

CSE 440: Introduction to HCI

User Interface Design, Prototyping, and Evaluation

Lecture 06:
Design of
Everyday Things

Tuesday / Thursday
12:00 to 1:20

James Fogarty
Kailey Chan
Dhruv Jain
Nigini Oliveira
Chris Seeds
Jihoon Suh



Project Status

Looking Forward

2d: Design Research Review due last night

2e: Task Review due Thursday 10/19

2f: Design Check-In (3x4) Due Monday 10/23

2g: Design Review (1x2) Due Thursday 10/26

“Getting the Right Design” Report and Presentation

Other Assignments

All Reading Assignments Now Posted

Reading 2 Due this Saturday 10/21

Reading 5 Can Be Done Anytime, Sooner is Better

Denny 303 on Tuesday 10/24



James Away on Tuesday 10/24

The screenshot shows the website for the Computing Research Consortium (CRC) symposium. The page features a navigation menu with links for ABOUT, VISIONING, LEADERSHIP DEVELOPMENT, TASK FORCES, RESOURCES, EVENTS, and BLOG. The main heading is "COMPUTING RESEARCH ADDRESSING NATIONAL PRIORITIES AND SOCIETAL NEEDS". Below this, the event title "Computing Research: Addressing National Priorities and Societal Needs 2017" is displayed, along with the dates "October 23-24, 2017" and the location "The InterContinental Washington D.C. at the Wharf". A map of the Washington D.C. area is provided. The "Event Contact" section lists Ann Orbinis as the contact. The "Event Type" is "2017 Events, Special Event" and the "Event Category" is "CCC". The "Tags" include "grand challenges, research, symposium". The "Overview" section provides a detailed description of the symposium's purpose and themes, including "Intelligent Infrastructure for our Cities and Communities", "Security and Privacy for Democracy", "AI and Amplifying Human Abilities", and "Data, Algorithms, and Fairness".

Computing Research: Addressing National Priorities and Societal Needs 2017

October 23-24, 2017

The InterContinental Washington
D.C. at the Wharf
801 Wharf Street, SW, Washington,
D.C. 20024

Map Satellite

New York
New York
Philadelphia
Washington
Maryland
Virginia
North Carolina

Event Contact

Ann Orbinis
aorbinis@cra.org

Event Type

2017 Events, Special Event

Event Category

CCC

Tags

grand challenges, research, symposium

Overview Agenda

Over the past several decades, computing and information technologies have shaped our lives, our society, and our physical world in ways we never would have imagined. An increasing number of jobs depend on IT, IT shrinks time and distance in our social lives, agriculture and transportation are rapidly becoming IT-based, and IT holds the promise of revolutionizing education and healthcare. Although many of the IT-powered innovations that are reshaping our society can be traced to fundamental computing-related research, their impact has been magnified through powerful applications in areas of broad societal need and opportunity.

Over the past 11 years, the Computing Community Consortium has hosted dozens of research visioning workshops to imagine, discuss, and debate the future of computing and its role in addressing societal needs. The second CCC Computing Research symposium draws these topics into a program designed to illuminate current and future trends in computing and the potential for computing to address national challenges.

The two days are organized around four main themes:

Intelligent Infrastructure for our Cities and Communities

- Intelligent infrastructure is already transforming our nation's cities and communities, but the technological revolution is just now beginning. The potential for major improvements in public health and safety, efficient use of our resources, and a higher quality of life for all citizens are enormous. At the same time, new risks arise as we attempt to integrate large scale data collection, advanced cyberphysical systems, and autonomous vehicles into our daily lives. This session will highlight some of the major advances now taking place, while at the same time emphasizing the substantial body of research, much of it crossing disciplinary boundaries, that still needs to be done.

Security and Privacy for Democracy

- Computing research enables new technology to help society cope with information security and privacy risks. Learn about how differential privacy will enable new understanding of the population while protecting privacy and about technologies used to help journalists and human rights workers to communicate safely in oppressive regimes.

AI and Amplifying Human Abilities

- This panel will examine the emerging role of AI in augmenting human abilities in new and powerful ways. In particular, this session will examine the spectrum of human and machine capabilities and how we develop systems that provide a seamless interface between the two. Speakers will also ground their remarks in application areas ranging from health, transportation, universal access, data analysis, and education.

Data, Algorithms, and Fairness

- Data-driven and algorithmic decision making increasingly determine how businesses target advertisements to consumers, how police departments monitor individuals or groups, how banks decide who gets a loan and who does not, how employers hire, how colleges and universities make admissions and financial aid decisions, and much more. As data-driven decisions increasingly affect every corner of our lives, there is an urgent need to ensure they do not become instruments of discrimination, barriers to equality, and threats to social justice.

Livestream

Today

Finish with tasks, personas, and scenarios

Review core design terminology

Selecting Tasks

Real tasks people have faced or requested

as supported by your design research

collect any necessary materials

Should provide reasonable coverage

compare check list of functions to tasks

Mixture of simple and complex tasks

easy tasks (common or introductory)

moderate tasks

difficult tasks (infrequent or for power use)

What Should Tasks Look Like?

Say what person wants to do, but not how
allows comparing different design alternatives

Be specific, stories based in concrete facts

say who person is (e.g., using personas or profiles)

design can really differ depending on who

give 'names' (allows referring back with more info later)

characteristics of person (e.g., job, expertise)

story forces us to fill in description with details

Sometimes describe a complete “accomplishment”

forces us to consider how features work together

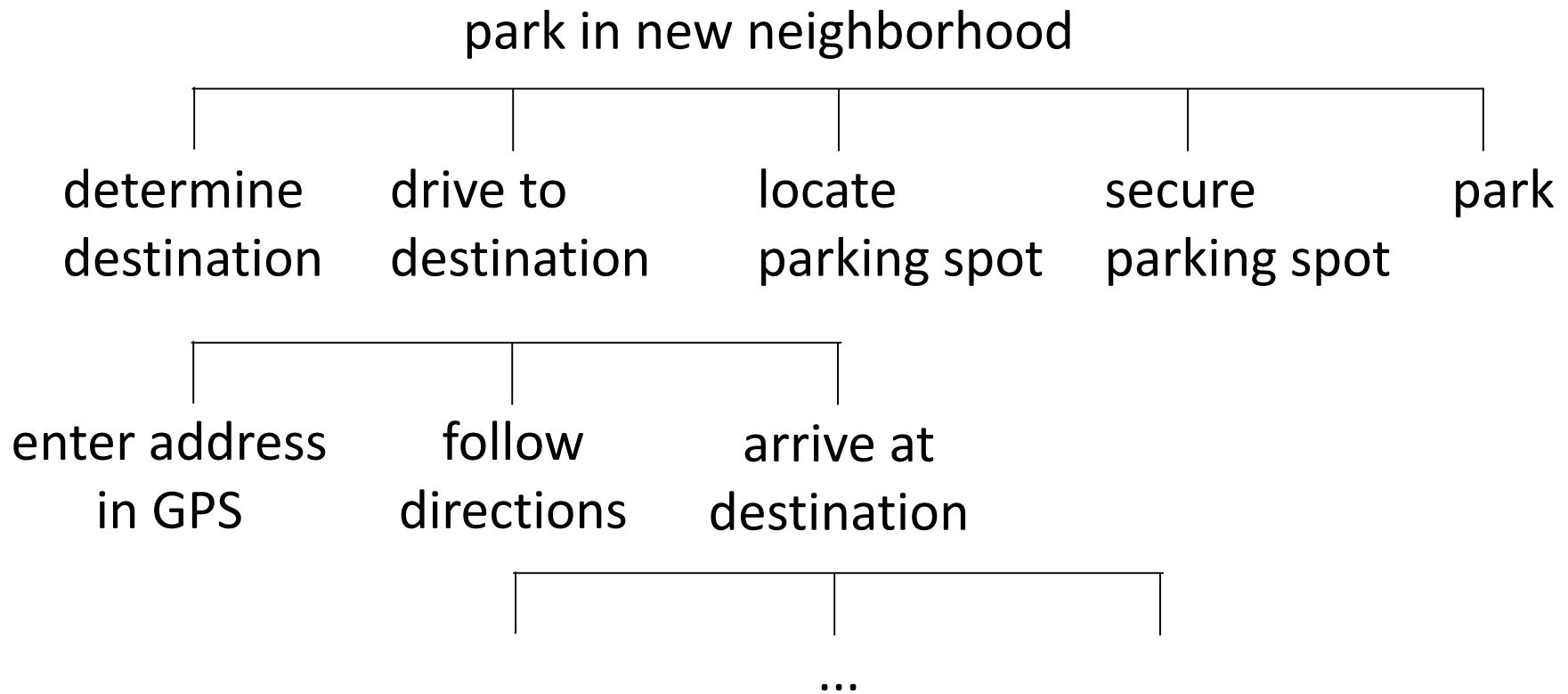
filename task example

Task: Park in a New Neighborhood

Peter is going to brunch on a Sunday with his roommates. He is trying a new place he found on Yelp. He has the address for the place and he is using his phone's GPS for directions. He leaves the apartment with his roommates at 8:30am and he wants to beat the crowd so they won't have to wait in line. He is driving a Toyota Corolla that he has owned for five years. It is a rainy day and he doesn't have an umbrella.

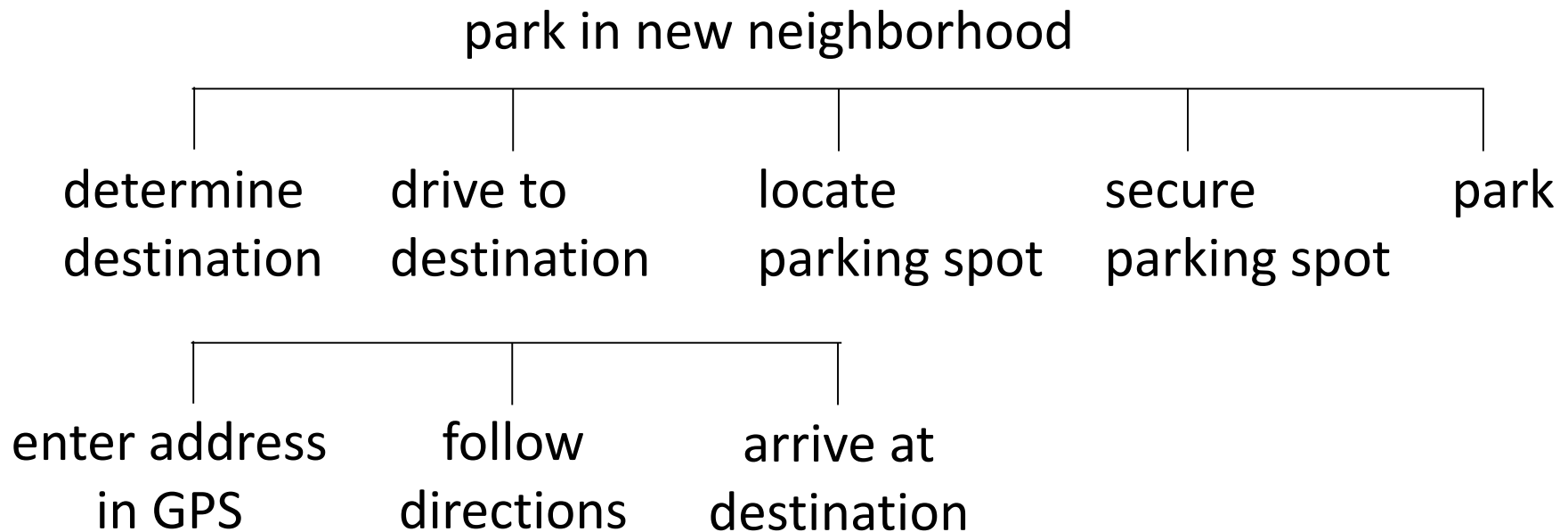
Hierarchical Task Analysis

Steps of the task execution (detailed in a hierarchy)



Hierarchical Task Analysis

Steps of the task execution (detailed in a hierarchy)



... Or step back a level and motivate ridesharing

Using Tasks in Design

Write up a description of tasks

formally or informally

run by people and rest of the design team

get more information where needed

Manny is in the city at a restaurant and would like to call his friend **Sherry to see when she will be arriving. She called from a friend's** house while he was in the bus tunnel, so he missed her call. He would like to check his missed calls and find the number to call her back.

Using Tasks in Design

Rough out an interface design

discard features that do not support your tasks
or add a real task that exercises that feature
major elements and functions, not too detailed
hand sketched

Produce scenarios for each task

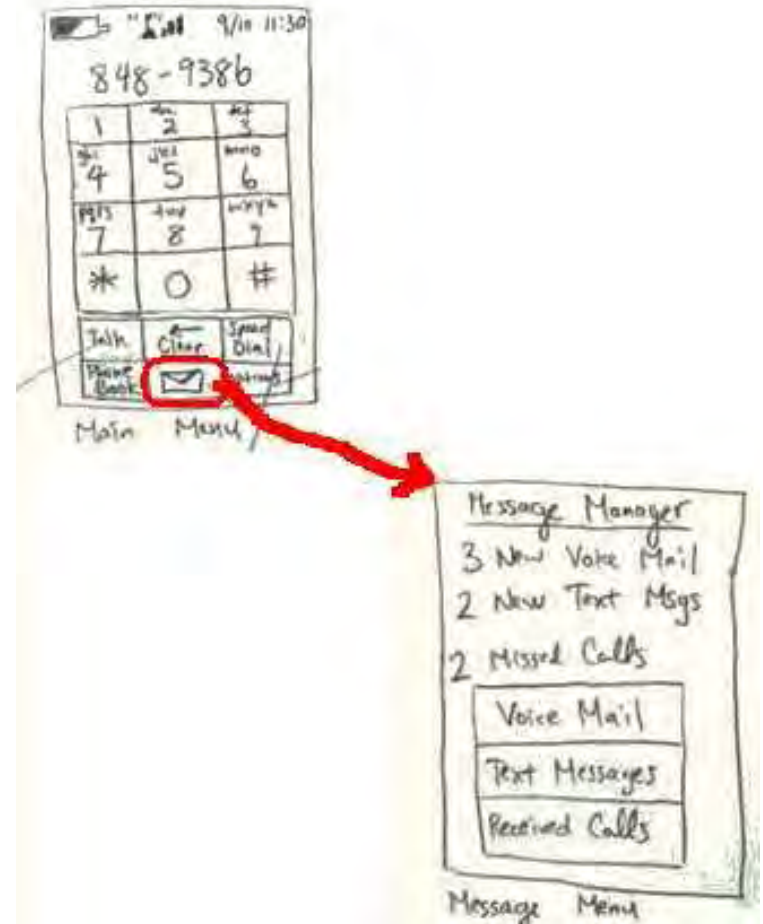
what person does and what they see
step-by-step performance of task
illustrate using storyboards

Scenarios

Scenarios are design specific, tasks are not

Scenarios force us to show how things work together settle arguments with examples but these are only examples, and may need to look beyond flaws

Show people storyboards topic for next Thursday



Tasks, Personas, and Scenarios

Task: a design-agnostic objective

Persona: a fictional person with a backstory

Scenario: narrative that demonstrates a persona completing a task using a particular design

Use Case: in software engineering, describes requirements using one or more scenarios

Tasks in Your Projects

Say what is accomplished, not how

Real tasks that people currently encounter,
or new tasks your design will enable

Reasonable coverage of the interesting aspects
of your problem and your design space

Range of difficulty and complexity

Park at the zoo

Park Friday night in Ballard

Park at the airport

Today

Finish with tasks, personas, and scenarios

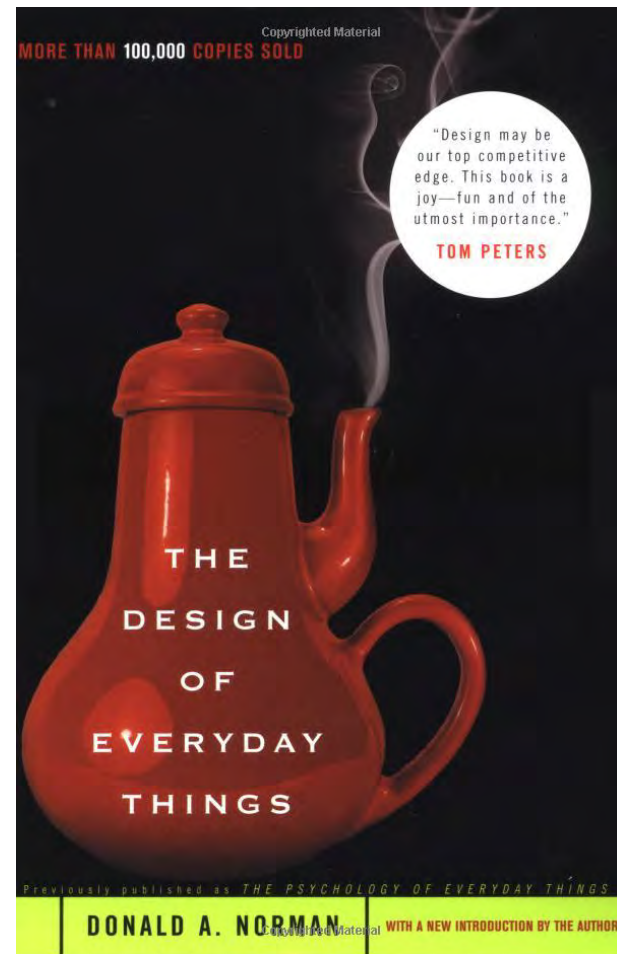
Review core design terminology

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



Objectives

Be able to:

Describe Norman's execution-evaluation cycle, including the Gulfs of Execution and Evaluation.

Define implementation, manifest, and mental models, describe their relationships and how they are created.

Describe and identify examples of affordances, including false and hidden affordances.

Describe and identify examples of metaphors.

Objectives

Be able to:

In terms of mental models, describe and differentiate affordances, metaphors, and idioms.

Describe and identify examples of visibility, constraints, and mappings.

In terms of mental models, describe and identify examples of consistency, including internal and external consistency.

In terms of mental models, describe the effect of modes.

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.

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]

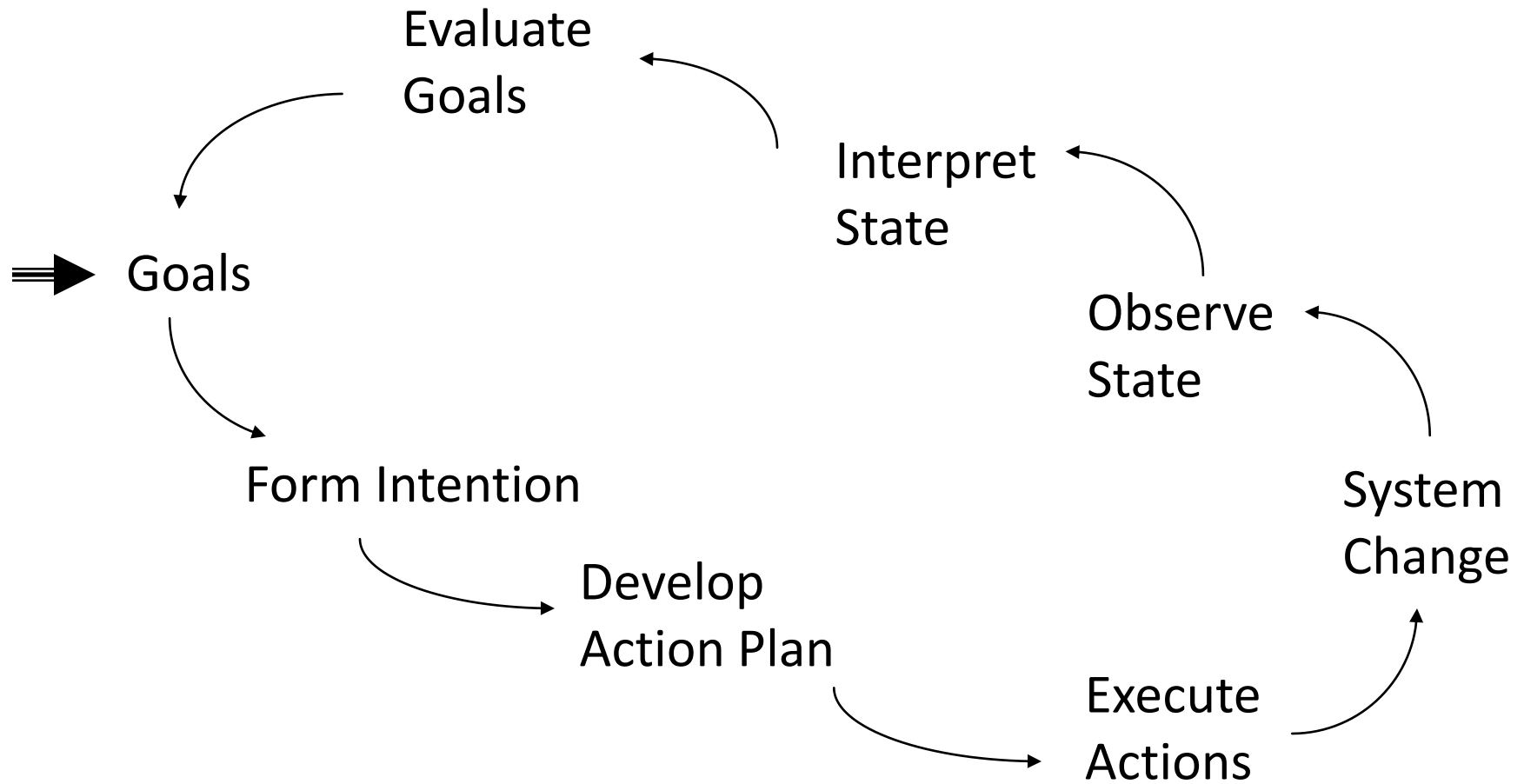
6. Interpret the system state

The knob rotated. The lamp is emitting light. The lamp seems to work

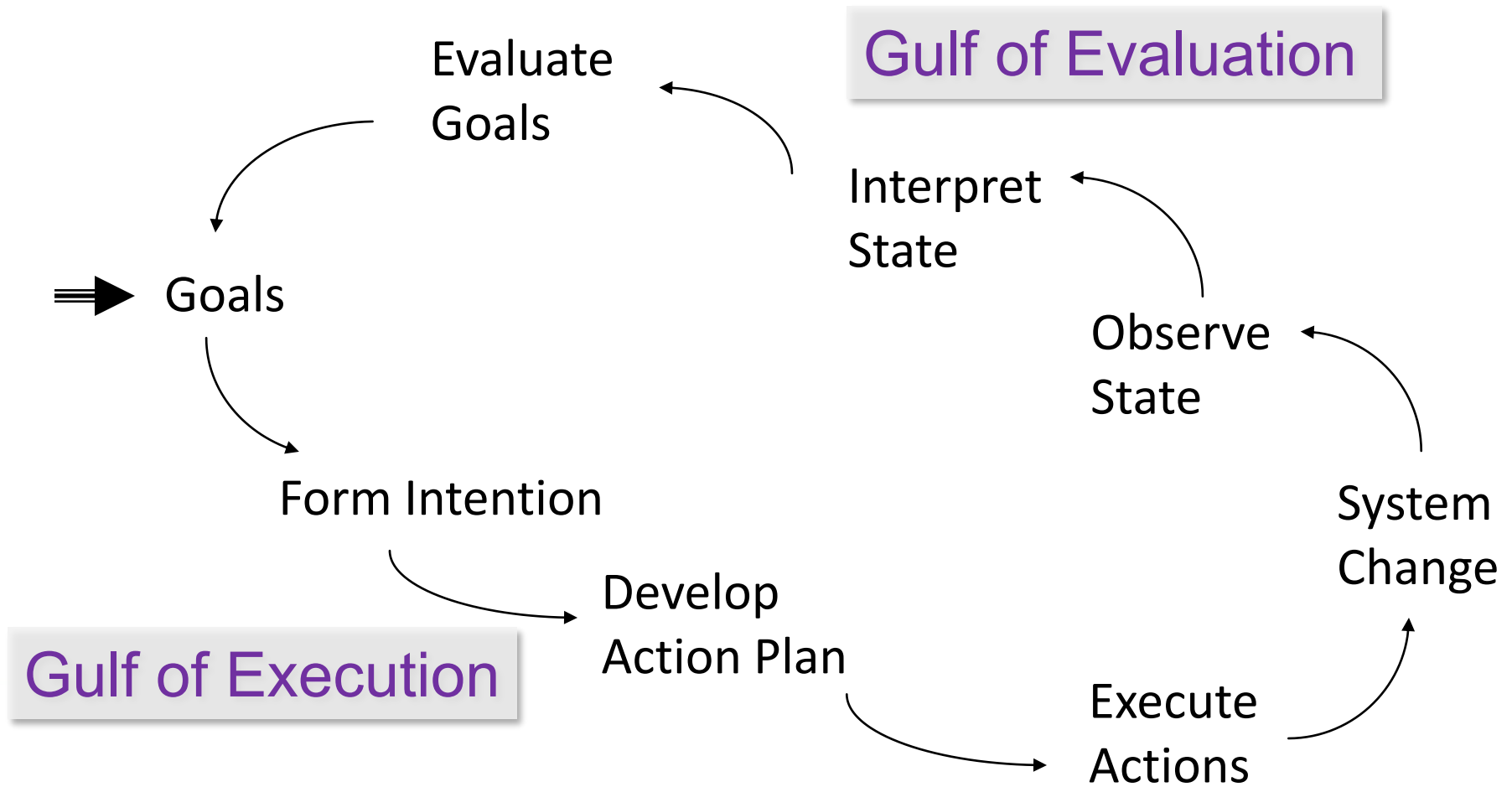
7. Evaluate the system state with respect to the goals and intentions

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?

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)



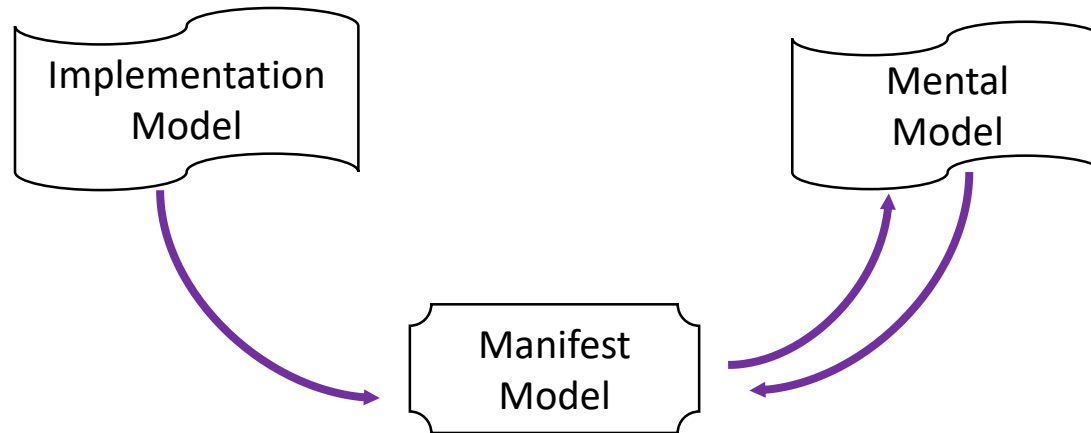
Mental Model

How a person thinks it works

(User Model, User's Conceptual Model)

These terms
are sloppy and
ambiguous out
in the world

Manifest and Mental Models



Designer projects their model into an artifact

Person forms their model based on interaction

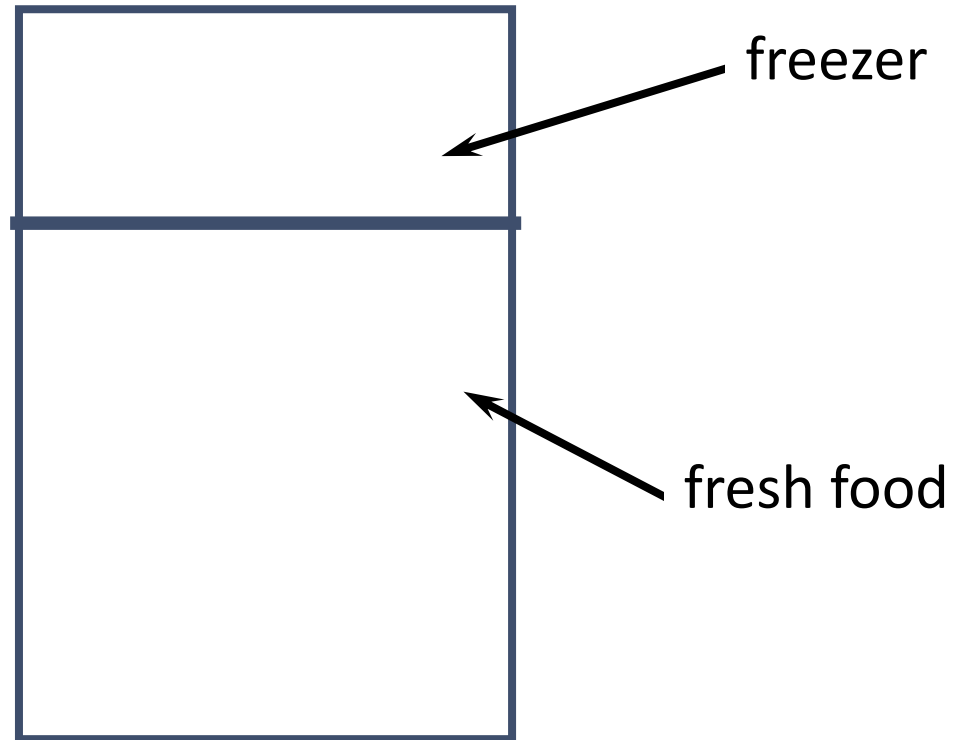
People struggle until model matches manifest model

Update mental model in response to breakdowns

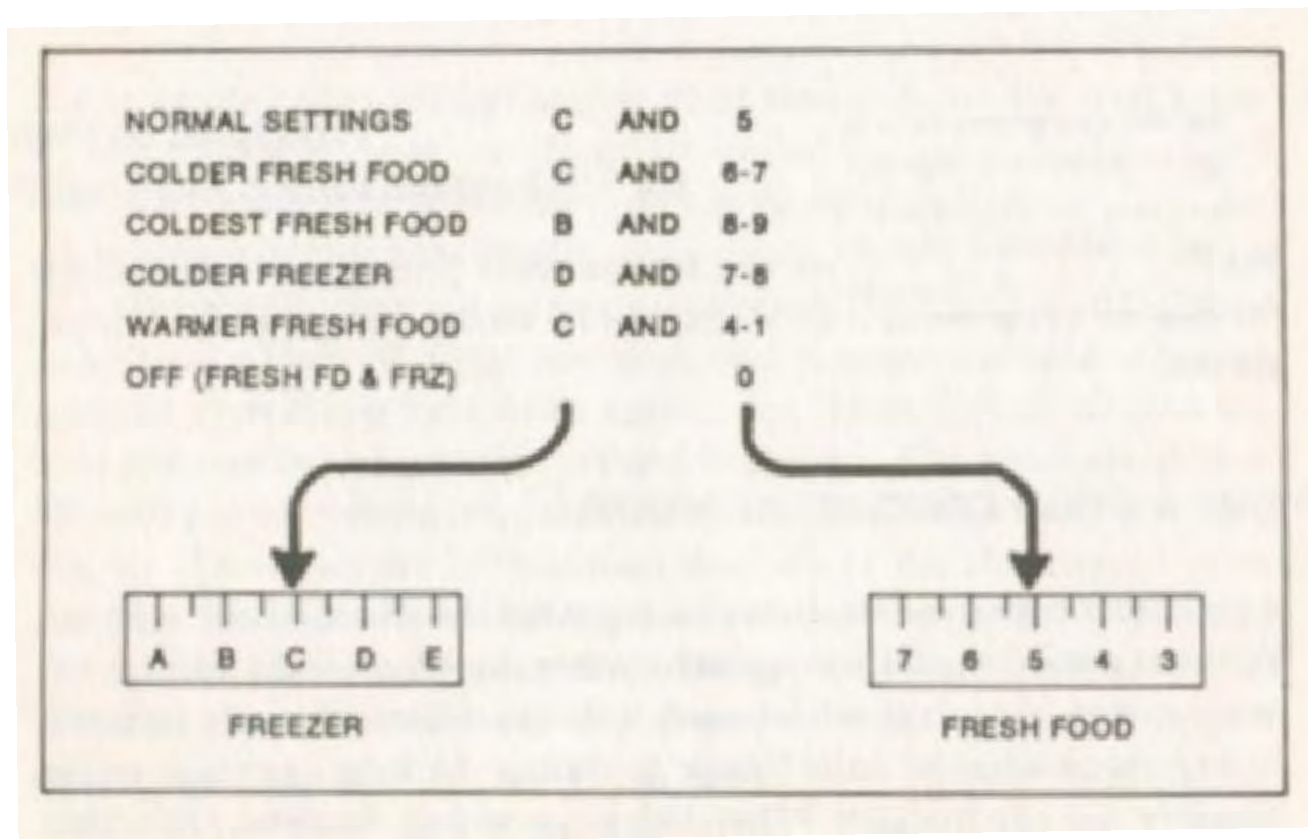
Matching the implementation model is not necessary

Mental Models

Problem: freezer too cold, fresh food just right

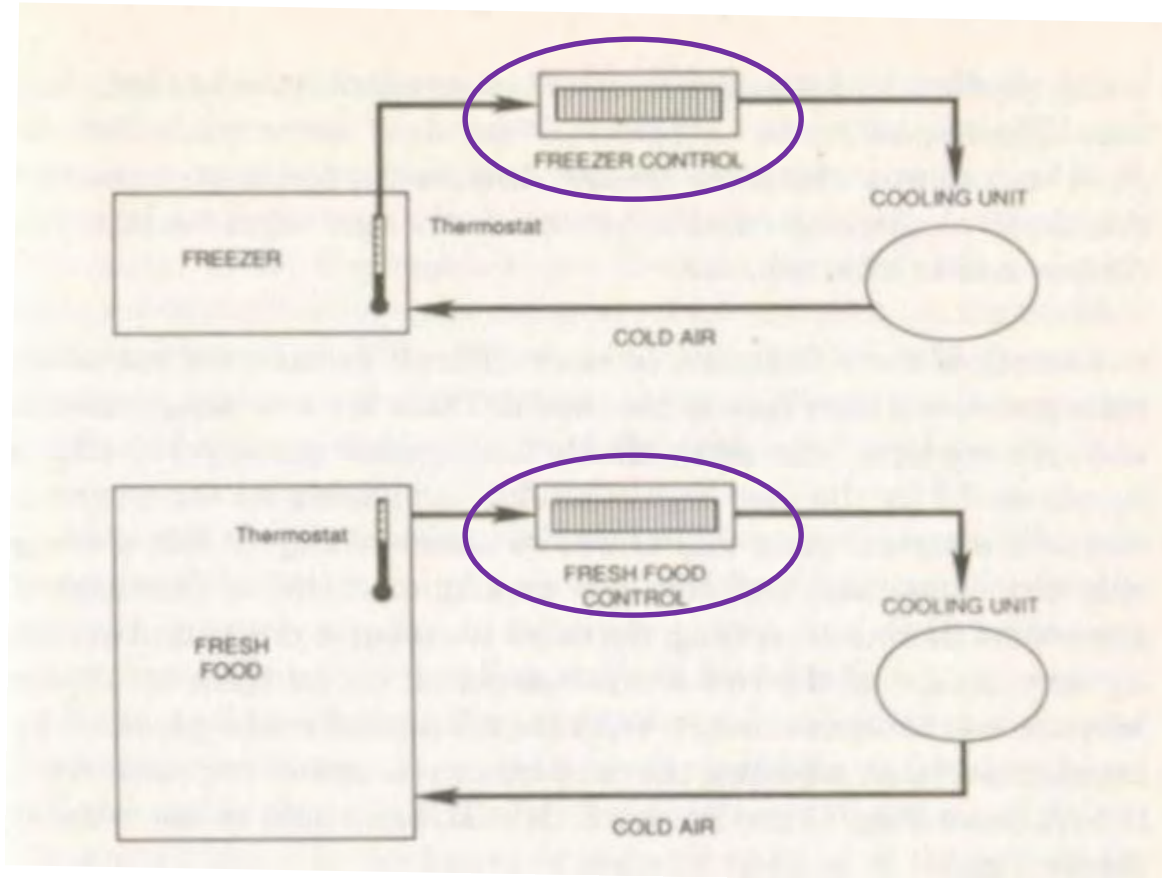


Manifest Model



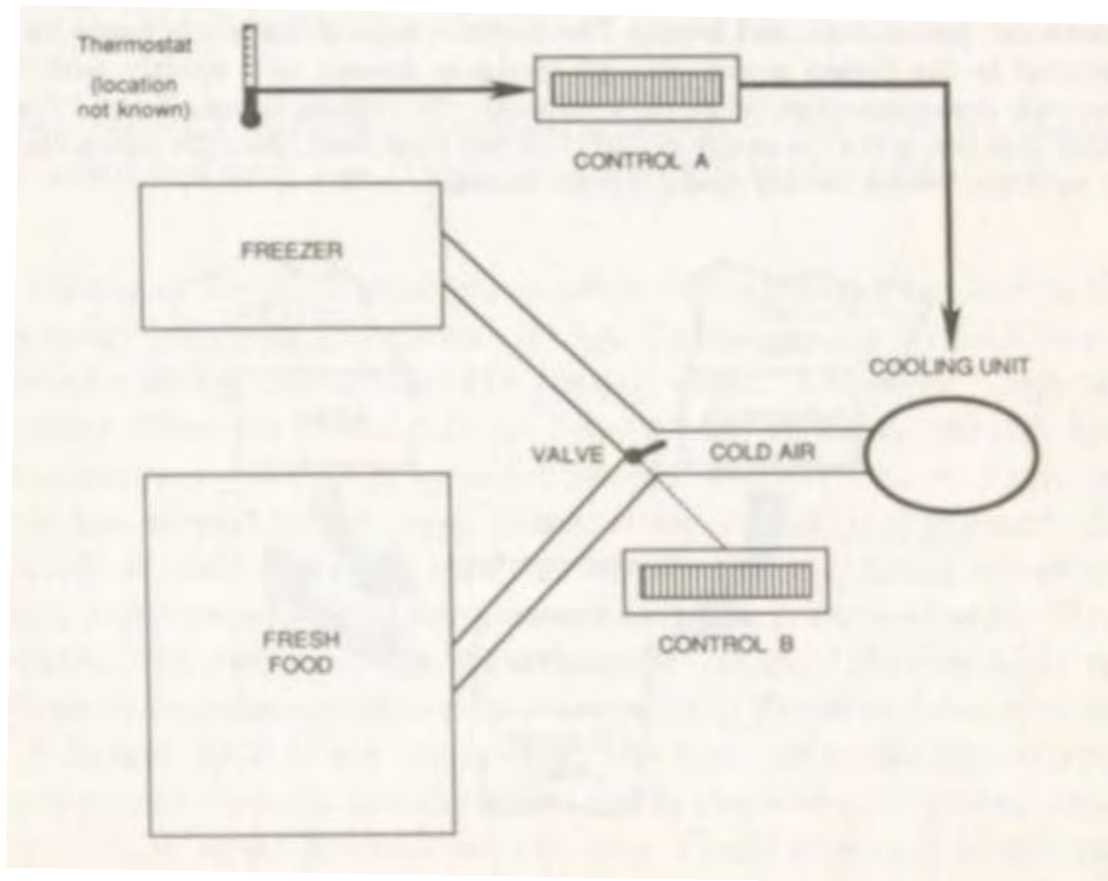
What if I want to make just the freezer warmer?

A Sensible Mental Model

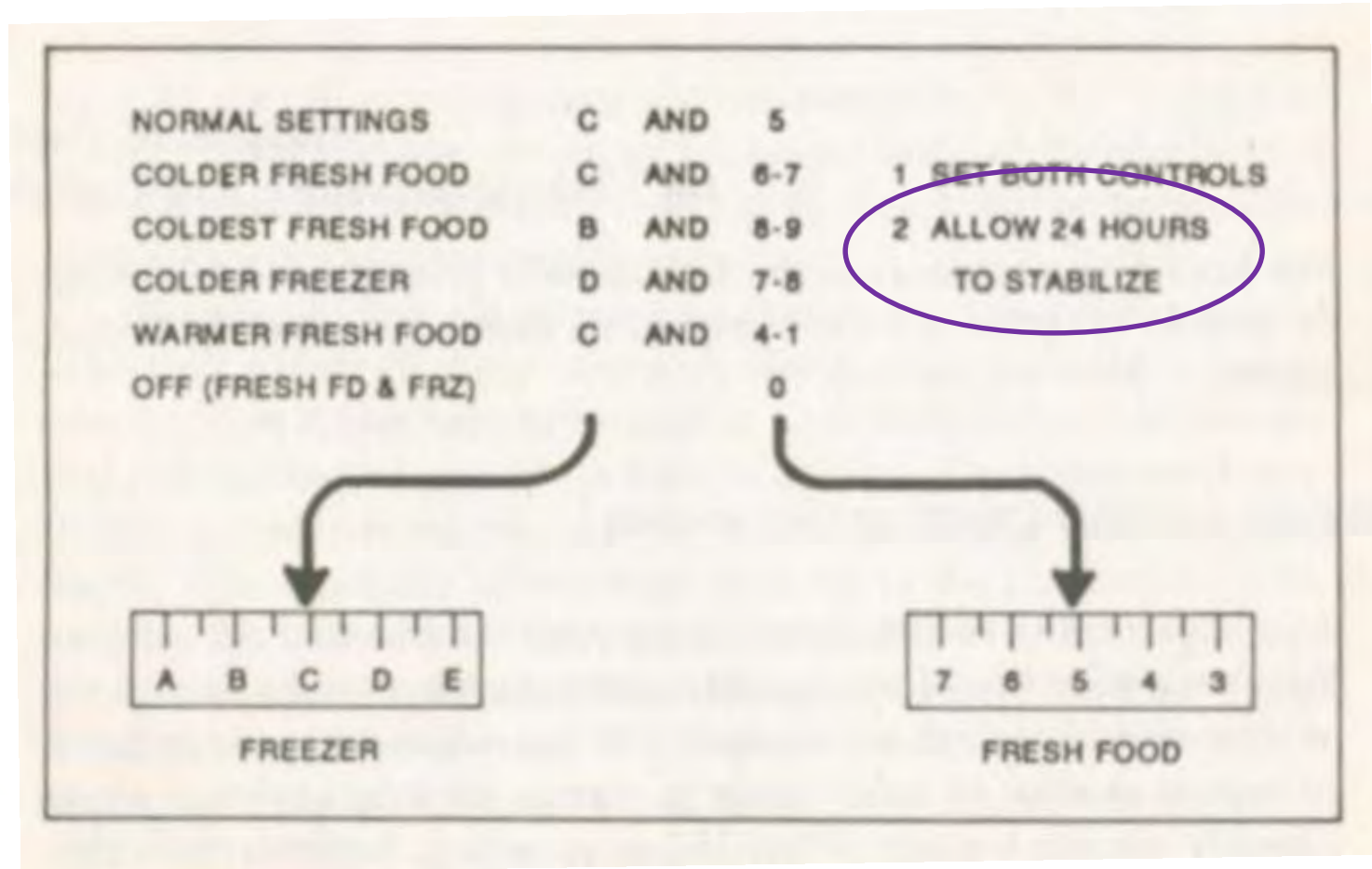


“The Freezer Control controls the freezer temperature and the Fresh Food Control controls the fresh food temperature”

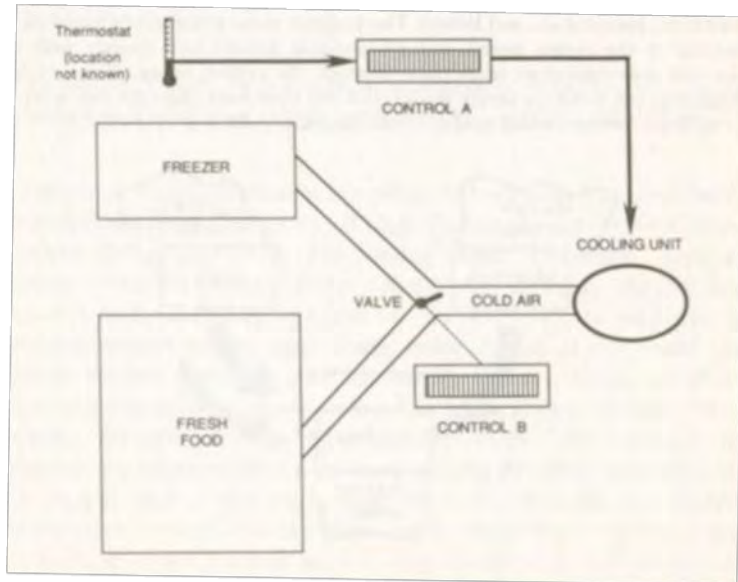
The Implementation Model



A Problem with Feedback



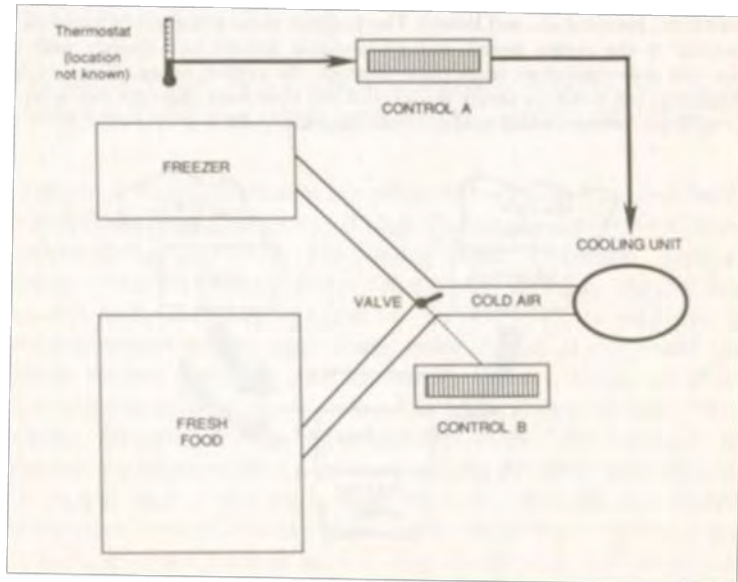
The Implementation Model



Why is there a problem?

Can you fix the problem?

The Implementation Model



“Design depends largely on constraints.”
Charles Eames

Why is there a problem?

Cost constraints

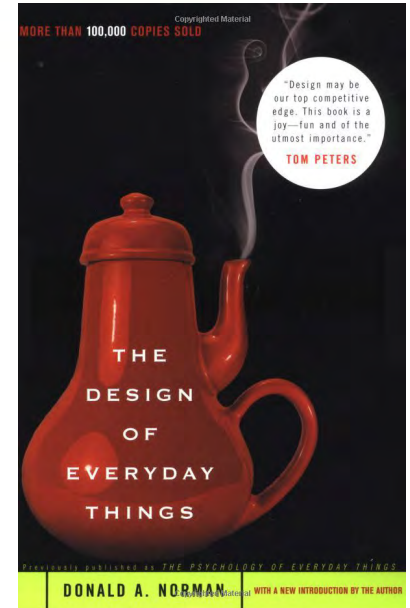
Can you fix the problem?

Make controls correspond to a person's mental model

Make controls correspond to the implementation model

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

Metaphors

Visibility

Knowledge in the World

Constraints

Mapping

Consistency

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?

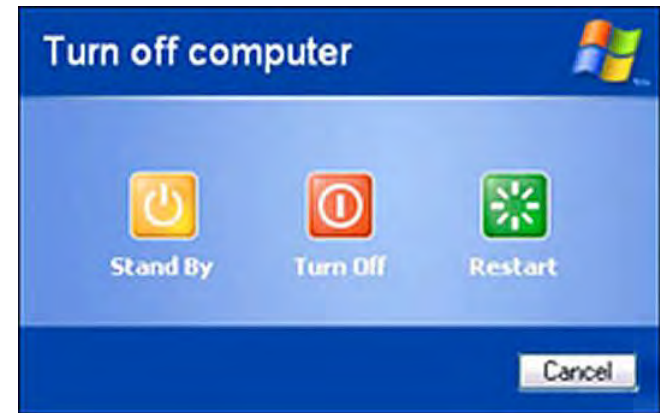


Affordances



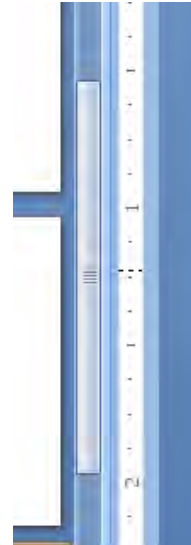
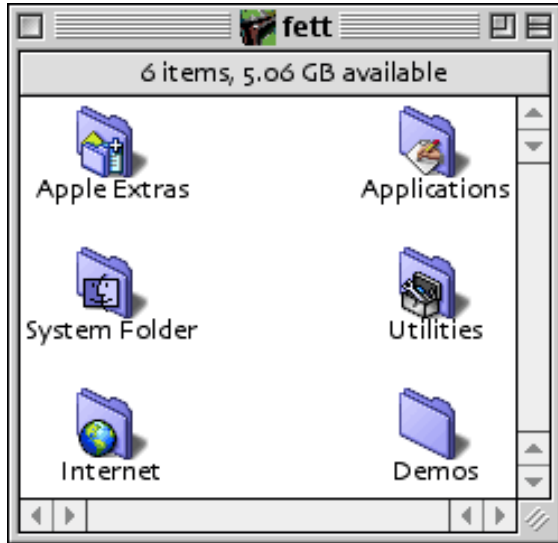
Affordances

Technology affordances are often based in affordances from the physical world



Affordances

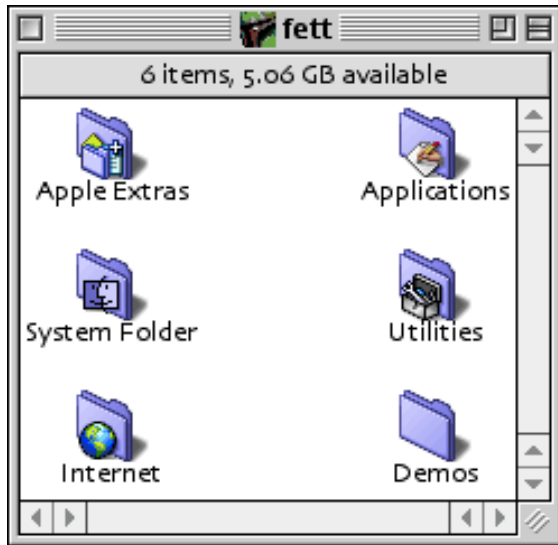
What is the affordance here?



Where does it come from?

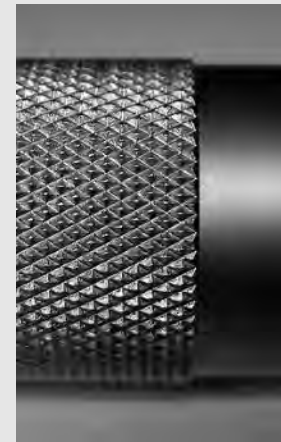
Affordances

What is the affordance here?



Where does it come from?

Knurling



Sequential Affordance

Acting on a perceptible affordance leads to information indicating new affordances

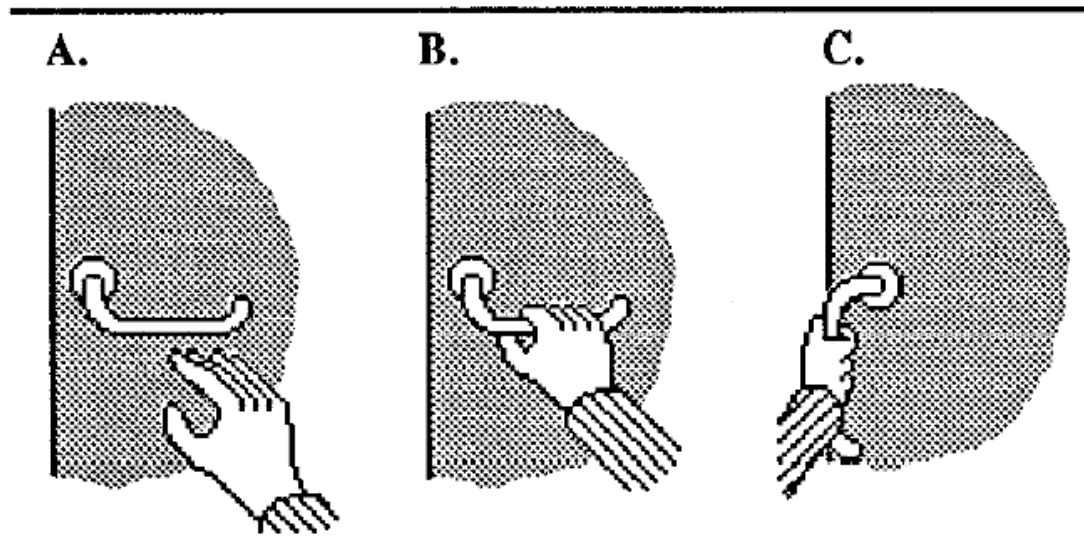


Figure 4. Sequential affordances: one affordance leads to another. Visual information indicates grasping (A & B); tactile information indicates turning (B & C).

Sequential Affordance

Acting on a perceptible affordance leads to information indicating new affordances

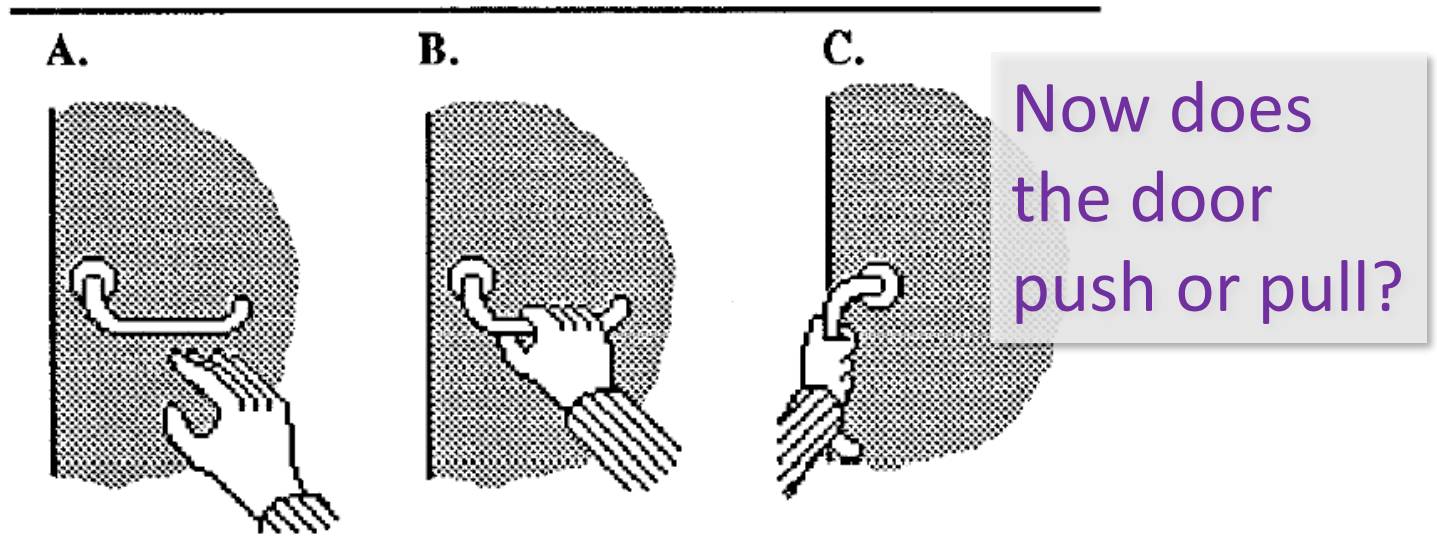
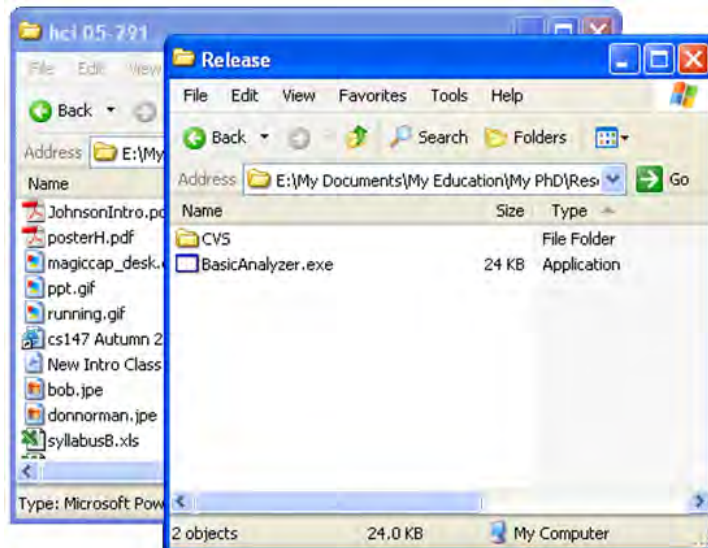


Figure 4. Sequential affordances: one affordance leads to another. Visual information indicates grasping (A & B); tactile information indicates turning (B & C).

Nested Affordances

Affordances due to spatial relationships revealing what actions can be done

Proximate to, contained in, part of



Copies:

In Other Words

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

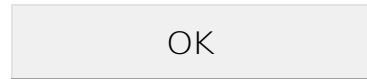
“In general, when the apparent affordances of an artifact matches its intended use, the artifact is easy to operate. When apparent affordances suggest different actions than those for which the object is designed, errors are common.”

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

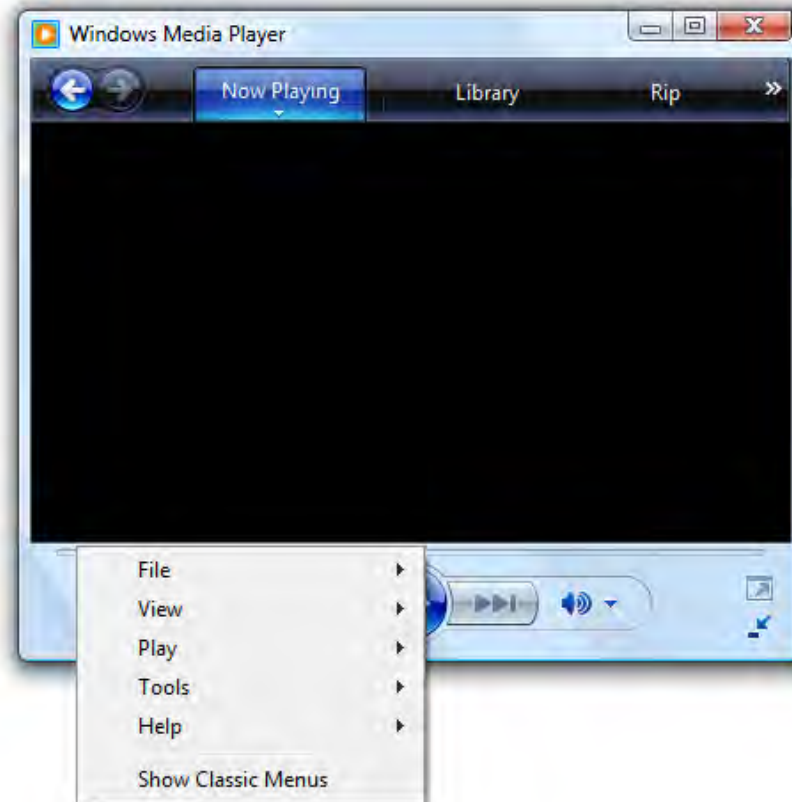


False Affordances

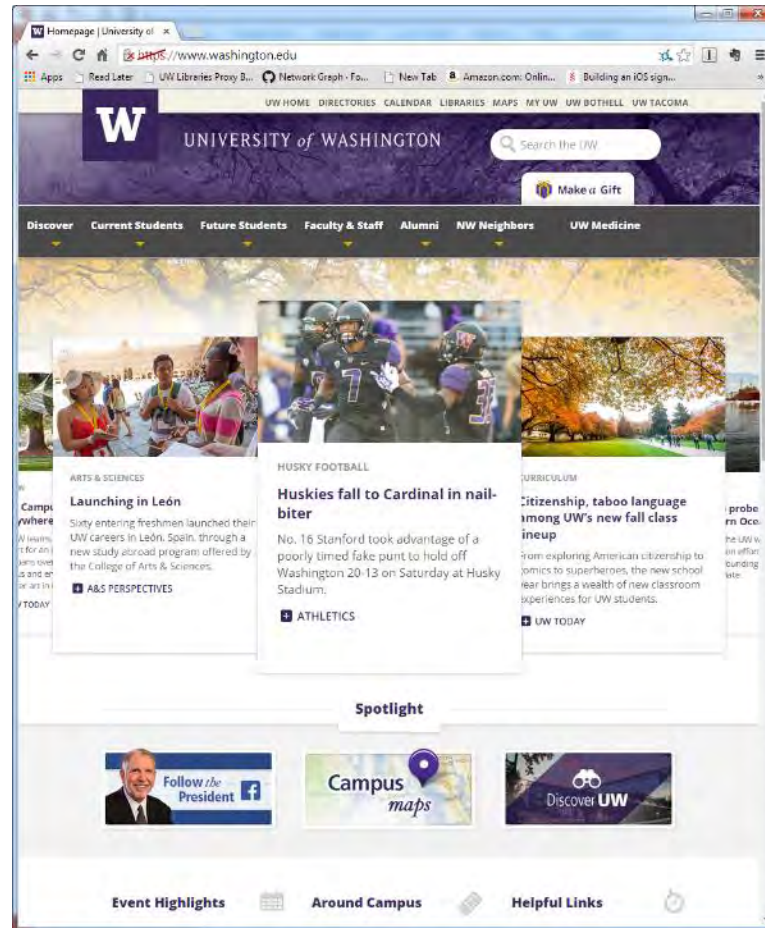


Hidden Affordances

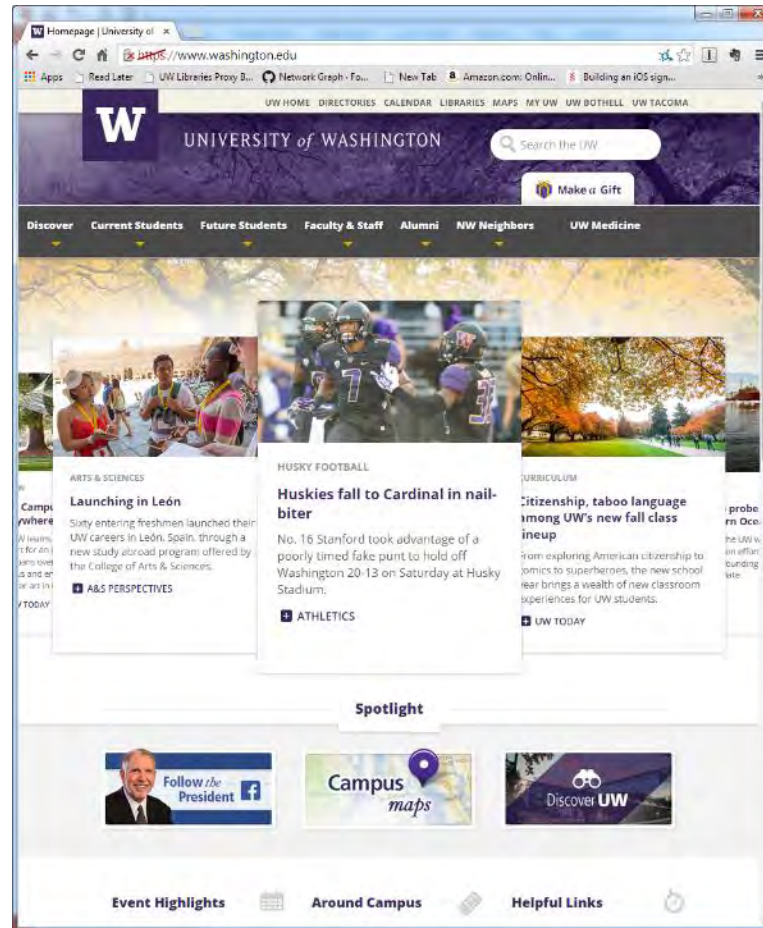
When there is no perceptual information suggesting an actual intended use



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”

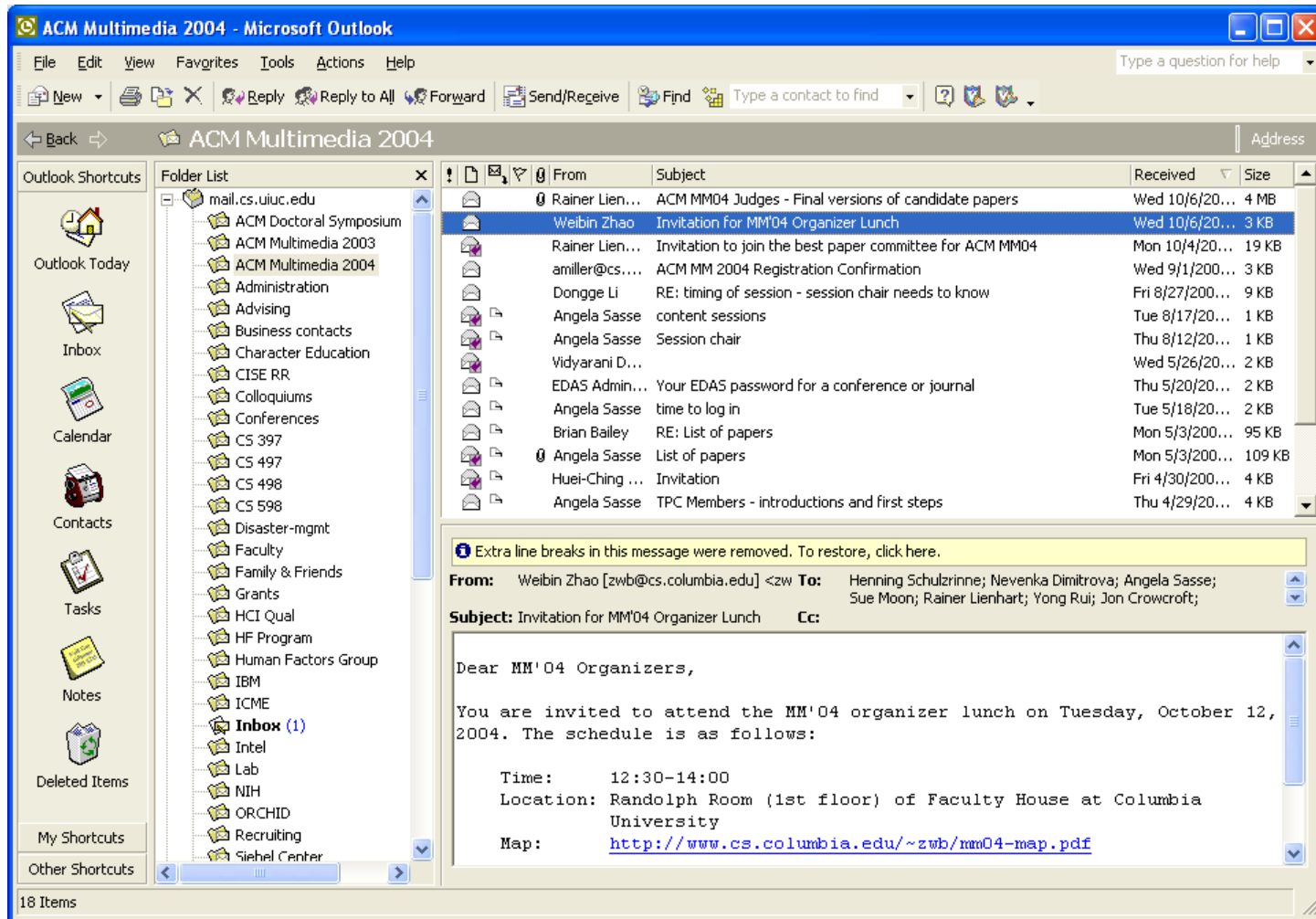
Desktop metaphor

Not an attempt to simulate a real desktop

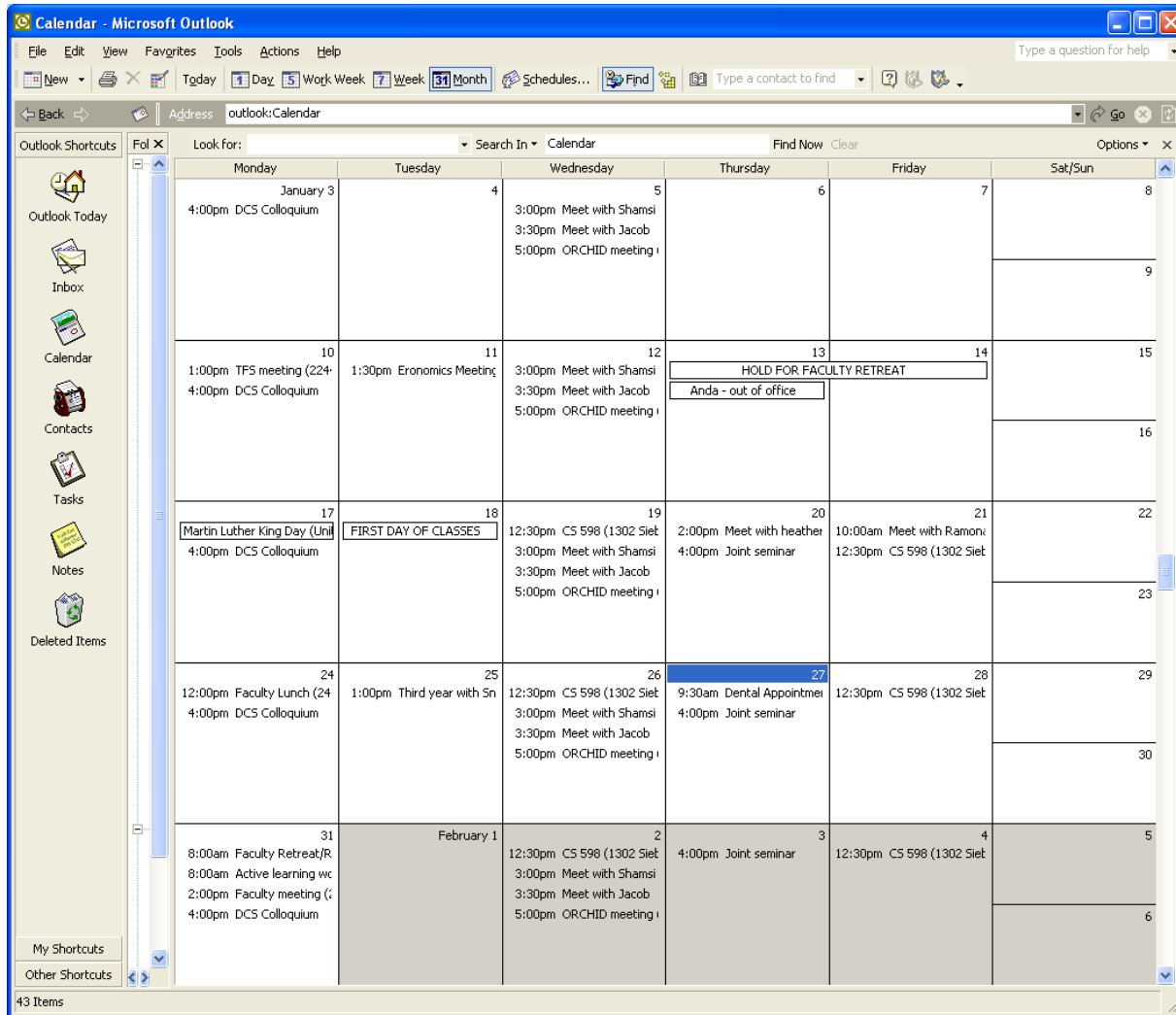
Leverages knowledge of files, folders, trash

Explains why some windows seem hidden

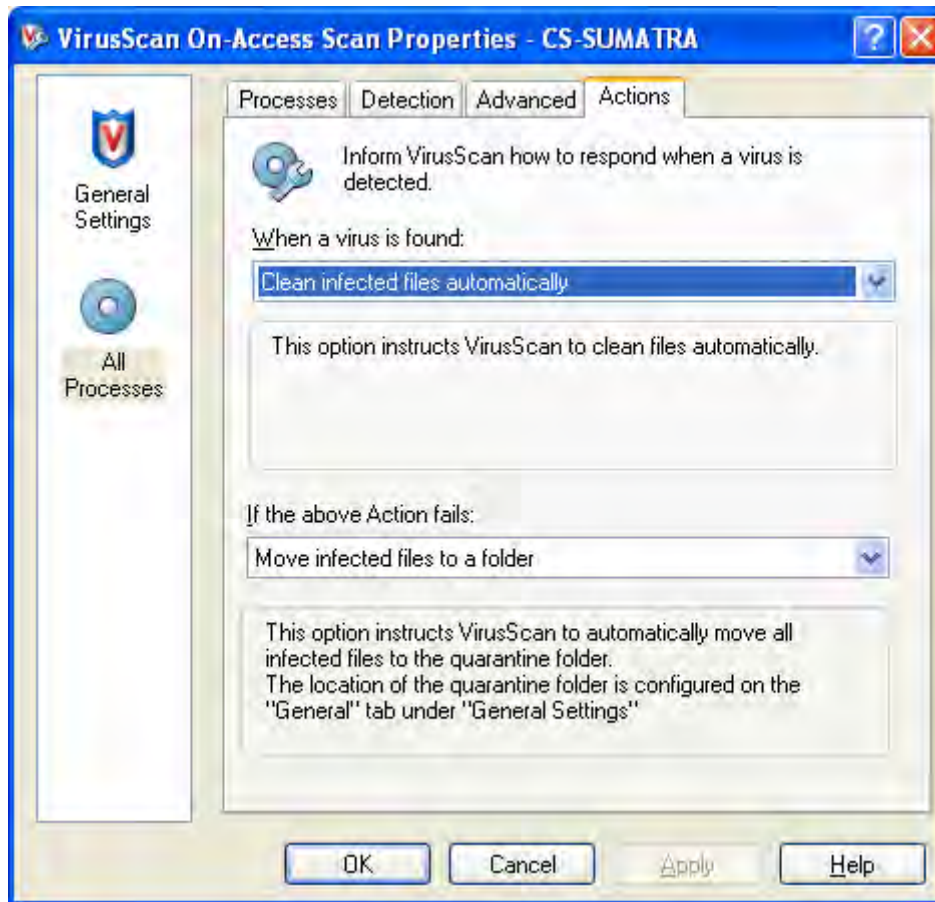
Mail Metaphor



Calendar Metaphor

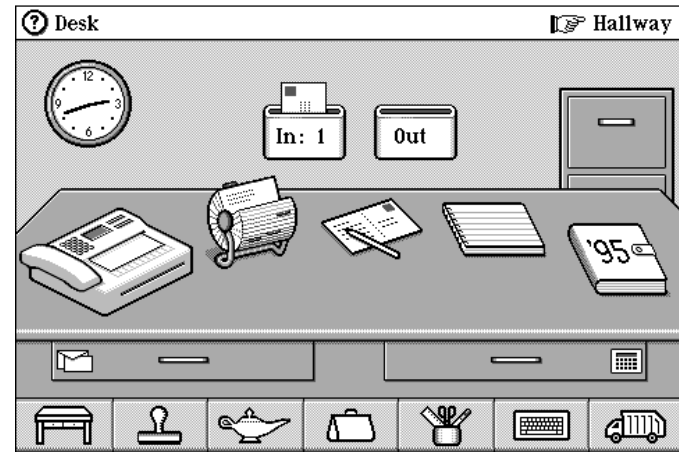


Health Metaphor



Shallow or Inappropriate Metaphors

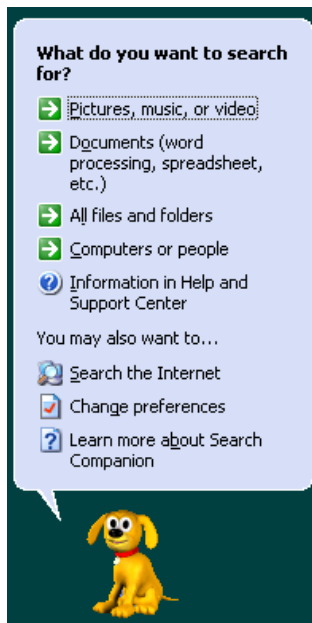
Informs a small range of possibilities, or none at all



Magic Cap



Microsoft Bob



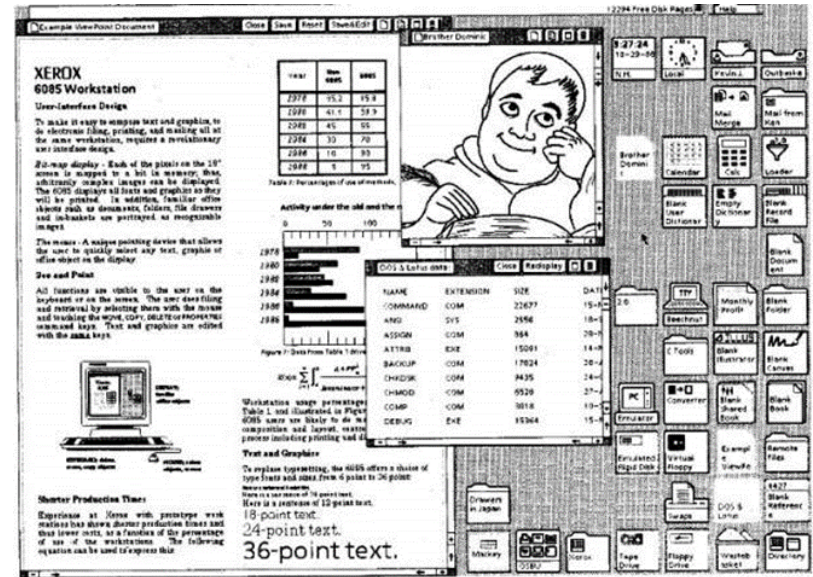
It is just a menu and a dialog box?

What does the living room add?

Mixed Metaphors

Two or more different metaphors coexist with some supposed relation

The desktop metaphor
Windows into content



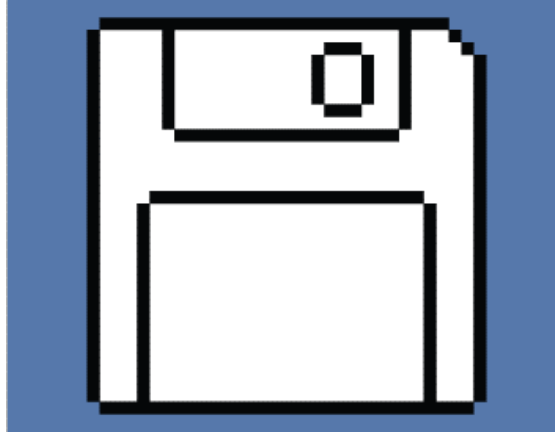
Good? Bad?
Neither? Both?

Windows are views into larger content regions

No desktop has windows

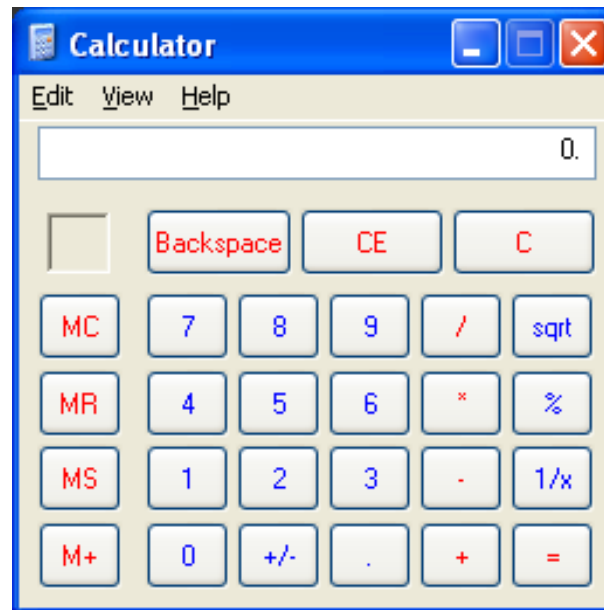
Broken Metaphors

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,
dragable 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

Signifiers

“There are trails. There are behaviors. We know how to behave by watching the behavior of others, or if others are not there, by the trails they have left behind.”

“I call any physically perceivable cue a signifier, whether it is incidental or deliberate. A social signifier is one that is either created or interpreted by people or society, signifying social activity or appropriate social behavior.”

“Social signifiers replace affordances, for they are broader and richer, allowing for accidental signifiers as well as deliberate ones, and even for items that signify by their absence, as the lack of crowds on a train platform. The perceivable part of an affordance is a signifier, and if deliberately placed by a designer, it is a social signifier.”

Norman

Visibility

Phones

How do you

put somebody on hold

change volume



Visibility

Location of Controls



Display



(This display shows all of the possible configurations.)

0 15-30 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).
- ⊗ The ringer is set to OFF (p. 10).
- ⊗ The MUTE button was pressed during a conversation (p. 24).
- ⊗ 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.
- ⌂ You pressed [*] while dialing or storing phone numbers in the TONE mode.
- # You pressed [#] while dialing or storing phone numbers in the TONE mode.
- 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).
- 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).
- [-] The MUTE button was pressed as a secret button while storing phone numbers (p. 18, 22).
- ⌂ While programming function items, such as the dialing mode, "⌂" will flash as a cursor.

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

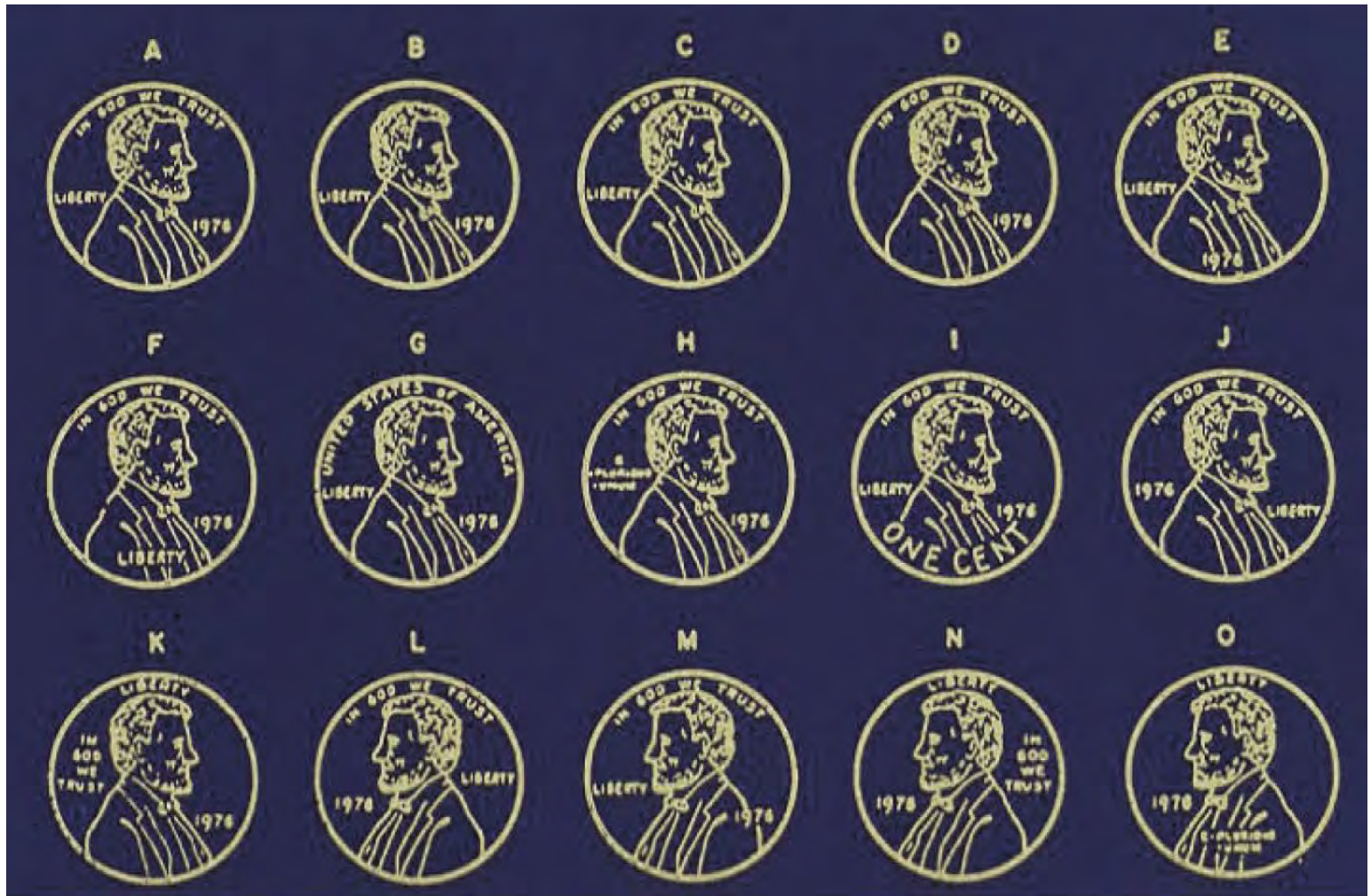
Compare to controls on simple car radio

Number of controls \approx Number of functions

Controls are labeled and grouped together



Knowledge in the World



Constraints

Prevent some actions while allowing others

Form1

Date:

Month Day Year

May 22 1997

Month Day Year

May 22 1997

Appointment

General Attendees Notes Planner

When

Start: 8:30AM Wed 5 /14 /97

End: 4:30PM Wed 5 /14 /97 All day

Description:

Smart Technology Sen

Where:

May 1997

S	M	T	W	T	F	S
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

Prevent errors before they can happen

Disruptive error messages are a last resort

Constraints



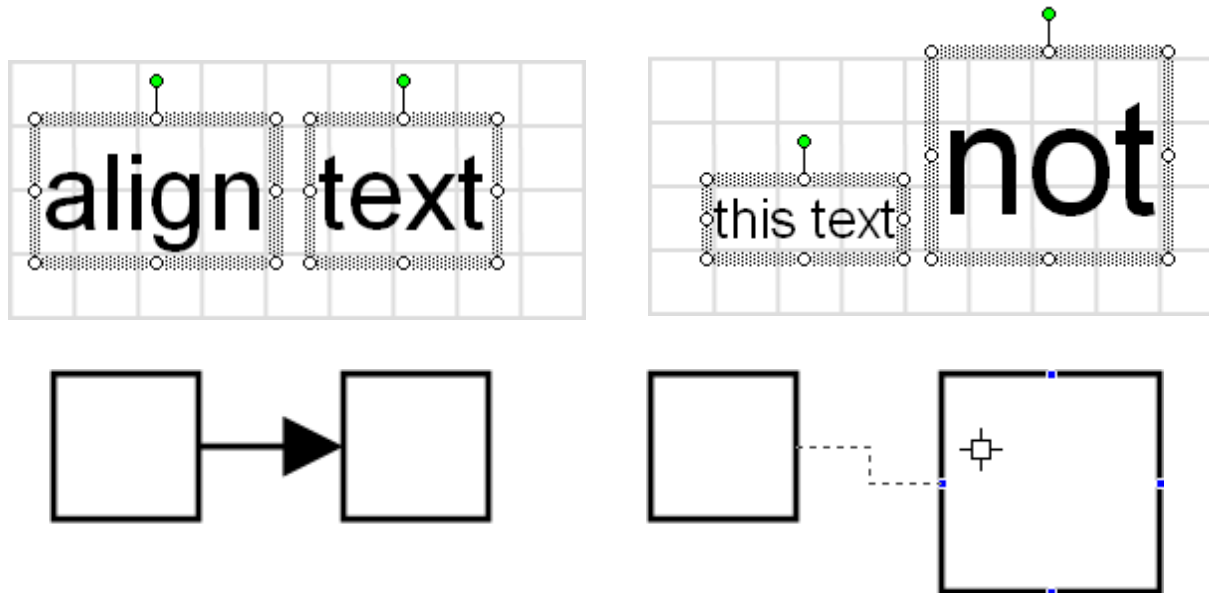
Constraints



Constraints

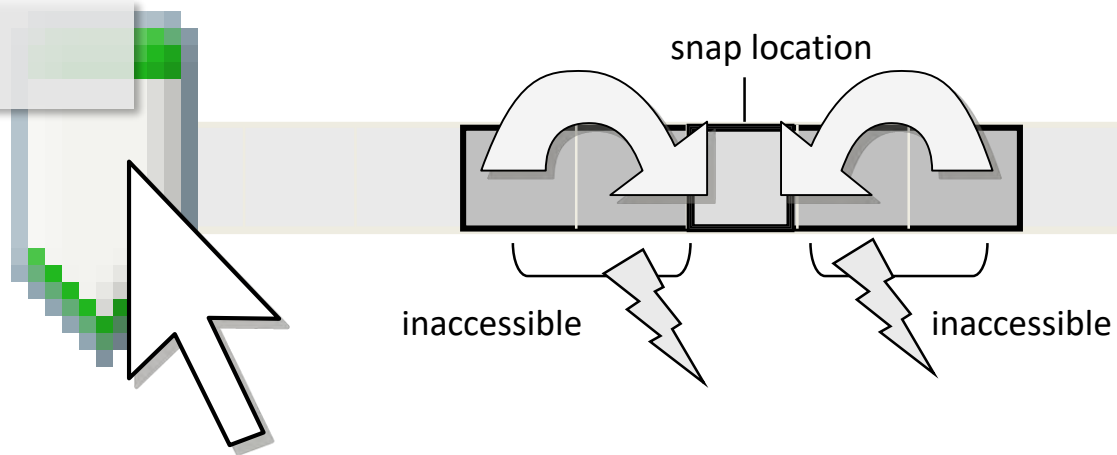


Constraints

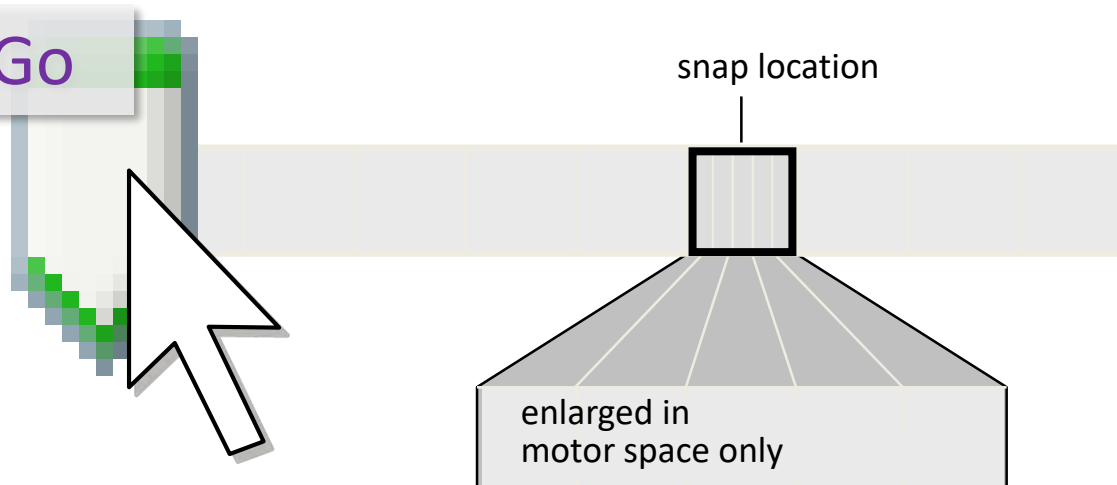


Constraints

Traditional



Snap-And-Go



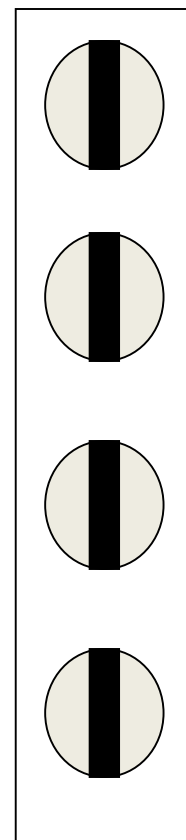
Mapping

Correspondence between an interface and the corresponding action in 'the world'

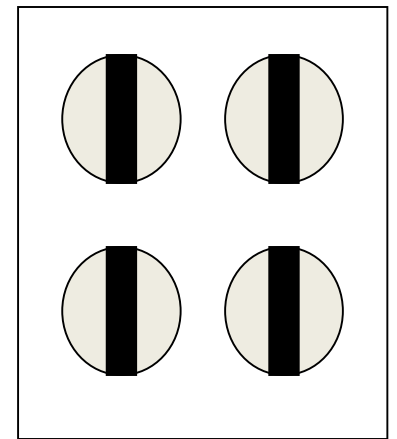
Minimize cognitive steps to transform action into effect, or perception into comprehension (i.e., execution and evaluation)



Very Bad Mapping



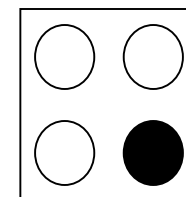
Slightly Better Mapping



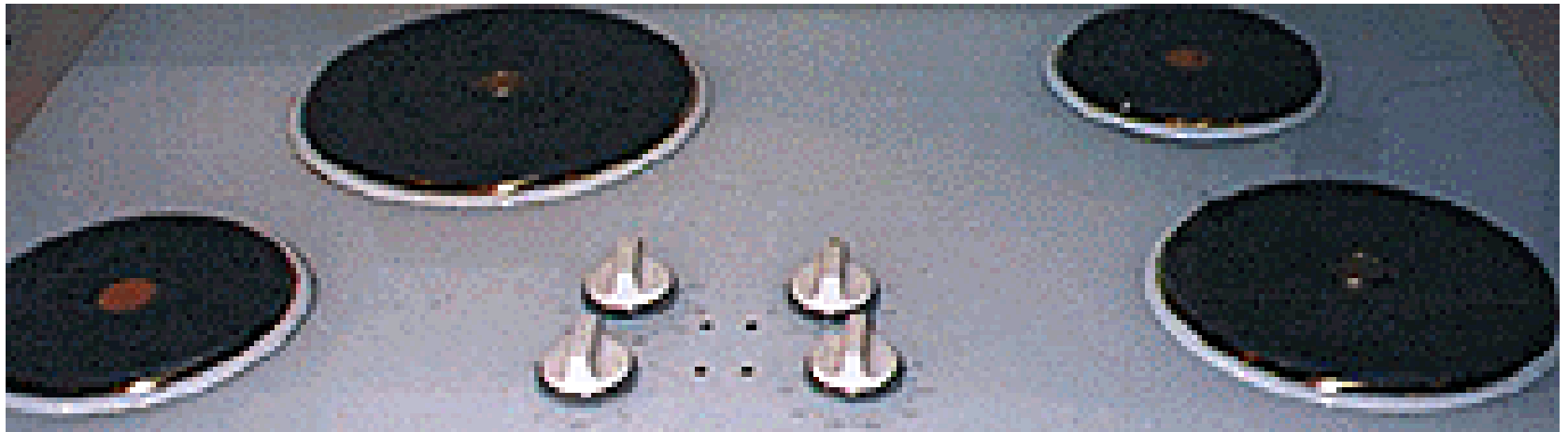
Good Mapping



Not this Stove



Great Mapping



Mapping



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

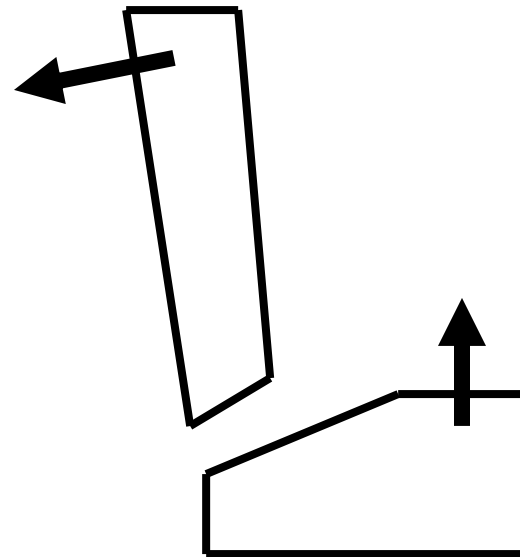
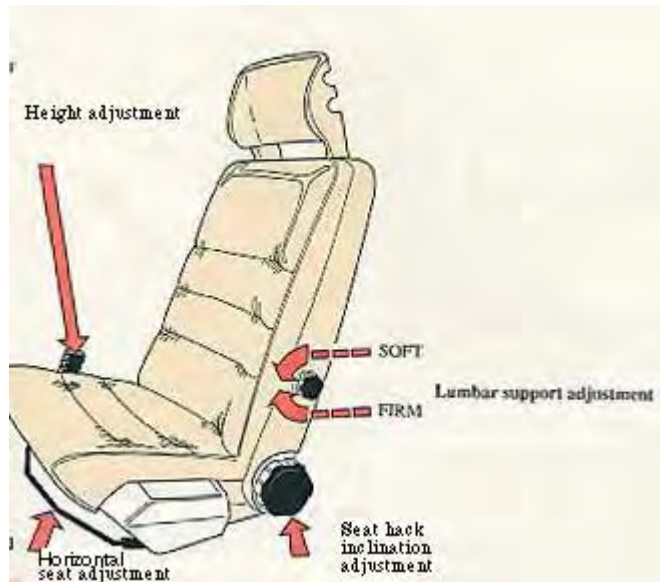


From <http://fivesketches.com/2009/11/natural-mapping-of-switches/>

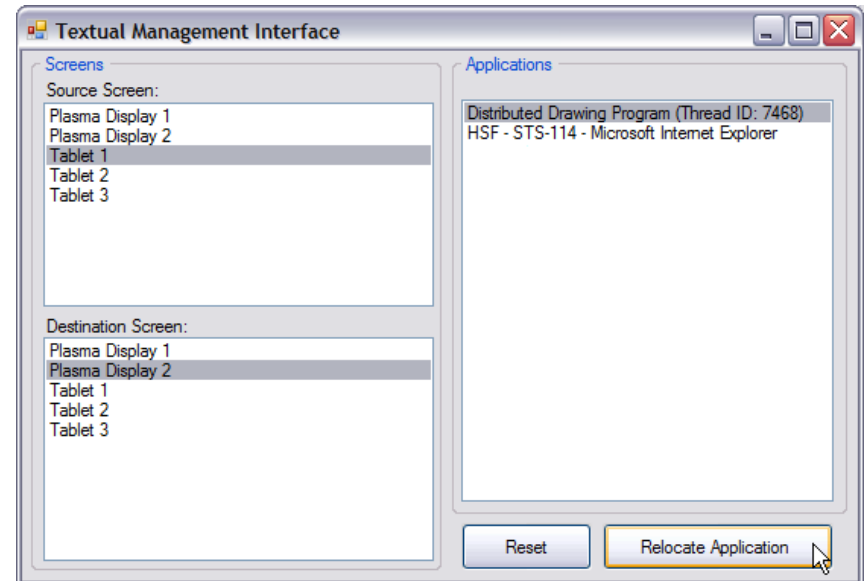
Mapping



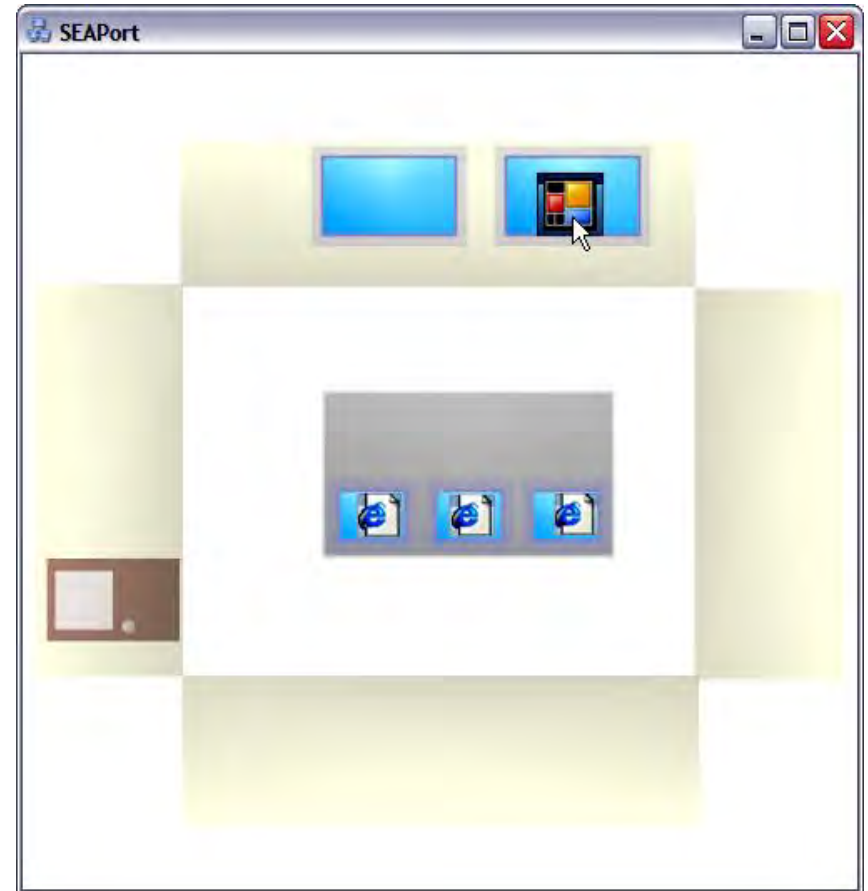
Mapping



Mapping



Mapping



Consistency

Interfaces should be meaningfully consistent

Ubiquitous use of same keys for cut/copy/paste

Helps in developing / applying a mental model

Types of consistency

Internal (i.e., within itself)

e.g., same terminology and layout throughout

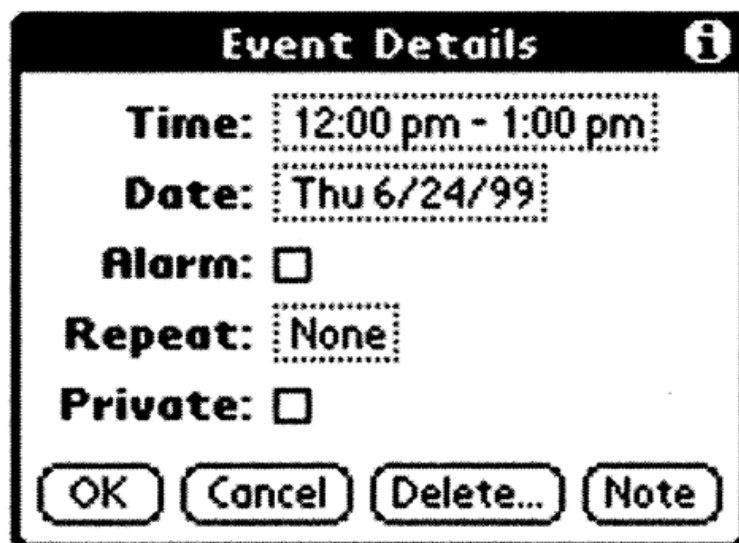
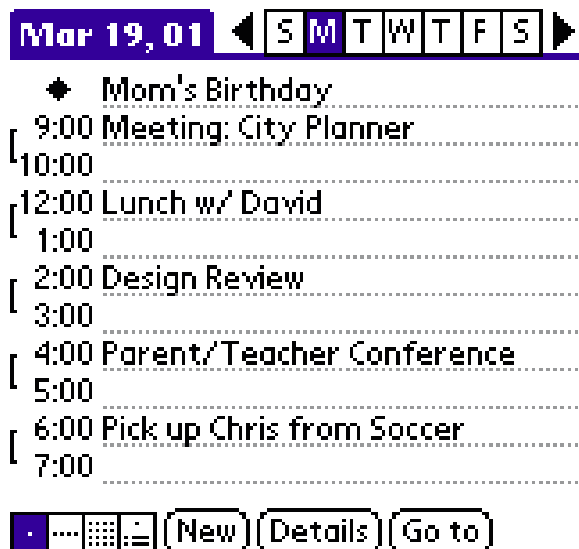
External (i.e., with other applications)

e.g., common widget appearance

e.g., design patterns common across applications

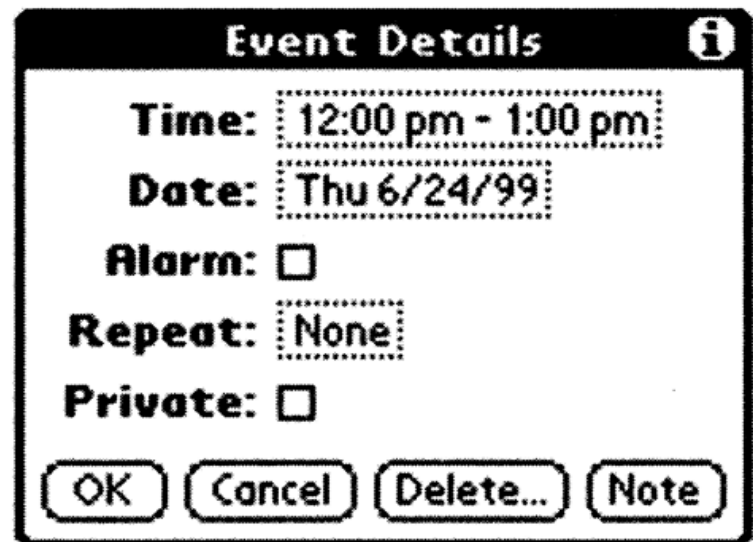
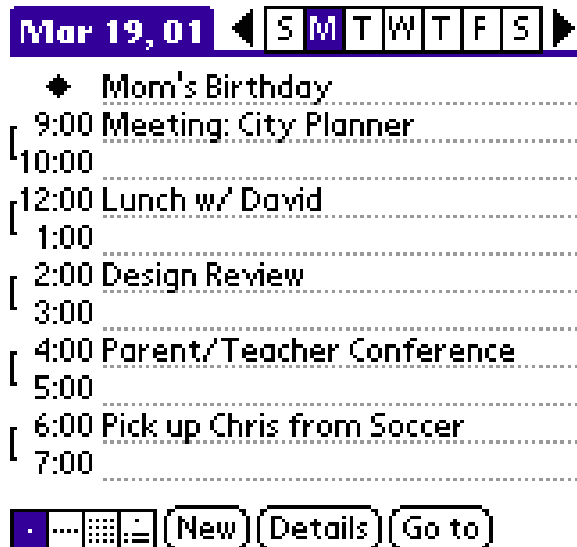
Is Consistent Always Better?

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?



Event Details ⓘ

Time: 12:00 pm - 1:00 pm

Date: Thu 6/24/99

Alarm:

Repeat:

None Day **Week** Month Year

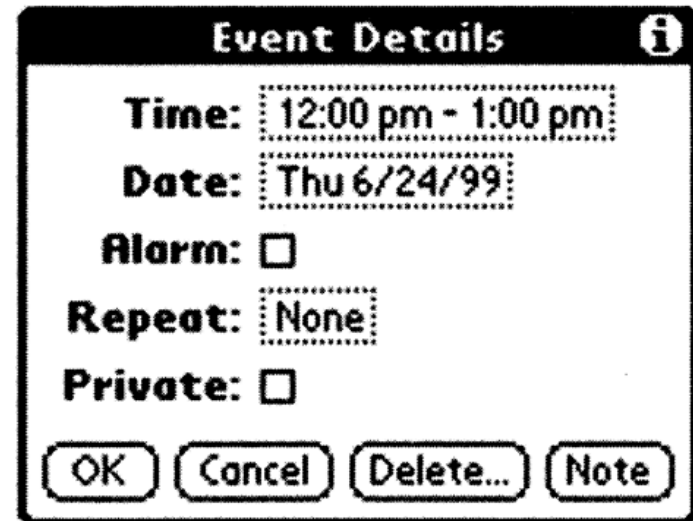
Every: ... 1 week(s)

End on: ▼ No End Date

Repeat on: S M T W T F S

Private:

OK Cancel Delete... Note



Event Details ⓘ

Time: 12:00 pm - 1:00 pm

Date: Thu 6/24/99

Alarm:

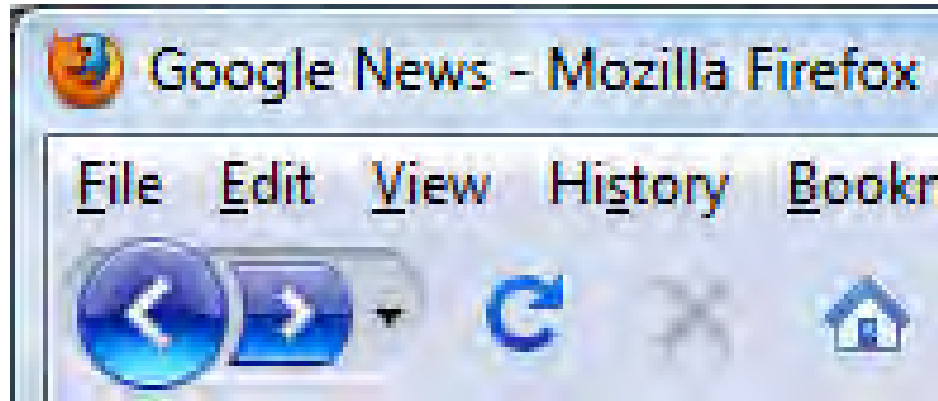
Repeat: None

Private:

OK Cancel Delete... Note

Original focus on consistency,
later design for mobile form

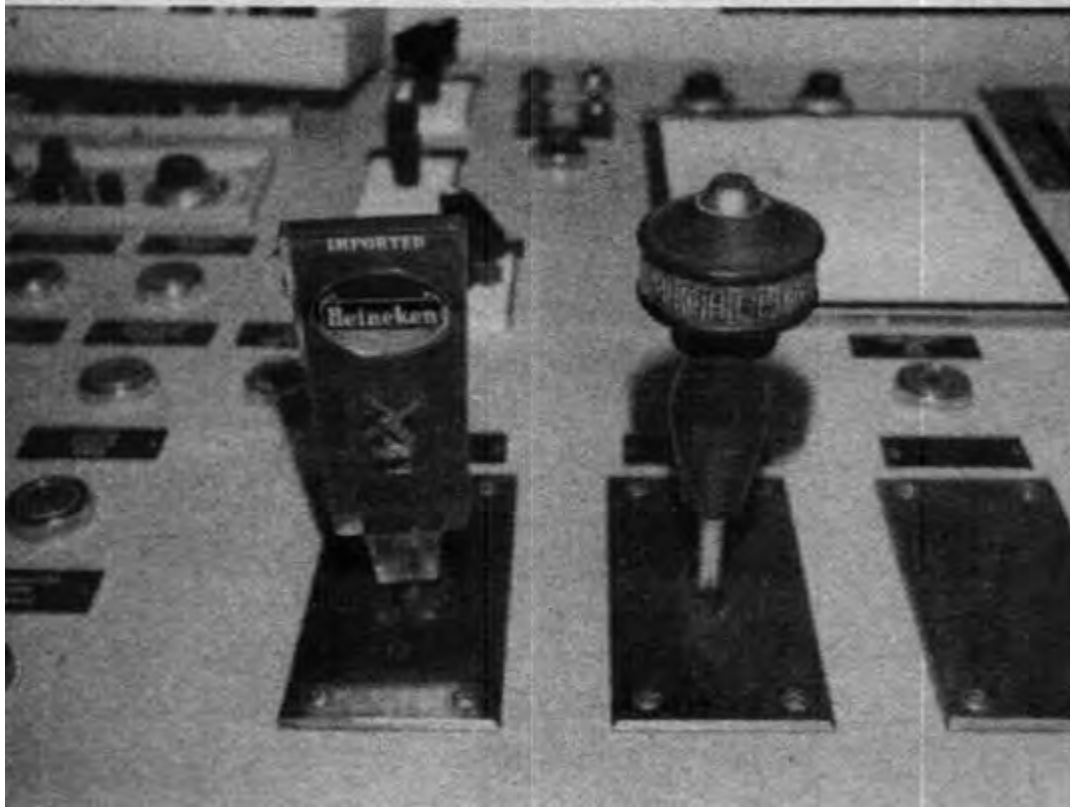
Is Consistency Always Better?



Is Consistency Always Better?

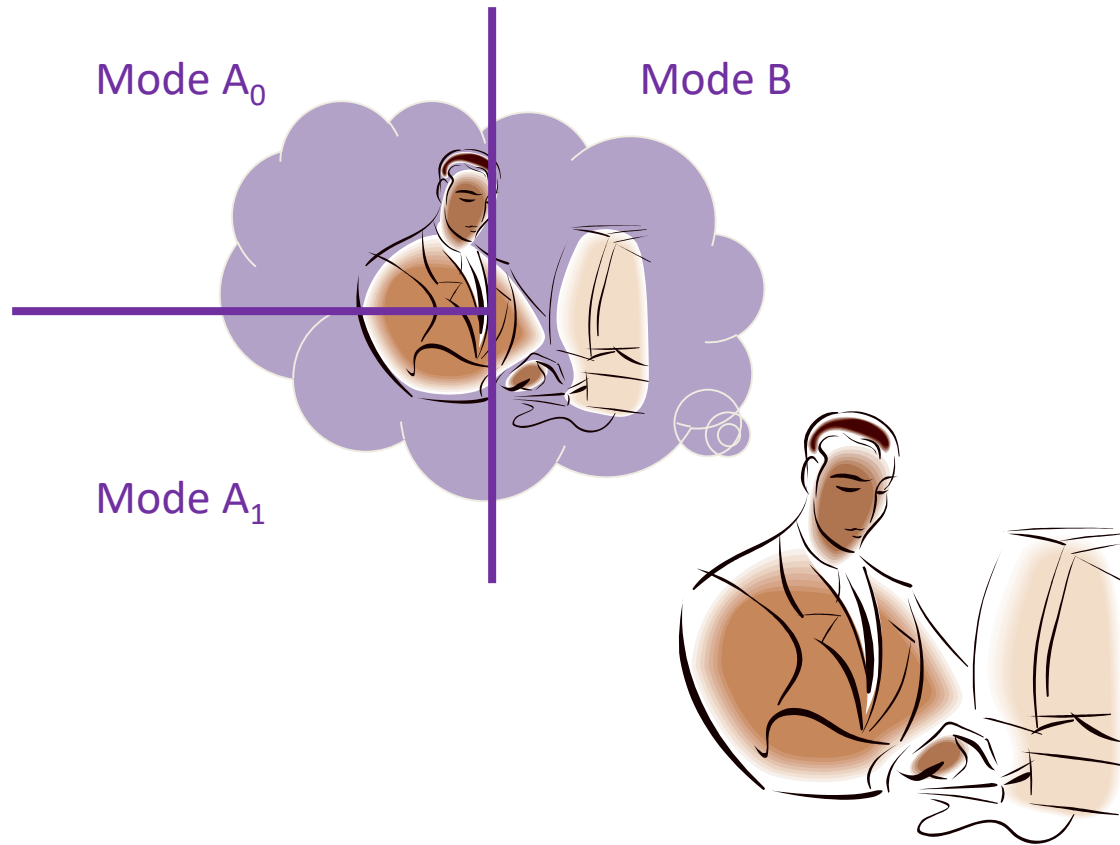


Is Consistency Always Better?



Modes

Modes force people to divide their model



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

CSE 440: Introduction to HCI

User Interface Design, Prototyping, and Evaluation

Lecture 06:
Design of
Everyday Things

Tuesday / Thursday
12:00 to 1:20

James Fogarty
Kailey Chan
Dhruv Jain
Nigini Oliveira
Chris Seeds
Jihoon Suh