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

Lecture 02: Design of Everyday Things



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James Fogarty Daniel Epstein Brad Jacobson King Xia

Tuesday/Thursday 10:30 to 11:50 MOR 234

Today

Calendar Overview

- Proposals, Bidding, Teams
- Reading
- Travel
- **Quarter Overview**
- Assignment 0

Design of Everyday Things



Assignment 0: Flash Card

Name (formal & informal)

Majors/Minors

Year (1,2,3,4,5,6,...)

Hometown

Interesting Fact or "What I did on my ..."



Submit PDF to Catalyst





What is Interaction?

Two-Way

one-way is a reaction

Communicative

information is sent

Receptive

information is received

Effective

the parties are changed as a result



What is Interaction?

Knocking over a chair

Two-Way Communicative Receptive Effective

- Clicking a Submit button on a web page
- Two televisions, turned on, facing each other
- A computer sending data to another via a network
- Typing on a computer that is turned off
- Picking up a telephone and putting it to your ear
- Typing ESC on a screen that does not allow it



Models of Interaction

Models of interaction allow a closer look Define and describe an interaction Isolate areas where problems occur Design new interaction

Two examples at different scales Buxton's 3-State Model Norman's Execution-Evaluation Cycle



Models of Interaction

Models of interaction allow a closer look Define and describe an interaction Isolate areas where problems occur Design new interaction

Two examples at different scales Buxton's 3-State Model Norman's Execution-Evaluation Cycle



"All models are wrong, but some are useful" George Box

Buxton's 3-State Model

Mouse

Button up State 1 Button Down Tracking Dragging

Stylus

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Touchpad



Touch Screen



Buxton's 3-State Model

Mouse

Button up State 1 Button Down Tracking Dragging

Stylus



Touchpad



Touch Screen





Which can support tooltip previews?

Norman's Execution-Evaluation Cycle

- 1. Establish the goal.
- 2. Form the intention.

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- 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.



Revise Goals

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



Norman's Execution-Evaluation Cycle



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? What result will it have? How do I do it? What is it telling me?



Cooper's Mental Model Terminology

- Implementation Model
 - How it works
 - (aka Design Model, Designer's Conceptual Model)
 - Manifest Model
 - How it presents itself
 - (aka System Image)



- Mental Model
- How a person thinks it works
- (aka User Model, User's Conceptual Model) University of Washington

Cooper's Mental Model Terminology

- Implementation Model
 - How it works

(aka Design Model, Designer's Conceptual Model)

Manifest Model

How it presents itself

(aka System Image)



Mental Model

These terms are sloppy and ambiguous out in the world

How a person thinks it works

(aka User Model, User's Conceptual Model)

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Manifest and Mental Models



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 Not necessarily matching the implementation model

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



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The Implementation Model



Why do we have a problem?

Can you fix the problem?



The Implementation Model



Why do we have 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



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:AffordancesMetaphorsVisibilityKnowledge in the WorldConstraintsMappingConsistencyModes

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Visual clue to interaction

knobs afford turning

levers afford moving

buttons afford pushing





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

Gibson, part of an 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?









Technology affordances are often based in affordances from the physical world







What is the affordance here?



Where does it come from?



What is the affordance here?



Where does it come from?

Knurling





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).

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).

Nested Affordances

Affordances due to spatial relationships revealing what actions can be done

Proximate to, contained in, part of



Copies:	1	+

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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." Challenges arise if

Gaver

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


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

OK



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

















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

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 conceptual 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 conceptual model

"horseless carriages", "iron horses", "wireless"

Desktop metaphor

Not an attempt to simulate a real desktop

Leverage

Explains





Mail Metaphor

Ele Edit yew Fargertes Look Actions Help Type a question for help Ele Edit yew Fargertes Look Actions Help Image Send/Regeive Image Find Image Type a contact to Find Image Seak Image Seak Image Search Find Image Service Image Search Find Image Security	🖸 ACM Multimedia 2004 - Microsoft Outlook						
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Calendar Metaphor

Image: Section Conduction Im	🗵 Calendar - Microsoft Outlook							
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Health Metaphor

Ķ	VirusScan (n-Access Scan Properties - CS-SUMATRA	?×
	General Settings All Processes	Processes Detection Advanced Actions Image: Second Se	
		OK Cancel Apply	<u>H</u> elp



Shallow or Inappropriate Metaphors

Informs a small range of possibilities, or none at all



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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





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, dragable title bar)

Single click to select, double click to open

Hyperlinks



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, undermining interaction Can limit designer creativity Can reduce the advantages of software Can be "cute" at the expense of functional



Phones

How do you put somebody on hold change volume







→> _	
(This disp	lay shows all of the possible configurations.)
0 /5-30	During a conversation, the call duration is displayed. (Example: 15 minutes, 30 seconds)
->>	The unit is in the programming mode (p. 9, 16, 20).
→•	The AUTO button was pressed while dialing or storing phone numbers for the Speed Dialer (p. 16, 19).
	The LOWER button was pressed (p. 21, 23).
黛	The ringer is set to OFF (p. 10).
8	The MUTE button was pressed during a conversation (p. 24).
-0	The dial lock mode is set. To cancel the mode, see page 27.
F	The FLASH button was pressed while storing phone numbers.
P	The PAUSE button was pressed while dialing or storing phone numbers.
5	You pressed $\ensuremath{\textcircled{\sc w}}$ while dialing or storing phone numbers in the TONE mode.
Ξ	You pressed $(\ensuremath{\#})$ while dialing or storing phone numbers in the TONE mode.
Ø	While storing a phone number in an UPPER memory location for the One-Touch Dialer, " ^Q " will appear when you press a one-touch auto dial button (p. 20).
٥	While storing a phone number in a LOWER memory location for the One-Touch Dialer, " <i>a</i> " will appear when you press a one-touch auto dial button (p. 21).
[-]	The MUTE button was pressed as a secret button while storing phone numbers (p. 18, 22).
U	While programming function items, such as the dialing mode, " ${\it u}$ " will flash as a cursor.

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Changing Ringer Volume

- Press "Program"
- Press "6"
- Set Volume
 - Low Press "1"
 - Medium Press "2"
 - High Press "3"
- Press "Program"



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



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Prevent some actions while allowing others

🖷 Form1 📃 🗆 🗙	Appointment
Date: Month Day Year May 22 1997 Month Day Year May 22 1997 -	General Attendees Notes Planner When Start: 8 : 30 AM ★ Wed 5 /14 /97 ★ End: 4 : 30 PM ★ Wed 5 /14 /97 ★ All day Description: S M T W T F S 27 28 29 30 1 2 3 Smart Technology Ser 27 28 29 30 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 1 2 3 4 5 6 7 If Where: If Where:

Prevent errors before they can happen

Disruptive error messages are a last resort















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







Mapping



🖳 Textual Management Interface	
C Screens	Applications
Source Screen:	
Plasma Display 1	Distributed Drawing Program (Thread ID: 7468)
Plasma Display 2 Tablet 1	HSF - STS-114 - Microsoft Internet Explorer
Tablet 2	
Tablet 3	
Destination Screen:	
Plasma Display 1	
Plasma Display 2	
Tablet 1 Tablet 2	
Tablet 3	
	Reset Relocate Application



Mapping







Consistency

Interfaces should be consistent in meaningful ways 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?

Mar 19,01 SMTWTFS	E
 Mom's Birthday 	
9:00 Meeting: City Planner	Time:
^L 10:00 _F 12:00 Lunch w.⁄ David	Date:
L 1:00 _F 2:00 Design Review	Alarm:
L 3:00	Repeat:
[4:00 Parent/Teacher Conference 5:00	Private
6:00 Pick up Chris from Soccer	Private
・	

Event Details 🚯		
Time: 12:00 pm - 1:00 pm		
Date: Thu 6/24/99		
Alarm: 🗖		
Repeat: None		
Private: 🗌		
OK Cancel Delete (Note		



Is Consistent Always Better?

Should "new" & "delete" be in the same place?

Mar 19,01 🖣 S M T W T F S 🕨	Event Details 🚯
 Mom's Birthday 9:00 Meeting: City Planner [10:00 	Time: 12:00 pm - 1:00 pm
[^{12:00} Lunch w/ David 1:00	Date: Thu 6/24/99 Alarm: 🗆
[2:00 Design Review 3:00 4:00 Device (Track or Conference)	Repeat: None
[4:00 Parent/Teacher Conference 5:00 1 6:00 Pick up Chris from Soccer	Private:
7:00	OK Cancel Delete Note

New is common, delete is not



Is Consistent Always Better?





Is Consistency Always Better?





Is Consistency Always Better?





Modes

Modes force people to divide their model



Active versus Passive Modes

Active modes require constant action to maintain Once that action has retired, 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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