Conceptual Models & Interface Metaphors

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Interface Hall of Fame or Shame?

- Tabbed dialog for setting options in MS Web Studio
  - more tabs than space to display them
- Clicking on the right arrow once gives:

Outline

- Review
- Meetings
- Design of Everyday Things
- Conceptual models
- Interface metaphors
- Ubiquitous computing

Human Abilities Review

- Color can be helpful, but pay attention to:
  - how colors combine
  - limitations of human perception
  - people with color deficiency
- Model Human Processor:
  - perceptual, motor, cognitive processors + memory
  - model allows us to make predictions
    - e.g., perceive distinct events in same cycle as one
- Memory:
  - three types: sensor, WM, & LTM
  - interference can make hard to access LTM
  - cues in WM can make it easier to access LTM
- Key time to remember?
  - 100 ms (processor cycle time & memory access)
- Fitts' Law:
  - moving hand is a series of microcorrections predicted by D & S
    - \( T_{\text{pos}} = a + b \log_2 (D/S + 1) \)
    - time to move hand depends only on relative precision required
Design of Everyday Things

- By Don Norman (UCSD, Apple, HP, NN Group)
- Design of everyday objects illustrates problems faced by designers of systems

- Explains conceptual models
  – doors, washing machines, digital watches, telephones, ...
- Resulting design guides

→ Highly recommend this book

Conceptual Models

- Mental representation of how an artifact works & how interface controls affect it
- People may have preconceived models that are hard to change
  – (4 + 5) vs. (4 5 +)
  – dragging to trash?
    • deletes file but ejects disk
- Interface must communicate model
  – visually (& possibly physically or using sound)
  – online help and documentation can help, but shouldn’t be necessary

Affordances as Perceptual Clues

- Well-designed objects have affordances
  – clues to their operation
  – often visual, but not always (e.g., speech)

What affordances do you see here?

Affordances as Perceptual Clues

- Poorly-designed objects
  – no clues or misleading clues

French artist Jacques Carelman
Crazy design for a screw punch!

Affordances as Perceptual Clues

Refrigerator

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

- Normal Settings: C and 5
- Colder Fresh Food: C and 6-7
- Coldest Fresh Food: B and 8-9
- Colder Freezer: D and 7-8
- Warmer Fresh Food: C and 4-1
- OFF (both): O

What is your conceptual model?

A Common Conceptual Model

- Independent controls

Actual Conceptual Model

- Can you fix the problem?
- Possible solutions
  - make controls map to customer’s model
  - make controls map to actual system

Design Model & Customer Model

- Customers get model from experience & usage
  - through system image
- What if the two models don’t match?

Conceptual Model Mismatch

- Mismatch between designer’s & customer’s conceptual models leads to...
  - slow performance
  - errors
  - frustration
  - ...

Notorious Example
**Design Guides**

- Provide good conceptual model
  - customer wants to understand how UI controls impact object
- Make things visible
  - if object has function, interface should show it
- Map interface controls to customer’s model
  - infix vs. postfix calculator – whose model is that?
- Provide feedback
  - what you see is what you get! (WYSIWYG)

**Make Things Visible**

- Refrigerator
  - make the A..E dial something about percentage of cooling between the two compartments?
- Controls available on watch w/ 3 buttons?
  - too many and they are not visible!
- Compare to controls on simple car radio
  - #controls = #functions
  - controls are labeled (?) and grouped together

**Map Interface Controls to Customer’s Model**

- Which is better for car dashboard speaker front / back control?
- Control should mirror *real-world*

**Map Interface Controls to Customer’s Model**

- Stove with burners and knobs
Metaphor

- **Definition**
  - “The transference of the relation between one set of objects to another set for the purpose of brief explanation.”
- **Lakoff & Johnson, Metaphors We Live By**
  - “…the way we think, what we experience, and what we do every day is very much a matter of metaphor.”
  - “argument is war”
  - “… be attacked every weak point … criticisms right on target … if you use that strategy
- We can use metaphor in interface design to leverage existing conceptual models

Desktop Metaphor

- Suggests a conceptual model
  - not really an attempt to simulate a real desktop
  - a way to explain why some windows seemed blocked
  - leverages existing knowledge about files, folders, & trash

Example Metaphors

- **Global metaphors**
  - personal assistant, wallet, clothing, pens, cards, telephone, eyeglasses
- **Data & function**
  - rolodex, to-do list, calendar, applications documents, find, assist
- **Collections**
  - drawers, files, books, newspapers, photo albums

How to Use Metaphor

- Develop interface metaphor tied to conceptual model
- Communicate that metaphor to the user
- Provide high-level task-oriented operations, not low-level implementation commands

Is Consistent Always Better? NO

- PDA example: should “new appointment” & “delete appointment” be in the same place?
- New (add) is common, but delete is not
Is Consistent Always Better? NO

Firefox 3 Back/Forward Buttons

Ways of Being Consistent

- Interfaces should be consistent in a meaningful way
  - E.g., ubiquitous use of same keys for cut/copy/paste
- Types of consistency
  - consistent internally
    - e.g., same terminology and layout throughout
  - consistent with other apps
    - ex. works like MS Word, uses keyboard conventions
  - design patterns (across many apps)
  - consistent with physical world

Summary

- Conceptual models
  - mental representation of how the object works & how interface controls effect it
- Design model should equal customer’s model
  - mismatches lead to errors
  - use customer’s likely conceptual model to design
- Design guides
  - make things visible
  - map interface controls to customer’s model
  - provide feedback

Further Reading

- Design of Everyday Things, Donald Norman
- Design as Practiced, Donald Norman
  - Talks about failure to make changes to Macintosh
- Computing the Case Against User Interface Consistency, Jonathan Grudin
  - Talks about why interfaces should not always be consistent
  - http://www1.ics.uci.edu/~grudin/Papers/CACM89/CACM89.html

Ubiquitous Computing?

Context-Awareness

- Modern computers divorced from our reality
  - unaware of who, where, and what around them
  - mismatch between expectations and functionality
  - also limits what we can do with computers
- Context-Aware Computing
  - one line of ubiquitous computing research
  - making computers more aware of the physical and social situations they are embedded in
**Why Context-Aware Computing?**

<table>
<thead>
<tr>
<th>Existing Examples</th>
<th>Context Types</th>
<th>Human Concern</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auto Lights On / Off</td>
<td>Room Activity</td>
<td>Convenience</td>
</tr>
<tr>
<td>File Systems</td>
<td>Personal Identity &amp; Time</td>
<td>Finding Info</td>
</tr>
<tr>
<td>Calendar Reminders</td>
<td>Time</td>
<td>Memory</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Potential Examples</th>
<th>Context Types</th>
<th>Human Concern</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tag Photos</td>
<td>Location</td>
<td>Finding Info</td>
</tr>
<tr>
<td>Health Alert</td>
<td>History</td>
<td>Safety</td>
</tr>
<tr>
<td>Service Fleet Dispatching</td>
<td>Activity  Proximity</td>
<td>Efficiency</td>
</tr>
</tbody>
</table>

**Technology Trends**

- **Location, Location, Location**
  - FCC’s E911, location for cell phones
- **Lots of potential apps here**
  - electronic tour guides
  - locating restaurants / gas stations / etc
  - keeping track of a group of friends
  - location-based games
- **But many technological barriers as well**
  - reliability
  - indoor location

**Sample Context-Aware Apps**

**ParcTabs**

- **Proximate selection**
  - display nearby objects
- **Auto-diaries**
  - people, places, and time
- **Triggers**
  - remind me to talk to John next time I see him
  - turn off oven when I leave
  - notify me on new coffee

**Sample Context-Aware Apps**

**ParcTabs**

<table>
<thead>
<tr>
<th>Name</th>
<th>Room</th>
<th>Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>caps</td>
<td>35-2-2-00</td>
<td>200 ft</td>
</tr>
<tr>
<td>claudia</td>
<td>35-2-1-08</td>
<td>30 ft</td>
</tr>
<tr>
<td>perfector</td>
<td>35-2-3-01</td>
<td>20 ft</td>
</tr>
<tr>
<td>snoball</td>
<td>35-2-1-03</td>
<td>100 ft</td>
</tr>
</tbody>
</table>

**Subject Field**

**Filter Field**

**Title Line**

**Mike's Biography**
Sample Context-Aware Apps

ParcTabs

Xerox PARC
Want, Schilit, et al

- Proximate selection
  - display nearby objects
- Auto-diaries
  - people, places, and time
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Ambient Interfaces

Ambient bus display (Mankoff)

Ambient Devices stock orb

Next Time

- Heuristic Evaluation
- Read
  - Lewis & Riemann 4.3-4.4
  - Nielsen HE chapter (read 5 links under "Jakob Nielsen’s Online Writings on Heuristic Evaluation")