Conceptual Models

CS160: User Interfaces
John Canny
• Too many tabs – take up lots of screen space
• Tab layout reorganized every time user clicks on one
• Unclear if OK corresponds to single tab or to whole dialog
Always keep files checked out
Act on projects recursively
Many tabs are hidden
Have to scroll through to see all tabs
- Can fit in many more options vertically
- Layout never changes (selecting one does not affect others)
Review

Tangible Interfaces

• Graspable widgets
• Motion input/output
• Real-world image capture
Topics

• Affordances
• Conceptual Models
• Design Principles
• Metaphors
Affordances
“... the term **affordance** refers to the *perceived* and *actual* properties of the thing, primarily those fundamental properties that determine just how the thing could possibly be used.

Some affordances obvious
- Knobs afford turning
- Buttons afford pushing
- Glass can be seen through

Some affordances learned
- Glass breaks easily
- Floppy disk
  - Rectangular – can’t insert sideways
  - Tabs prevent backwards insertion

*The Design of Everyday Things. 1988. Don Norman*
Door Handles

Affordances suggest how to use the object
Door Handles

Affordances suggest how to use the object
Affordances

Clues about how object/interface works
Affordances

Clues about how object/interface works

Affordances

– holes for insertion of fingers
– blades for cutting

Implications clear for how operating parts work
Affordances

Clues about how object/interface works or doesn’t

Teapot

Screw
Dependencies

Affordances suggest how to use the object

Can be dependent on the
  – Experience
  – Knowledge
  – Culture
Cultural Dependencies

Affordances suggest how to use the object

Can be dependent on the
– Experience
– Knowledge
– Culture
  • Switches (US down=off, UK down=on)
  • red = danger, green = go

Can make an action easy/difficult
Perceived Affordances

Affordances suggest how to use the object

Can be dependent on the
  – Experience
  – Knowledge
  – Culture of the actor

Can make an action easy/difficult

Affordances may be perceived without actually existing
Game controller affordances

Wii remote, roughly flashlight sized, easy to grip the right way.

Roughly the diameter of a tennis racket/baseball bat/golf club

“Trigger” button underneath falls under the index finger.

Most-used buttons are thumb- or index-finger operated.
Game controller affordances

But the Wii remote also supports two-handed use.

In this position, the main select “A” button falls under the left hand. The right hand button replaces it.

Main select doesn’t work in older Nintendo games. This takes some getting used to…
Screen-Based Interfaces

Physical affordances

- Screen, pointing device, physical buttons, keyboard
- These afford touching, pointing, looking, clicking on every pixel
Screen-Based Interfaces

Physical affordances
- Screen, pointing device, selection buttons, keyboard
- These afford touching, pointing, looking, clicking on every pixel

Physical affordances of screens often unused
- Screen affords touching, but most screens are not touch sensitive
Designer Controls Perceived Affordances

What are the affordances of these graphical objects?
Do Graphical Objects Afford Clicking?

- Graphical design emphasizes affordances
- Does user recognize object as a button to be clicked?
Well-designed widgets have clear affordances

e.g. resize handles:

crop handles:

motion arrows
Conceptual Models
Mental Representations

Users’ understanding of how interface works

People have preconceived models
- Infix vs. postfix calculators
- Delete file by dragging into trash can

Changing mental models can be difficult
Interfaces Must Communicate Model

Online help / documentation useful (but shouldn’t be necessary)
Refrigerator

Problem: freezer too cold, but fresh food just right
# Refrigerator Controls

**What is your conceptual model?**

<table>
<thead>
<tr>
<th>Setting</th>
<th>Freezer</th>
<th>Fresh Food</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal Settings</td>
<td>C and 4</td>
<td>C and 5-6</td>
</tr>
<tr>
<td>Colder Fresh Food</td>
<td>C and 5-6</td>
<td>B and 7</td>
</tr>
<tr>
<td>Coldest Fresh Food</td>
<td>B and 7</td>
<td>D and 6-7</td>
</tr>
<tr>
<td>Colder Freezer</td>
<td>D and 6-7</td>
<td>C and 3-1</td>
</tr>
<tr>
<td>Warmer Fresh Food</td>
<td>C and 3-1</td>
<td>0</td>
</tr>
<tr>
<td>OFF (both)</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

What is your conceptual model?
Most Likely Conceptual Model

Independent Controls

cooling unit

A B C D E

7 6 5 4 3
Correct Conceptual Model

Possible solutions:
- Make controls map to user’s model *
- Make controls map to actual system
Conceptual Models

- Designers model may not match user’s model
- Users get model from experience & usage
  - Users only work with system image, not with designer
- What if the two models don’t match?
Mismatches between models

- Errors
- Slow
- Frustration
- ...

![Image of a frustrated person kicking a monitor and a calculator]

*Note: The image includes a person who appears to be frustrated, kicking a monitor and a calculator.*
Preconceived Models

People have preconceived models of how things work:
- how does your car start?
- how does an ATM machine work?
- how does your computer boot?

Allows us to predict how things will work or not work

Based on slide by Saul Greenberg
Preconceived Models

People have preconceived models of how things work:

– how does your car start?
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Allows us to predict how things will work
Preconceived Models Often Wrong!

Extracted from fragmentary evidence
  – Turn thermostat up above final setting to heat room up faster.

People find ways to explain things
  – Computer terminal breaks when accessing the library catalog
  – Certain you’re driving on the correct road
Design Principles
1. Make Controls Visible
Poor Visibility (BMW’s iDrive)

Don Norman’s critique is here.
Poor Visibility (BMW’s iDrive)

Single control to access 700 parameters.

Large display shows choices
- Full visual attention required
- Heavy use of abbreviations:
  - “DSC/DTC” “BC” etc
- Mapping inconsistent, sometimes turn left to move right.
How do you put someone on hold?
How do you set the alarm?
Too Much Visibility?

6 remote controls for “modest” home theater
2. Make Sure Mapping is Clear

Mapping: Relationship between controls and their result

Mercedes Seat Adjustment
Front-back audio balance
Does it control moving sound left/right or front/back?
Stovetop Controls

- **arbitrary**: 24 possibilities, requires:
  - visible labels
  - memory

- **paired**: 2 possibilities per side
  - 4 total possibilities

- **full mapping**:
Transfer Effects

People transfer expectations from known objects to similar new ones
- Positive: previous experience applies to new situation
- Negative: previous experience conflicts with new situation
What happens when disk is dragged onto trash can?
3. Provide Feedback

People press >> 1 time
- Unclear if system has registered the button press
Elevator buttons light up → reducing multiple presses
Poor Feedback

Took a day for refrigerator to adjust to new settings
Direct Manipulation

Use one-to-one “identity” mappings.
Hand action = object action

First demonstrated in Sutherland’s Sketchpad

Literal DM is hard to do without a pen interface, in fact tangible interfaces the only real examples

But interfaces can be DM from the mouse pointer onward – the mouse interface doesn’t require any more learning.
Metaphor

Definition
The transference of the relation between one set of objects to another set for the purpose of brief explanation.

Lakoff & Johnson
– “...the way we think, what we experience, and what we do every day is very much a matter of metaphor."
– in our language & thinking - “argument is war”
  • ...he attacked every weak point
  ... criticisms right on target
  ... if you use that strategy

Metaphors can highlight some features, suppress others
– There is some systematicity to the transference
Interface Metaphors

Purpose
- Function as natural models
- Leverages knowledge of familiar, concrete objects/experiences
- Transfer this knowledge to abstract tasks and concepts

Problem
- Inaccurate or naive conceptual model of the system

A presentation tool is like a slide projector
The Painting Metaphor
The Desktop Metaphor

Started at Xerox PARC
- Xerox Star
- Bitmapped screens made it possible
- Windows, Folders
- Document actions: open, edit,…

Not meant to be a real desktop
- Idea is to organize information in a way to allow people to use it in the way they use information on their desktops
- Allow windows to overlap – make the screen act as if there were objects on it
Noun-Verb VS Verb-Noun

Noun-Verb: Select object, *then* do action
- Emphasizes 'nouns' (visible objects) rather than 'verbs' (actions)

Advantages
- Closer to real world
- Modeless interaction
- *Actions* always within context of object
  - inappropriate ones can be hidden
- *Generic commands*
  - the same type of action can be performed on the object
  - e.g. drag ‘n drop:
Bob’s “Living Room” Metaphor
Apple’s Cyberdog
Metaphor Caveats

Too limited
- The metaphor restricts interface possibilities

Too powerful
- The metaphor implies the system can do things it can’t

Too literal or cute
- Makes it difficult to understand abstract concept

Mismatched
- The metaphor conveys the wrong meaning
Summary

Conceptual model is the user’s mental model of how the interface works

Perceived affordances help users form this model

Designers must provide clues in system to make conceptual model clear
- Make controls visible
- Make sure mapping is clear
- Provide feedback