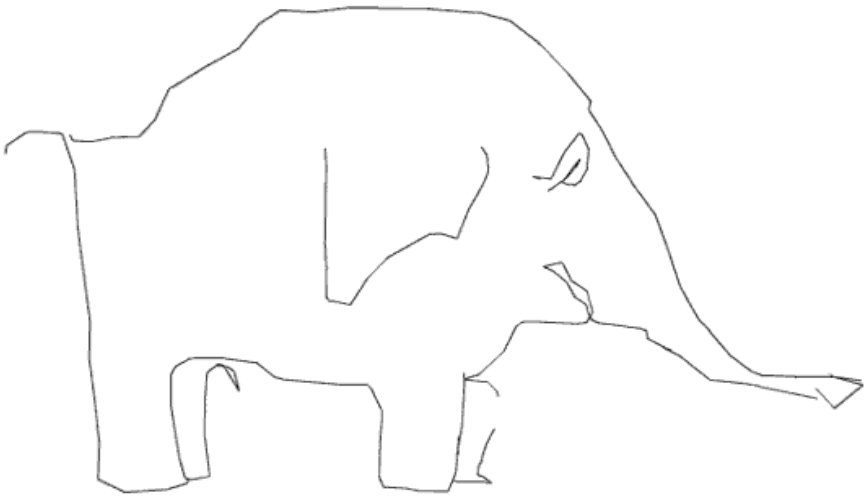
Many kinds of interaction styles available…

- Command
- Speech
- Data-entry
- Form fill-in
- Query
- Graphical
- Web
- Pen
- Augmented reality
- Gesture

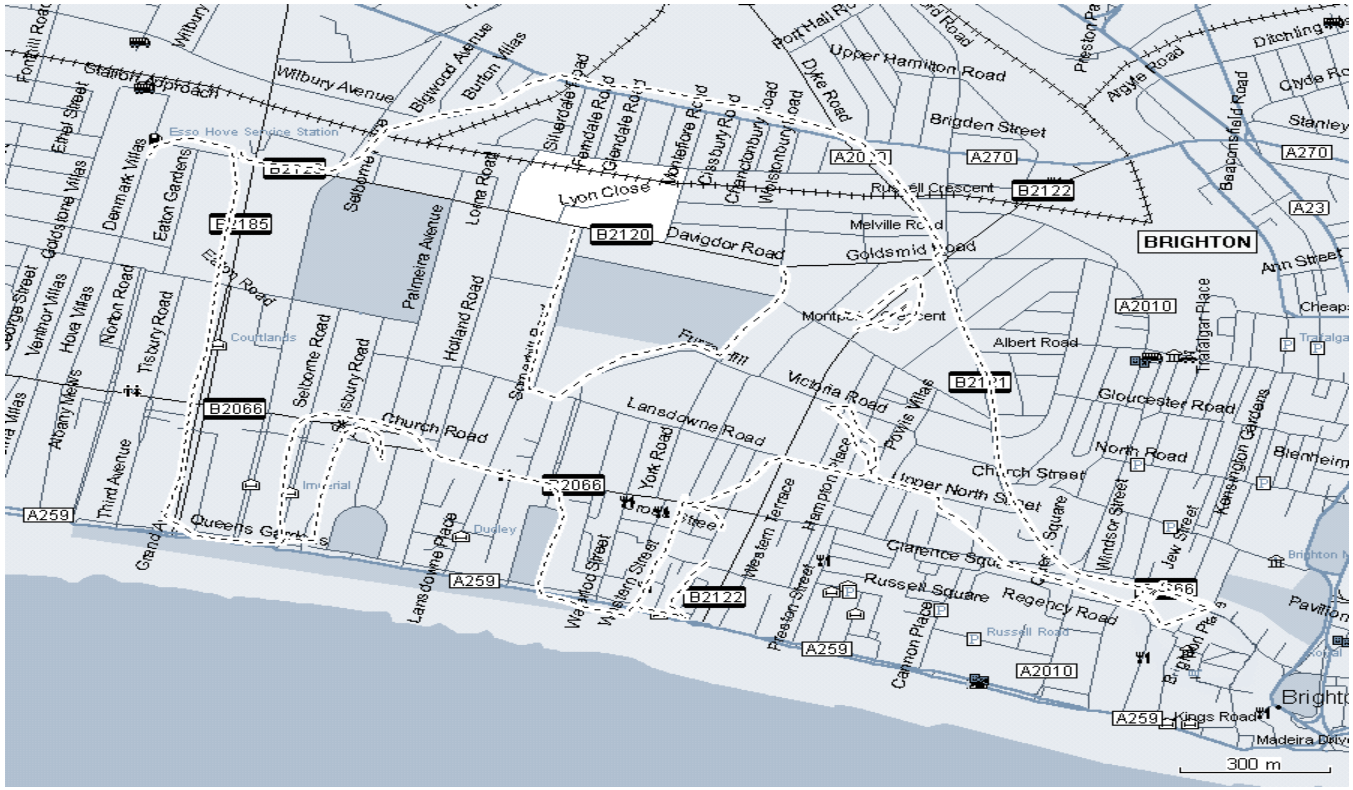


Interacting via GPRS enabled cell phone…

- Drawing an elephant by walking round the streets of a city (or other mode of transport) and entering data points along the way via the cell phone
- Example: Brighton and Hove (UK)
  - J. Wood by foot, track length 11.2km (see www.gpsdrawing.com fo



Making art by recording where walking in a city

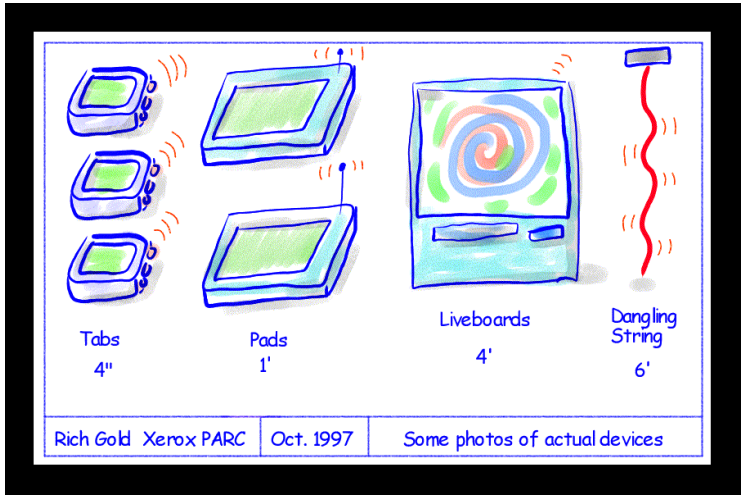


Which interaction style to choose?

- Need to determine requirements and user needs
- Take the budget and other constraints into account
- Also will depend on suitability of technology for activity being supported
- This topic will be covered more later when discuss how to actually design conceptual models

Interaction paradigms

- Another form of inspiration for conceptual models
- From the desktop to ubiquitous computing (embedded in the environment)

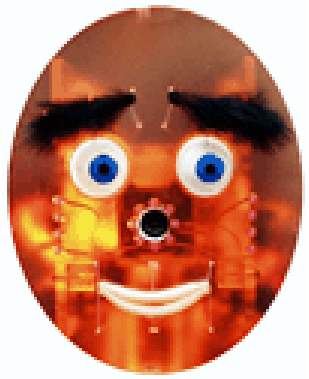


Examples of new paradigms

- Ubiquitous computing (mother of them all)
- Pervasive computing
- Wearable computing
- Tangible bits, augmented reality
- Attentive environments
- Transparent computing
  - and many more….

Two examples: BlueEyes (IBM) and Cooltown (HP)

- Visionary approaches for developing novel conceptual paradigms



Almalden.ibm.com/cs/blueeyes/

cooltown.hp.com/mpulse/backissues/0601/0601-cooltown.asp

Activity: TV Gourmet

- select only the best programs to view
- facets:
  - paper-based TV listings (“TV Guide”)
  - video *recorder* (not player)

Paper TV Guide

- Describe the conceptual model that underlies the design of a paper-based TV program listing.
  - e.g. TV Guide, or the little booklets that come with newspapers
- What are the main tasks, activities, and objects?
- What are the metaphors used in their design?
- What is the underlying conceptual model?
- What are the main interaction styles?

Video Recorder

- Describe the conceptual model for a video cassette recorder (VCR).
  - mainly the *recording* aspect, not the playing of pre-recorded tapes
- What are the main tasks, activities, and objects?
- What are the metaphors used in their design?
- What is the underlying conceptual model?
- What are the main interaction styles?

Intelligent Video Recorder

- Give an outline of the interaction design and user interface for a combination of program guide and a VCR.
  - conceptual model
  - tasks, activities, objects
  - metaphors
  - conceptual model
  - interaction styles

Activity: From Video Player to Music Player

- assume that we have developed a conceptual model of a computer-based video player with the following functionalities
  - keyword search (title, director, actor, …)
  - similarity-based search (genres, other users with similar preferences)
  - favorites (most often viewed)
- you've done usability testing on prototypes, and the users really like it

Activity cont.: Re-using Conceptual Models

- your boss is ecstatic, and suggests to use the same interface for a music player
- do you think that is a good idea?
  - if so, why; if not, what are the problems?

Summary points

- Important to have a good understanding of the problem space
- Fundamental aspect of interaction design is to develop a conceptual model
- Interaction modes and interface metaphors provide a structure for thinking about which kind of conceptual model to develop
- Interaction styles are specific kinds of interfaces that are instantiated as part of the conceptual model
- Interaction paradigms can also be used to inform the design of the conceptual model