CSE 440: Introduction to HCI
User Interface Design, Prototyping, and Evaluation

Lecture 02:
Design of
Everyday Things

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Tuesday / Thursday
10:30 to 11:50
Today

Examining a Design Process

Administrative

Section Balance and Movement
Assignment 0
Assignment 1a

Design of Everyday Things
Examining a Design Process

By example:

A video from the 90s about a shopping cart with no bottom
ABC News and IDEO’s Deep Dive

http://courses.cs.washington.edu/courses/cse440/videos/design/IDEO-DeepDive.mp4
Today

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Assignment 0
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Design of Everyday Things
Assignment 0: Flash Card

Name
  formal, preferred, pronouns
Majors/Minors
  Career goals
Year
  1, 2, 3, 4, 5, 6, ...
Hometown

Interesting Fact or “What I did on my …”

Submit PDF via Canvas
Today

Examining a Design Process

Administrative

Section Balance and Movement
Assignment 0
Assignment 1a

Design of Everyday Things
Design Terminology

Design of Everyday Things reviews a common and useful vocabulary of design.

We will use these in feedback and conversations without even realizing that we are doing it.

You should know these terms and recognize them in practice.
Norman’s Execution-Evaluation Cycle

1. Establish the goal.
2. Form the intention.
3. Specify the action sequence.
4. Execute the action sequence.
5. Perceive the system state.
6. Interpret the system state.
7. Evaluate the system state with respect to the goals and intentions.
Turning on the Light

1. Establish the goal
   Increase light in the room
2. Form the intention
   To turn on the lamp
3. Specify the action sequence
   Walk to the lamp, reach for the knob, twist the knob
4. Execute the action sequence
   [walk, reach, twist]
5. Perceive the system state
   [hear “click” sound, see light from lamp]
6. Interpret the system state
   The knob rotated. The lamp is emitting light. The lamp seems to work
7. Evaluate the system state with respect to the goals and intentions
   The lamp did indeed increase the light in the room [goal satisfied]
Norman’s Execution-Evaluation Cycle

- Goals
  - Evaluate Goals
  - Interpret State
  - Observe State
  - System Change
- Form Intention
  - Develop Action Plan
  - Execute Actions
- Action Plan

Norman’s Execution-Evaluation Cycle

Gulf of Execution

→ Goals

Form Intention

Evaluate Goals

Interpret State

Observe State

System Change

Execute Actions

Gulf of Evaluation

Develop Action Plan
Bridging the Gulfs

Gulf of Execution: “How do I do it?”

Commands and mechanisms need to match the goals, thoughts, and expectations of a person

Gulf of Evaluation: “What does it mean?”

Output needs to present a view of the system that is readily perceived, interpreted, and evaluated

People build mental models to anticipate and interpret system response to their actions

What can I do?        How do I do it?
What result will it have?    What is it telling me?
Cooper’s Mental Model Terminology

Implementation Model
How it works
(Design Model, Designer’s Conceptual Model)

Manifest Model
How it presents itself
(System Image)

Mental Model
How a person thinks it works
(User Model, User’s Conceptual Model)
Cooper’s Mental Model Terminology

- **Implementation Model**
  - How it works
  - (Design Model, Designer’s Conceptual Model)

- **Manifest Model**
  - How it presents itself
  - (System Image)

- **Mental Model**
  - How a person thinks it works
  - (User Model, User’s Conceptual Model)

These terms are sloppy and ambiguous out in the world.
Designer projects their model into an artifact

Person forms their model based on interaction

People struggle until model matches manifest model

Update mental model in response to breakdowns

Matching the implementation model is not necessary
Mental Models

Problem: freezer too cold, fresh food just right
Manifest Model

What if I want to make just the freezer warmer?
A Sensible Mental Model

“The Freezer Control controls the freezer temperature and the Fresh Food Control controls the fresh food temperature”
The Implementation Model
A Problem with Feedback

1. Set both controls.
2. Allow 24 hours to stabilize.
Why is there a problem?

Can you fix the problem?
The Implementation Model

Why is there a problem?

Cost constraints

Can you fix the problem?

Make controls correspond to a person’s mental model

Make controls correspond to the implementation model

“Design depends largely on constraints.”
Charles Eames
Building the Right Model

Having the right model helps people bridge the Gulf of Execution and the Gulf of Evaluation

How can we help people build the right models:

- Affordances
- Visibility
- Constraints
- Consistency
- Metaphors
- Knowledge in the World
- Mapping
- Modes
Affordances

Visual clue to interaction

- knobs afford turning
- levers afford moving
- buttons afford pushing
Affordances

“The affordances of the environment are what it offers animals, what it provides or furnishes, for good or ill.”

Gibson, ecological approach to psychology

“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.”

Norman
What’s the Affordance?
Affordances

AN
AFFORDANCE
Affordances

Technology affordances are often based in affordances from the physical world
Affordances

What is the affordance here?

Where does it come from?
Affordances

What is the affordance here?

Where does it come from?
Sequential Affordance

Acting on a perceptible affordance leads to information indicating new affordances

---

A.  B.  C.

Figure 4. Sequential affordances: one affordance leads to another. Visual information indicates grasping (A & B); tactile information indicates turning (B & C).
Sequential Affordance

Acting on a perceptible affordance leads to information indicating new affordances

Figure 4. Sequential affordances: one affordance leads to another. Visual information indicates grasping (A & B); tactile information indicates turning (B & C).

Now does the door push or pull?
Nested Affordances

Affordances due to spatial relationships revealing what actions can be done

Proximate to, contained in, part of
In Other Words

An affordance is what a thing communicates about how it can be used, often by its appearance.

“In general, when the apparent affordances of an artifact matches its intended use, the artifact is easy to operate. When apparent affordances suggest different actions than those for which the object is designed, errors are common.”

Gaver

Challenges arise if there is a mismatch between implied use versus intended use.
False Affordances

When there is perceptual information suggesting an implied use that does not exist

(Just an image of a button, not one that responds)
False Affordances
False Affordances
False Affordances
False Affordances
Hidden Affordances

When there is no perceptual information suggesting an actual intended use
Hidden Affordances
Hidden Affordances

Logos linking to home is a convention, but not afforded by the page.
Confusion of the Term

“Note also that affordances are not intrinsic, but depend on the background and culture of users. Most computer-literate user will click on an icon. This is not because they go around pushing pictures in art galleries, but because they have learned that this is an affordance of such objects in a computer domain…”

Dix

I disagree. Icons do not afford “pushability” or “clickability” by their attributes. They do not give an indication of their intended use, except by convention.
Clarification on Convention

“Designers sometimes will say that when they put an icon, cursor, or other target on the screen, they have added an ‘affordance’ to the system. This is a misuse of the concept. … It is wrong to claim that the design of a graphical object on the screen ‘affords clicking.’ … Yes, the object provides a target and it helps the user know where to click and maybe even what to expect in return, but those aren’t affordances, those are conventions, and feedback, and the like. … Don’t confuse affordances with conventions.”

Norman
Metaphors

Suggest an existing mental model

“horseless carriages”, “iron horses”, “wireless”

Desktop metaphor

Not an attempt to simulate a real desktop
Leverages knowledge of files, folders, trash
Explains why some windows seem hidden
Metaphors

Suggest an existing mental model

“horseless carriages”, “iron horses”, “wireless”

Desktop metaphor

Not an attempt to simulate a real desktop

Leverages knowledge of files, folders, trash

Explains why some windows seem hidden
Mail Metaphor
Calendar Metaphor
Health Metaphor

Inform VirusScan how to respond when a virus is detected.

When a virus is found:
- **Clean infected files automatically**

This option instructs VirusScan to clean files automatically.

If the above Action fails:
- **Move infected files to a folder**

This option instructs VirusScan to automatically move all infected files to the quarantine folder. The location of the quarantine folder is configured on the "General" tab under "General Settings".
Shallow or Inappropriate Metaphors

Informs a small range of possibilities, or none at all

It is just a menu and a dialog box?
What does the living room add?

Magic Cap

Microsoft Bob
Mixed Metaphors

Two or more different metaphors coexist with some supposed relation

The desktop metaphor
Windows into content

Good? Bad? Neither? Both?

Windows are views into larger content regions
No desktop has windows
Broken Metaphors

Are not consistent, do not operate in every circumstance, or do not uphold things consistent with what the metaphor would suggest.
Mechanical-Age Metaphors

Operate as their mechanical-age counterparts did, not taking advantage of the digital domain to escape the limitations of the original
Dead Metaphors
Lost the original imagery of their meaning

- Milk
- Butter
- Cheese
- Water
- Beer
- Wine
Metaphors versus Idioms

Idioms
- rely on shared experience or custom
- are learned, often early in life
- are supported or revealed by context
- become conventions
- do not rely on metaphors

Idiomatic widgets (e.g., screen splitter, draggable title bar)

Single click to select, double click to open

Hyperlinks
Idioms

Star Trek IV: Scotty Uses a Mouse
Idioms

Star Trek IV: Scotty Uses a Mouse
Metaphors and Affordances

Affordances “jump start” a model for interaction
Metaphors “jump start” a model of a system

But if designed poorly, both can be damaging

Lead to an incorrect model, undermine interaction
Can limit designer creativity
Can reduce the advantages of software
Can be “cute” at the expense of functional
Visibility

Phones

How do you

put somebody on hold

change volume
Visibility

Location of Controls

- Headset Jack (p. 28)
- One-Touch Auto Dial Buttons (p. 20)
- Display (p. 5)
- TONE Button (p. 24)
- MIC (Microphone) (p. 13)
- VOLUME Buttons (p. 14, 29)
- MUTE Button (p. 18, 22, 24)
- AUTO Button (p. 16)
- PROGRAM Button (p. 9, 16, 20)
- REDIAL/PAUSE Button (p. 14, 25)
- SP-PHONE (Speakerphone)/HEADSET Button and Indicator (p. 13, 15, 29)

Display

<table>
<thead>
<tr>
<th>Display</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>01-30</td>
<td>During a conversation, the call duration is displayed. (Example: 15 minutes, 30 seconds)</td>
</tr>
<tr>
<td>Press 1</td>
<td>The unit is in the programming mode (p. 9, 16, 20).</td>
</tr>
<tr>
<td>Press 2</td>
<td>The AUTO button was pressed while dialing or storing phone numbers for the Speed Dialer (p. 16, 19).</td>
</tr>
<tr>
<td>Press 3</td>
<td>The LOWER button was pressed (p. 21, 23).</td>
</tr>
<tr>
<td>Press 4</td>
<td>The ringer is set to OFF (p. 10).</td>
</tr>
<tr>
<td>Press 5</td>
<td>The MUTE button was pressed during a conversation (p. 24).</td>
</tr>
<tr>
<td>Press 6</td>
<td>The dial lock mode is set. To cancel the mode, see page 27.</td>
</tr>
<tr>
<td>Press 7</td>
<td>The FLASH button was pressed while storing phone numbers.</td>
</tr>
<tr>
<td>Press 8</td>
<td>The PAUSE button was pressed while dialing or storing phone numbers.</td>
</tr>
<tr>
<td>Press 9</td>
<td>You pressed [9] while dialing or storing phone numbers in the TONE mode.</td>
</tr>
<tr>
<td>Press 10</td>
<td>You pressed [10] while dialing or storing phone numbers in the TONE mode.</td>
</tr>
<tr>
<td>Press 11</td>
<td>While storing a phone number in an UPPER memory location for the One-Touch Dialer, “*” will appear when you press a one-touch auto dial button (p. 20).</td>
</tr>
<tr>
<td>Press 12</td>
<td>While storing a phone number in a LOWER memory location for the One-Touch Dialer, “*” will appear when you press a one-touch auto dial button (p. 21).</td>
</tr>
<tr>
<td>Press 13</td>
<td>The MUTE button was pressed as a secret button while storing phone numbers (p. 18, 22).</td>
</tr>
<tr>
<td>Press 14</td>
<td>While programming function items, such as the dialing mode, “*” will flash as a cursor.</td>
</tr>
</tbody>
</table>
Visibility

Changing Ringer Volume

Press “Program”
Press “6”

Set Volume

Low - Press “1”
Medium - Press “2”
High - Press “3”

Press “Program”
Visibility

Controls available on watch with 3 buttons?
  Too many and they are not visible

Compare to controls on simple car radio
  Number of controls ≈ Number of functions
  Controls are labeled and grouped together
Knowledge in the World

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
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<tr>
<td>F</td>
<td>G</td>
<td>H</td>
<td>I</td>
<td>J</td>
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<td>K</td>
<td>L</td>
<td>M</td>
<td>N</td>
<td>O</td>
</tr>
</tbody>
</table>
Constraints

Prevent some actions while allowing others

Prevent errors before they can happen

Disruptive error messages are a last resort
Constraints
Constraints
Constraints
Mapping

Correspondence between an interface and the corresponding action in ‘the world’

Minimize cognitive steps to transform action into effect, or perception into comprehension (i.e., execution and evaluation)
Very Bad Mapping
Slightly Better Mapping
Good Mapping
Not this Stove
Great Mapping
Mapping

Removing the cover plate, then removing and swapping the switches.

Mapping
Mapping

- Height adjustment
- Lumbar support adjustment
- Horizontal seat adjustment

[Diagram of seat adjustments]
Mapping
Mapping
Consistency

Interfaces should be meaningfully consistent

Ubiquitous use of same keys for cut/copy/paste

Types of consistency

Internal (i.e., within itself)
- e.g., same terminology and layout throughout

External (i.e., with other applications)
- e.g., common widget appearance
- e.g., design patterns common across applications
Is Consistent Always Better?

Should “new” & “delete” be in the same place?
Is Consistent Always Better?

Should “new” & “delete” be in the same place?

New is common, delete is not
Is Consistent Always Better?

Original focus on consistency, later design for mobile form
Is Consistency Always Better?
Is Consistency Always Better?
Is Consistency Always Better?
Modes

Modes force people to divide their model

- Mode $A_0$
- Mode $A_1$
- Mode $B$
Active versus Passive Modes

Active modes require constant action to maintain
   When that action has ended, so does the mode
   e.g., Shift

Passive modes require action to set, and a separate action to unset, or to set again
   e.g., CAPS LOCK

Active modes are generally preferred
Standardization

If all else fails, standardize
Fewer things to memorize
Reduced learning time
Adapt to new situations faster

e.g., keyboard layout not optimal, but standard
Norman’s Seven Principles for Design

Use knowledge in the head and in the world
Simplify the structure of tasks
Making things visible
Get the mappings right
Exploit the power of constraints
Design for error
When all else fails, standardize
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