CSE 440: Introduction to HCI

User Interface Design, Prototyping, and Evaluation

Lecture 02:
Design of Everyday Things

James Fogarty

Daniel Epstein

Brad Jacobson

King Xia

design:
use:
build:

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

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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

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What is Interaction?

Knocking over a chair

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

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Models of Interaction

Models of interaction allow a closer look

Define and describe an interaction

Isolate areas where problems occur

Design new interaction

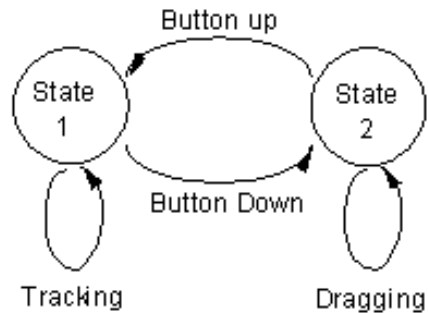Two examples at different scales

Buxton's 3-State Model

Norman's Execution-Evaluation Cycle

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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

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Buxton's 3-State Model

Mouse

Touchpad

Stylus

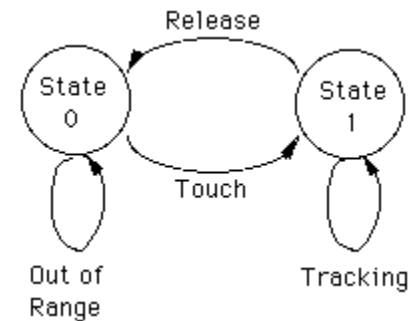## Touch Screen

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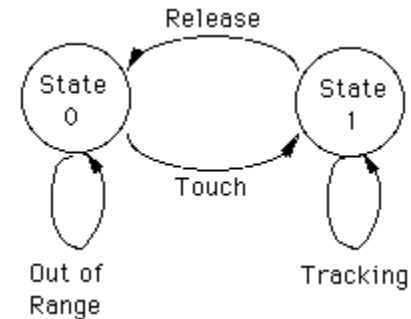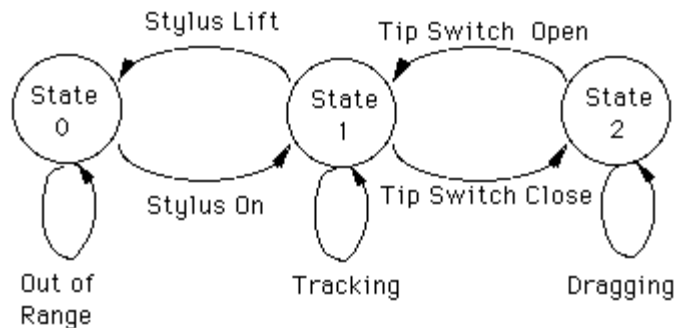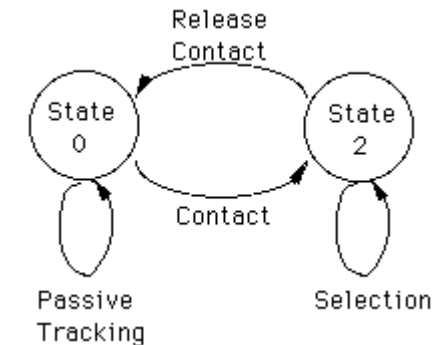
Buxton's 3-State Model
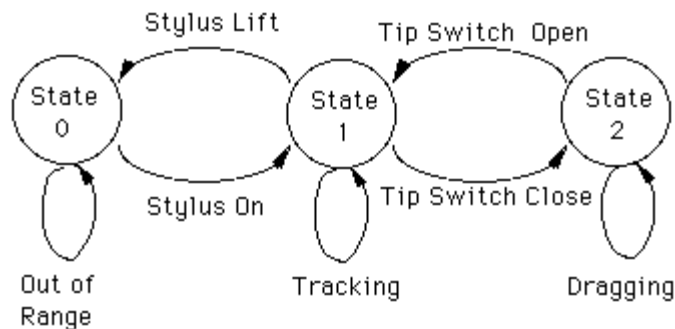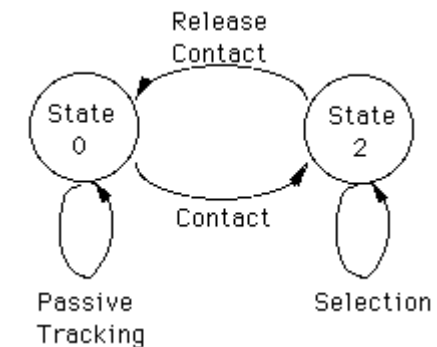
Mouse
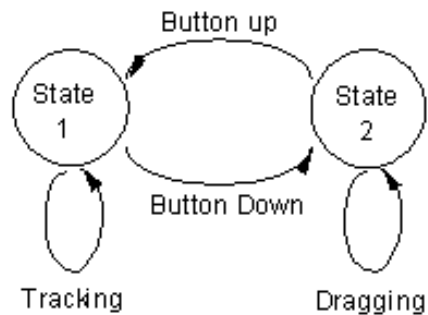
Touchpad

Stylus

Touch Screen

Which can support tooltip previews?

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
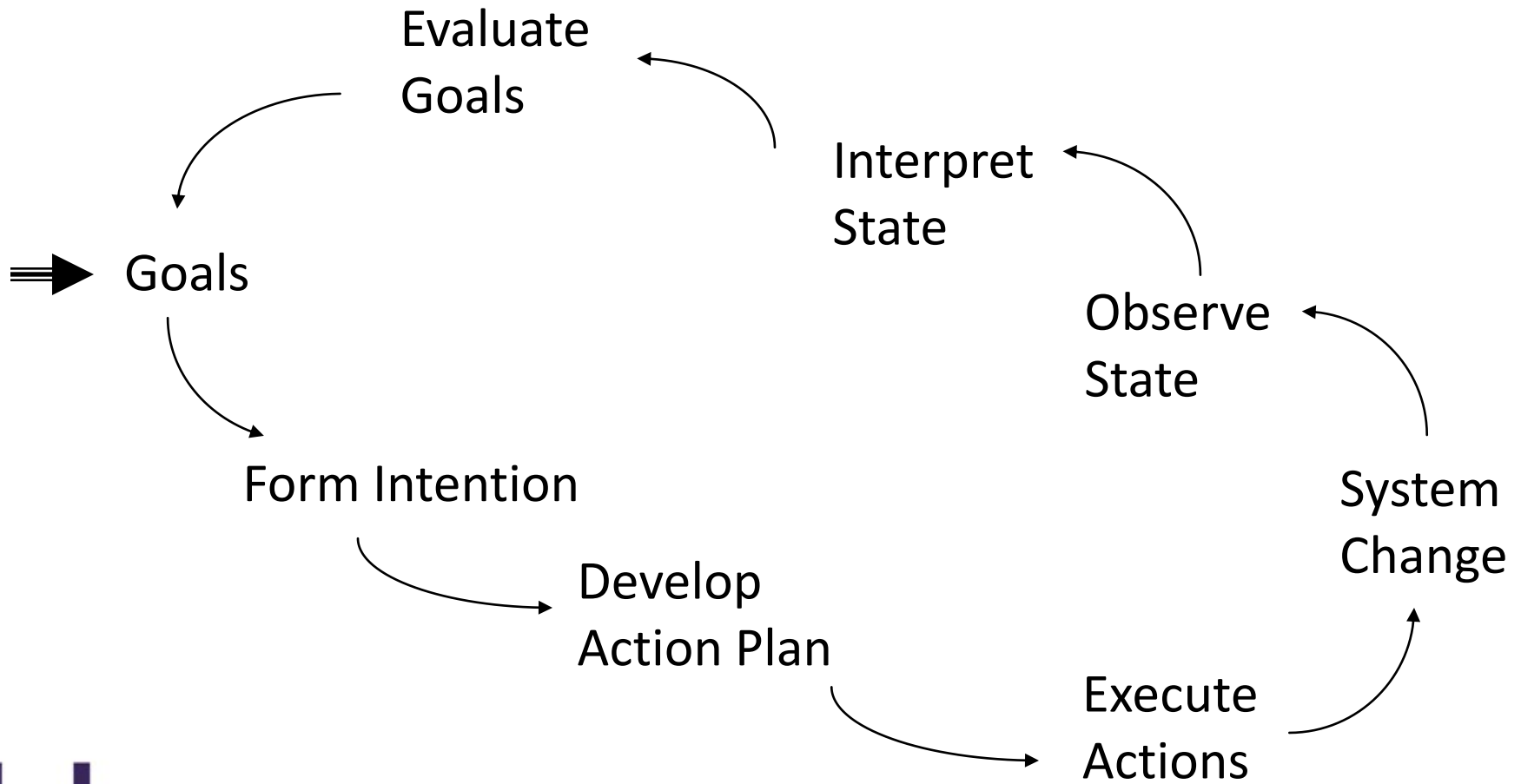
   [hear "click" sound, see light from lamp]

6. Interpret the system state

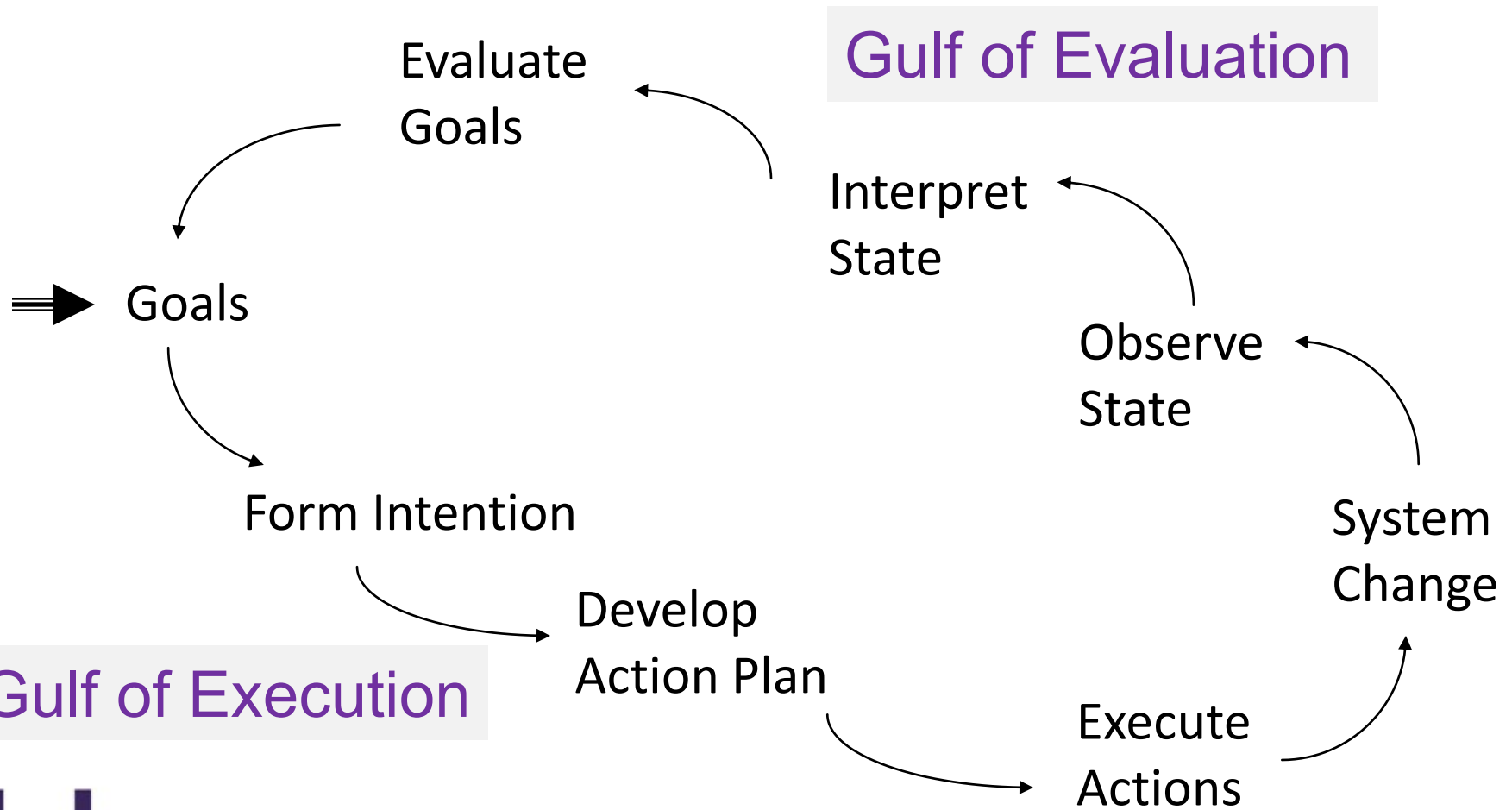   The knob rotated. The lamp is emitting light. The lamp seems to work

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

   The lamp did indeed increase the light in the room [goal satisfied]

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Norman's Execution-Evaluation Cycle

Evaluate Goals

Interpret State

Goals

Observe State

Form Intention

System Change

Develop Action Plan

Execute Actions

Norman's Execution-Evaluation Cycle

Evaluate Goals

Gulf of Evaluation

Interpret State

Goals

Observe State

Form Intention

System Change

Gulf of Execution

Develop Action Plan

Execute Actions

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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

(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)

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)

These terms are sloppy and ambiguous out in the world

Mental Model

How a person thinks it works

(aka User Model, User's Conceptual Model)

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Manifest and Mental Models
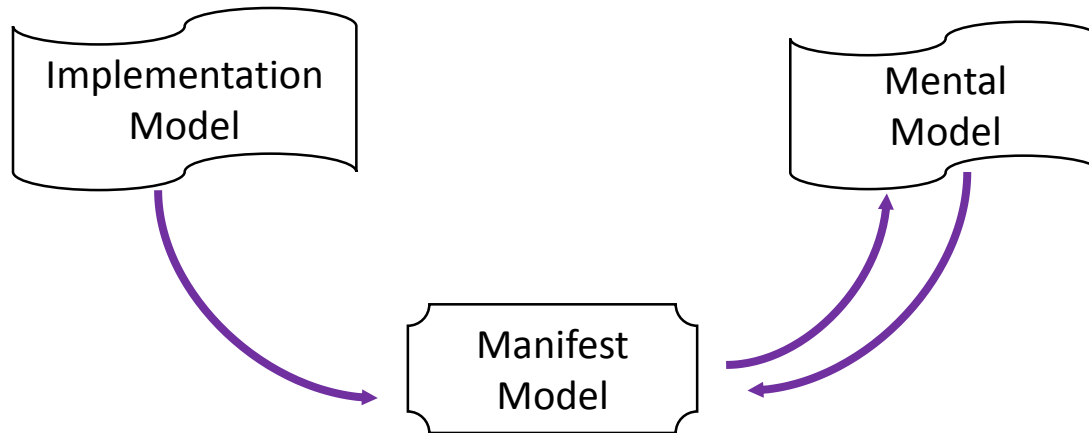
Designer projects their model into an artifact

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

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Mental Models

Problem: freezer too cold, fresh food just right
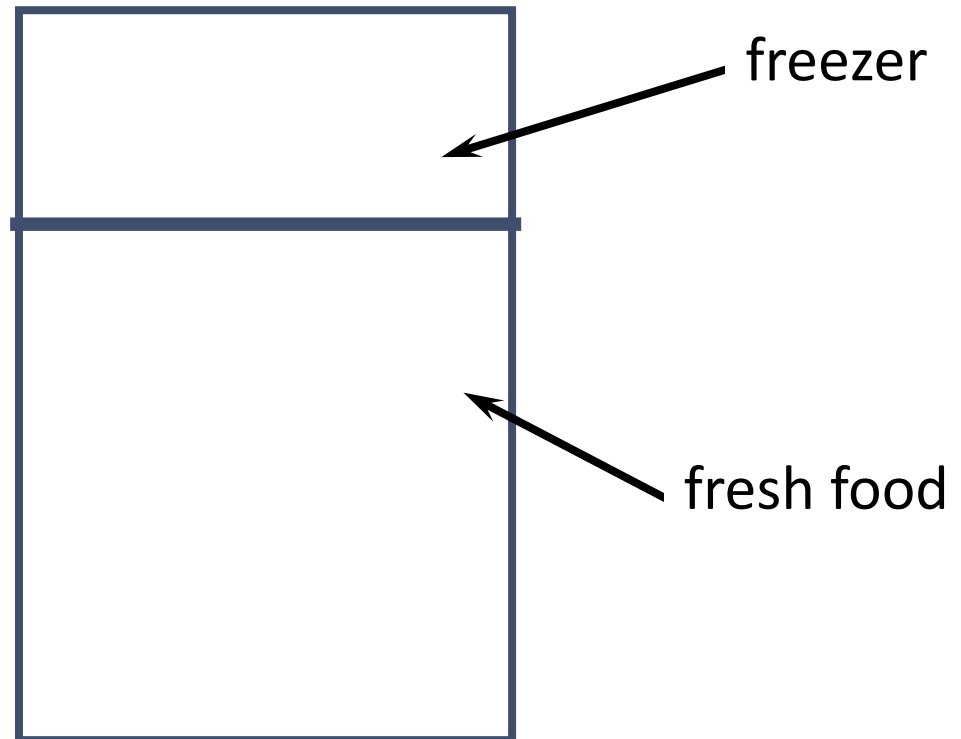
freezer

fresh food

Manifest Model
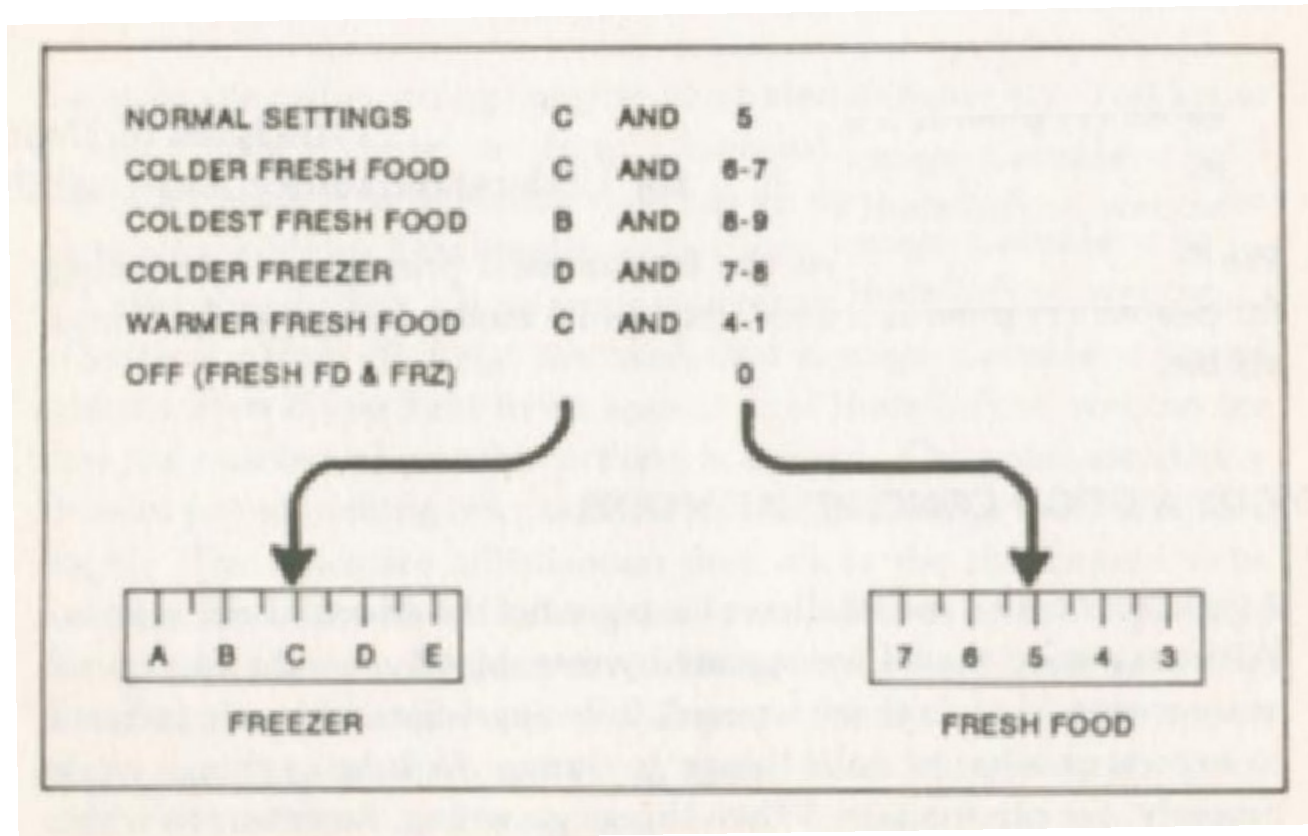
What if I want to make just the freezer warmer?

A Sensible Mental Model
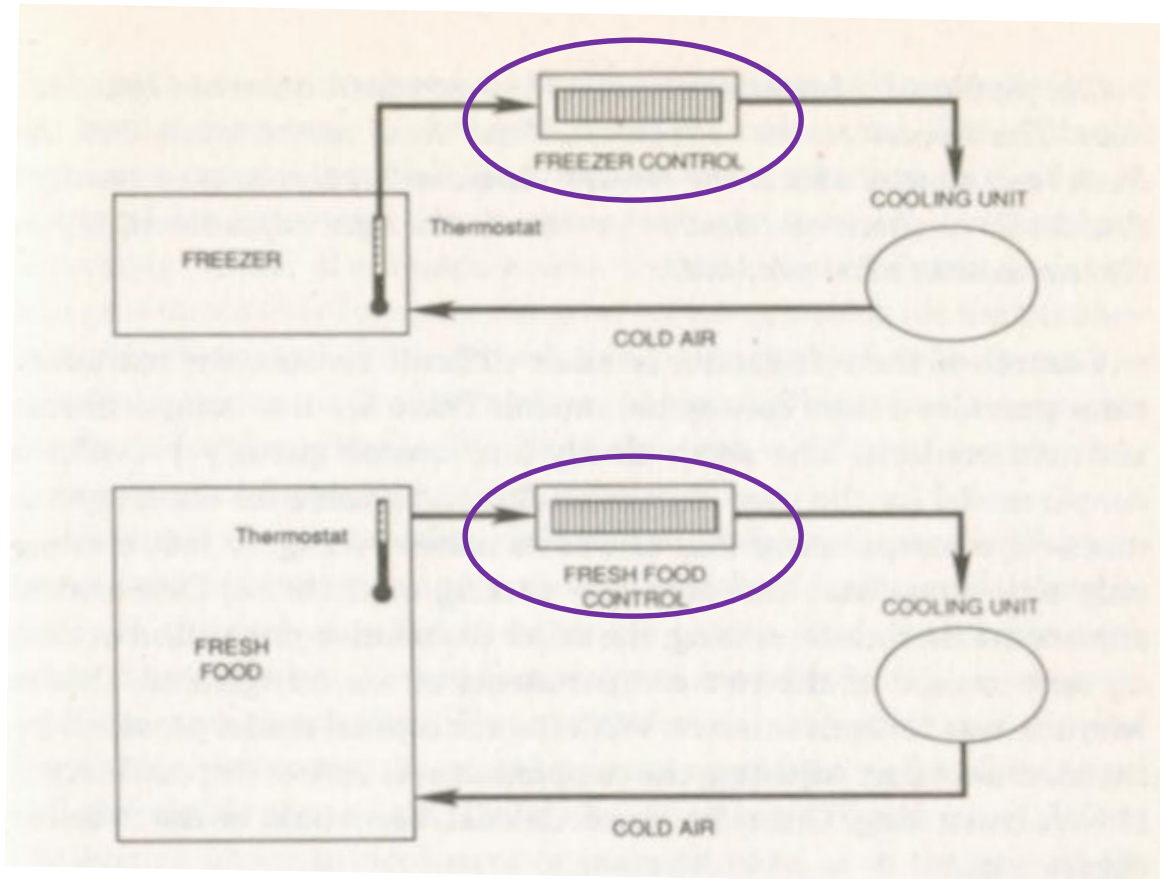
"The Freezer Control controls the freezer temperature and the Fresh Food Control controls the fresh food temperature"

The Implementation Model
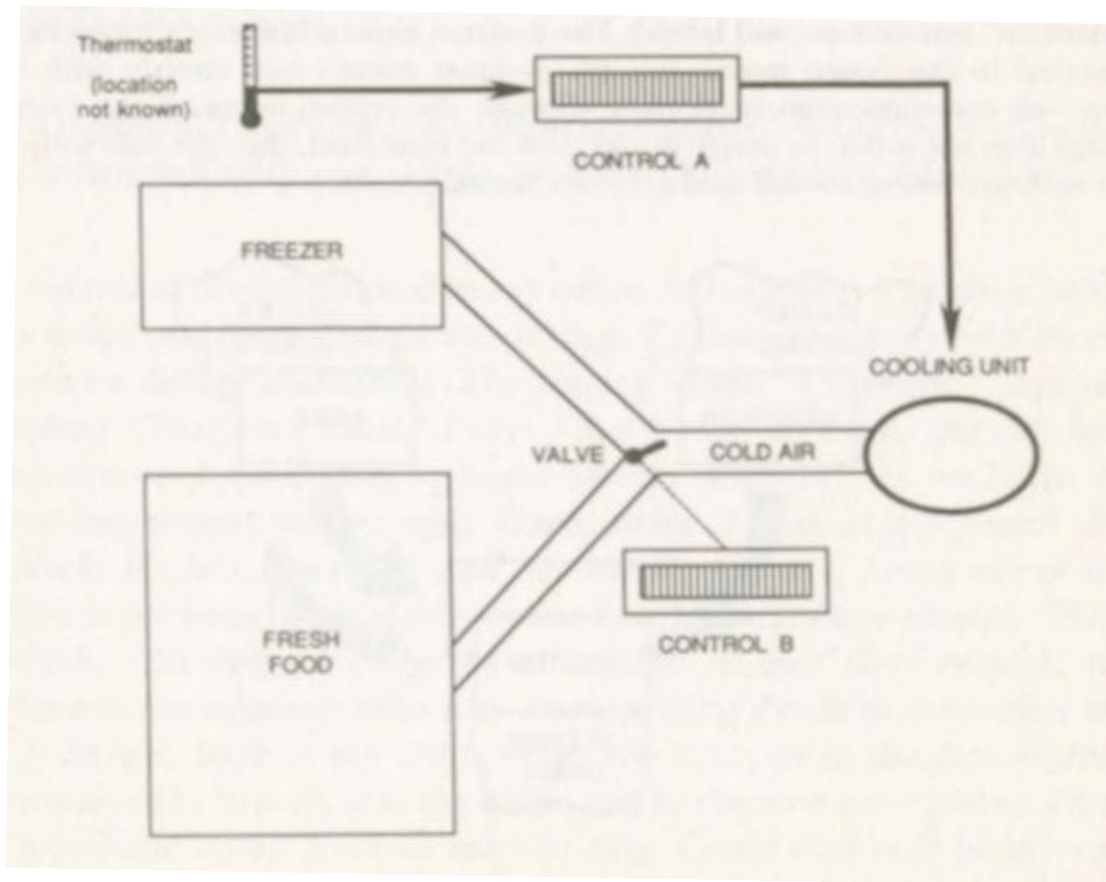
A Problem with Feedback
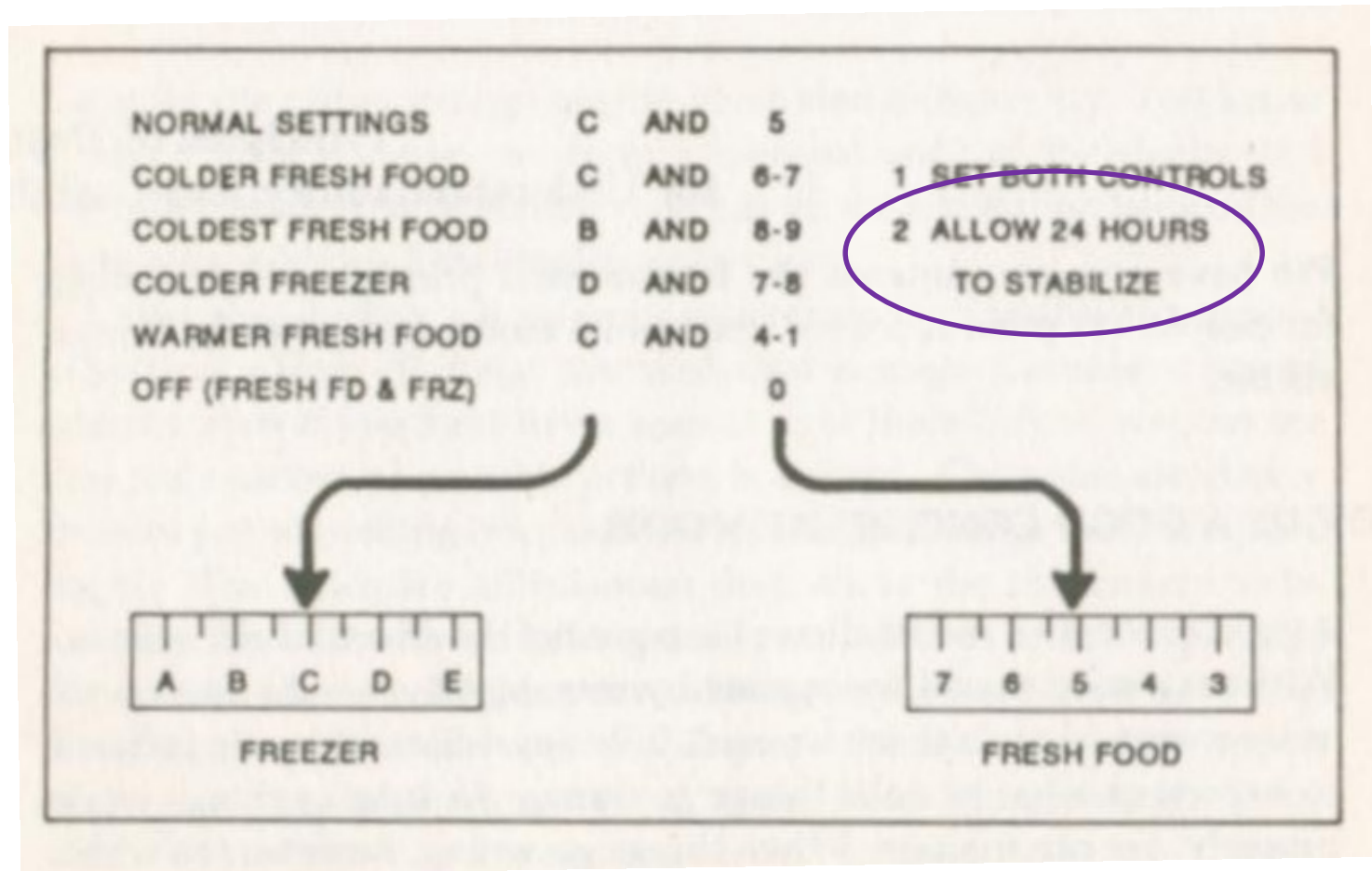
The Implementation Model
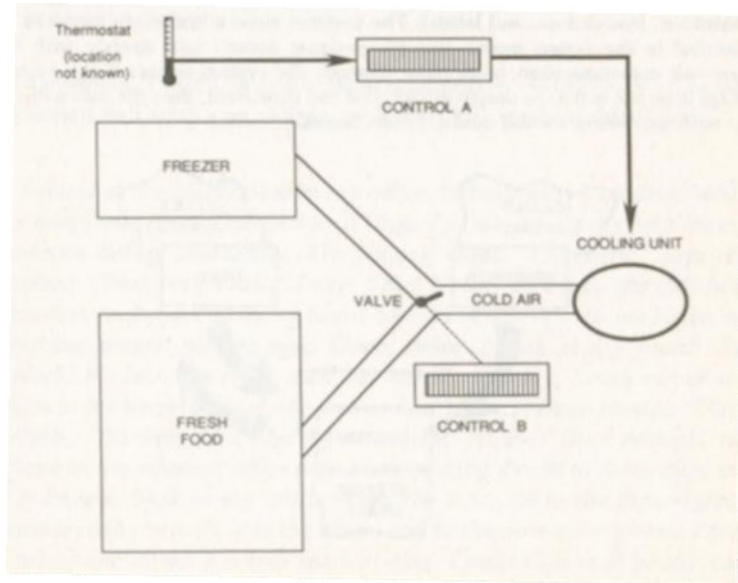
Why do we have a problem?

Can you fix the problem?

The Implementation Model
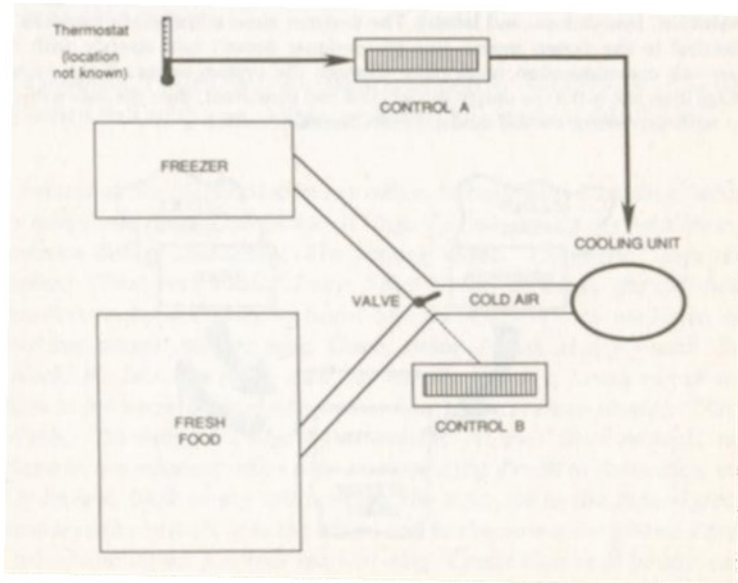
Why do we have a problem?

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
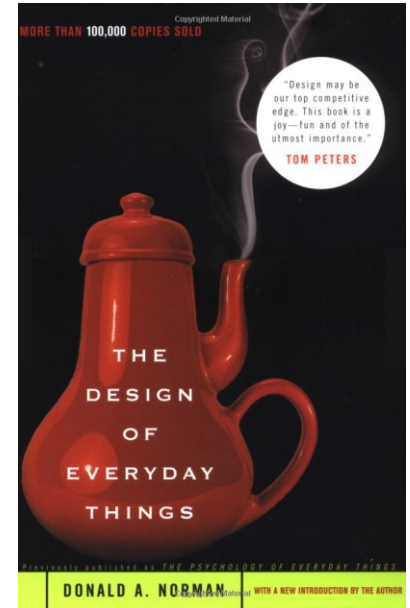
How can we help people build the right models:

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, 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

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What's the Affordance?

Affordances

Affordances

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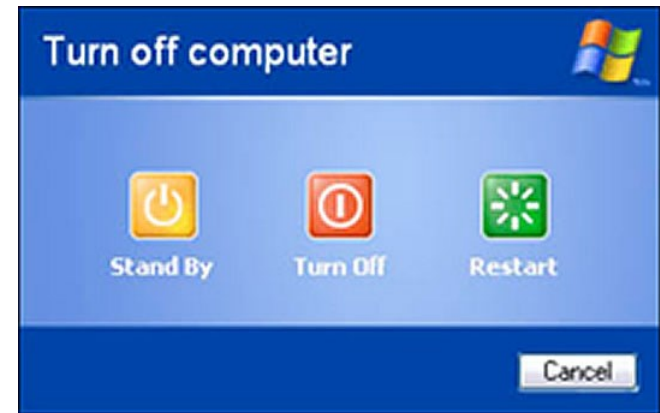
Affordances

What is the affordance here?
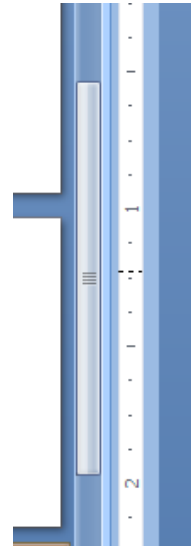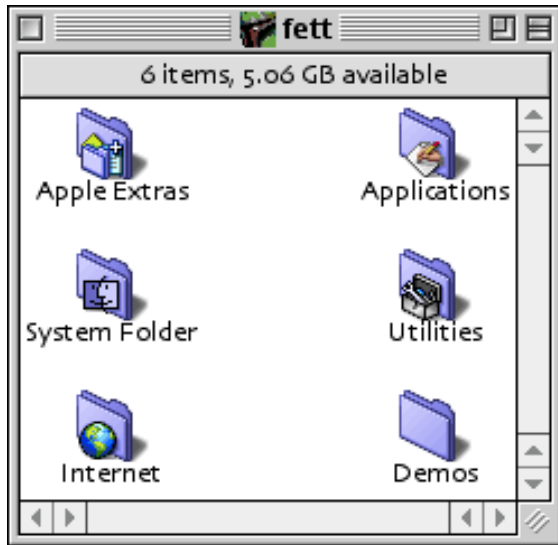
Where does it come from?

Affordances

What is the affordance here?
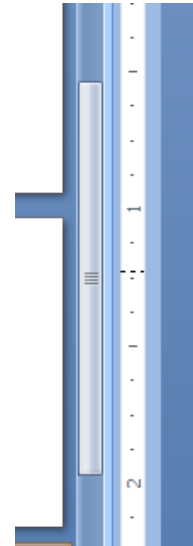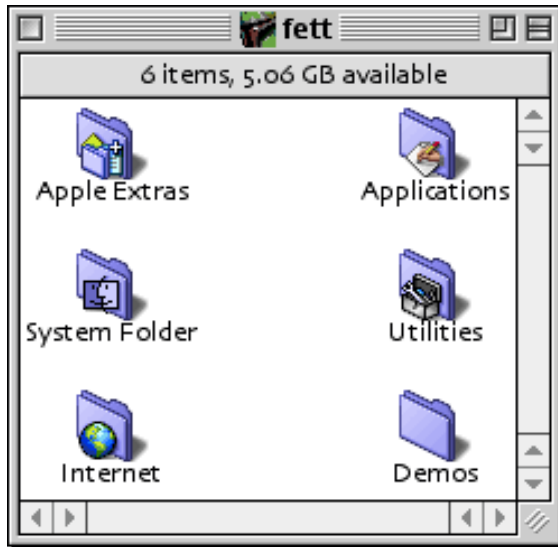
Where does it come from?

Knurling
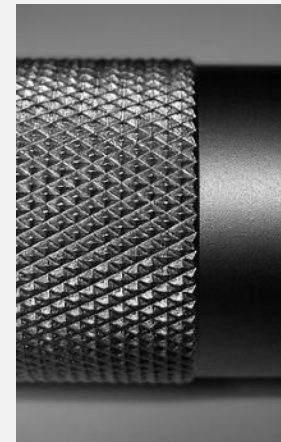
Sequential Affordance
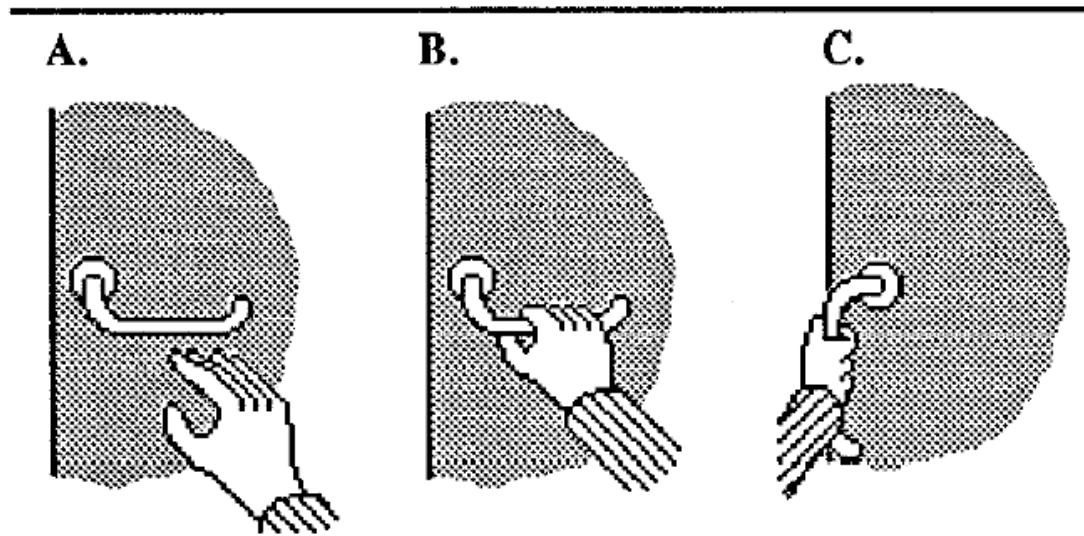
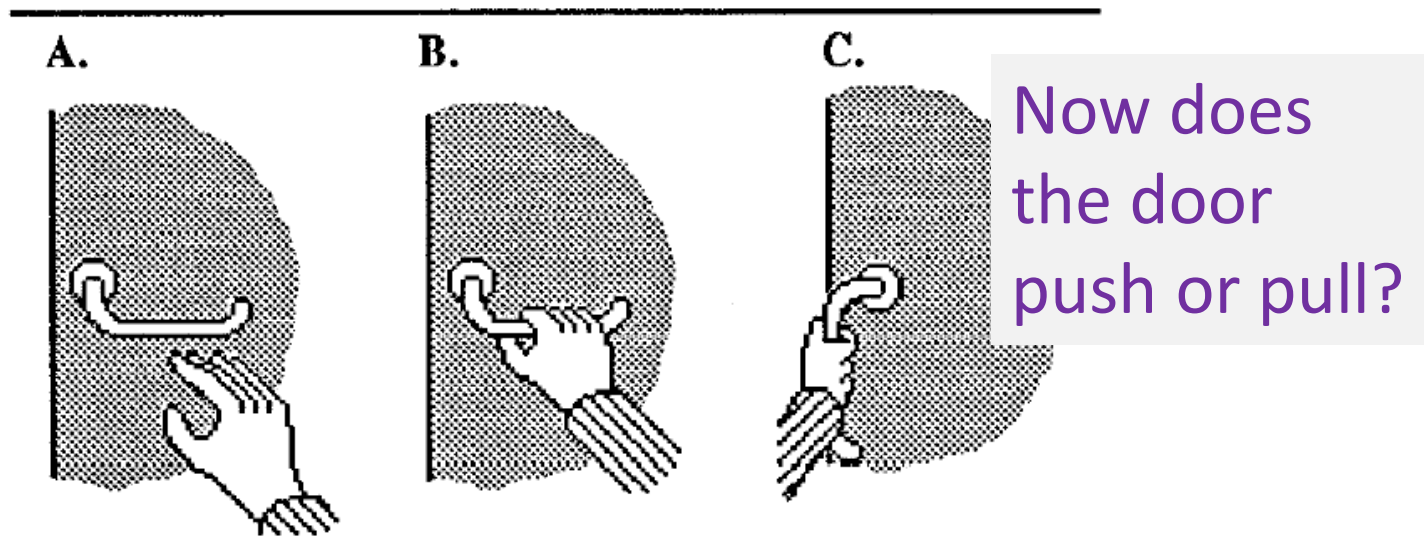Acting on a perceptible affordance leads to information indicating new affordances

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

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Sequential Affordance

Acting on a perceptible affordance leads to information indicating new affordances

A.   B.   C.

Now does the door push or pull?

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

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Nested Affordances

Affordances due to spatial relationships revealing what actions can be done

Proximate to, contained in, part of
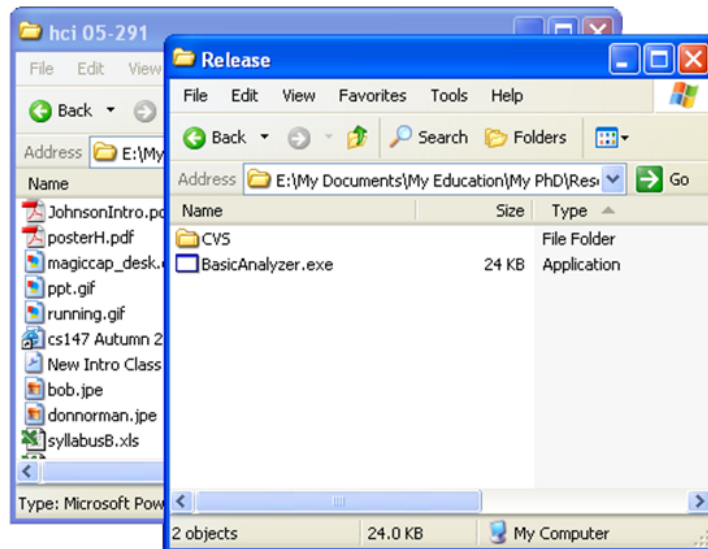
In Other Words

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

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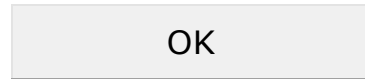
(Just an image of a button, not one that responds)

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False Affordances

False Affordances

False Affordances

False Affordances

THIS IS A MOP SINK

Hidden Affordances

When there is no perceptual information suggesting an actual intended use
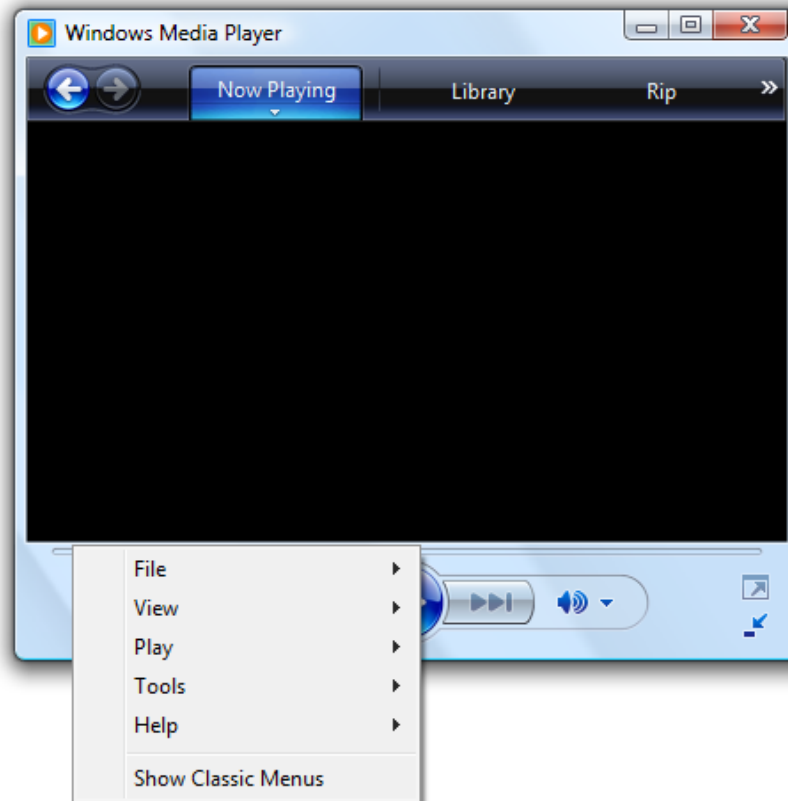
Hidden Affordances
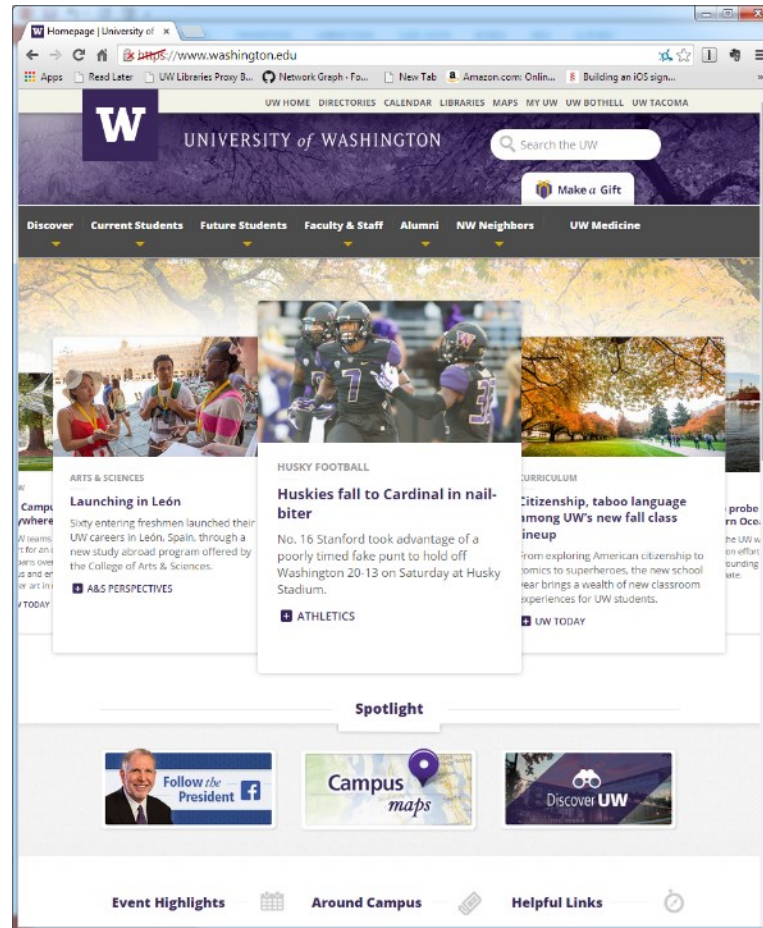
Hidden Affordances
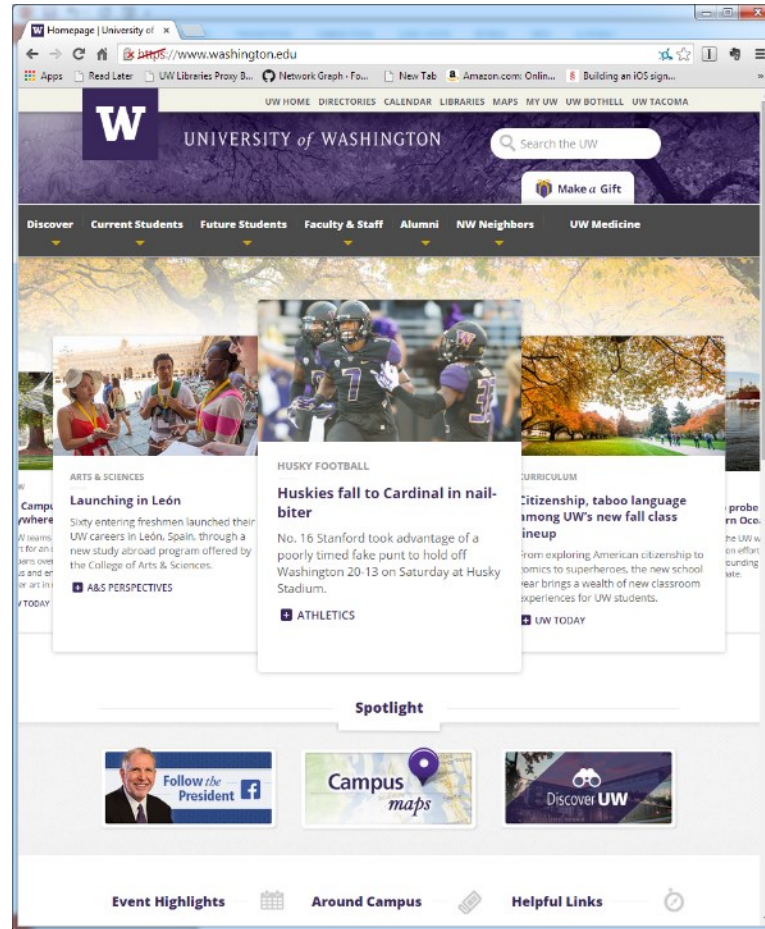
Logos linking to home is a convention, but not afforded by the page

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.

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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
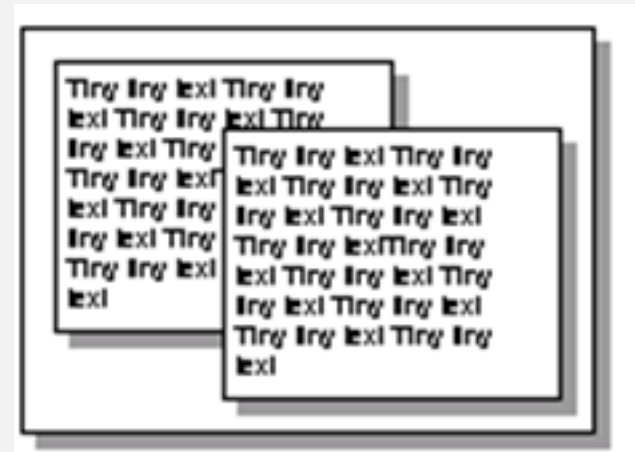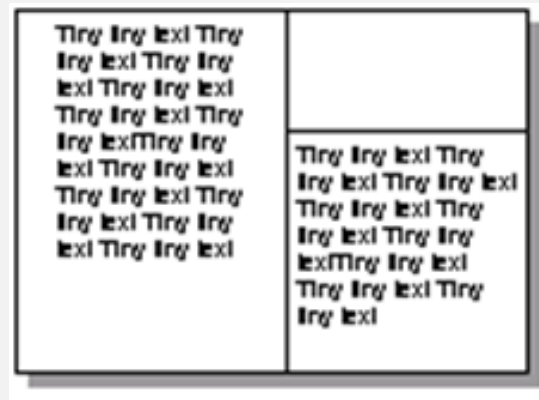
Mail Metaphor
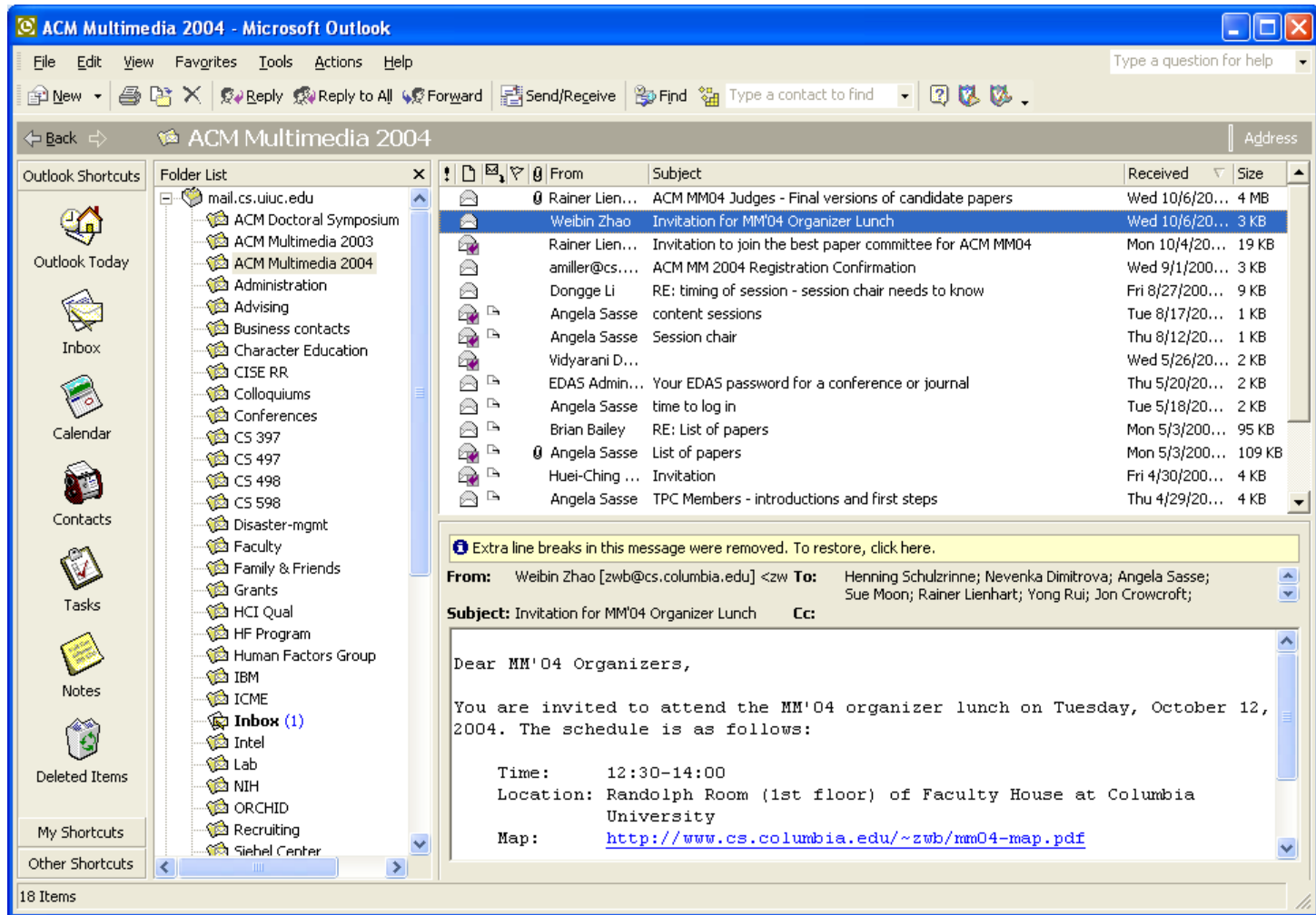
Calendar Metaphor
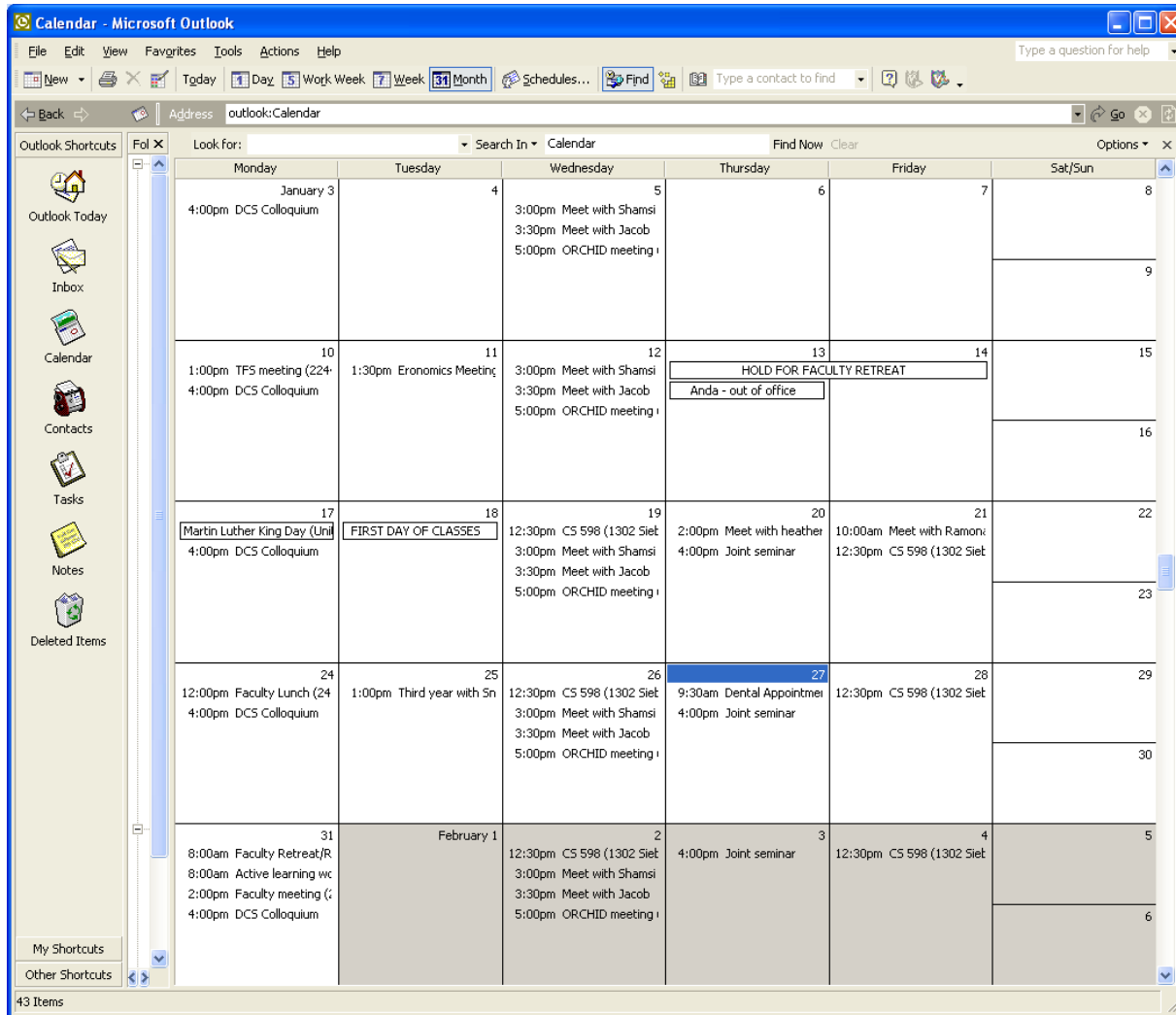
Health Metaphor
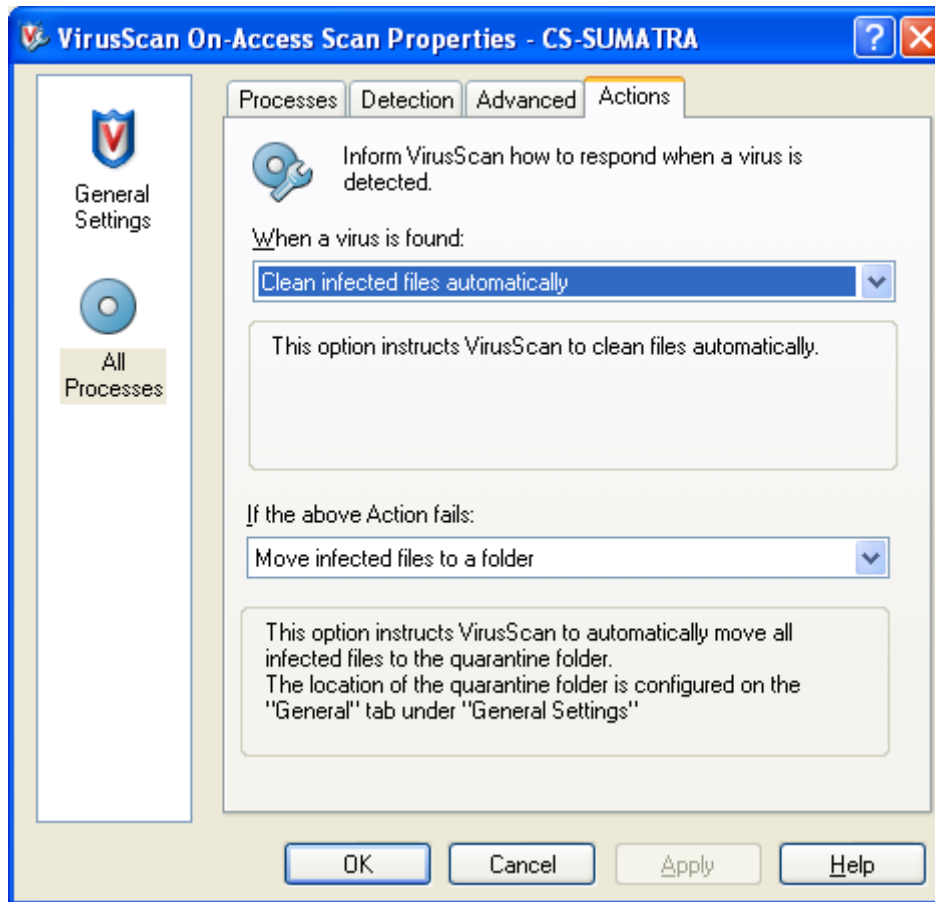
Shallow or Inappropriate Metaphors

Informs a small range of possibilities, or none at all
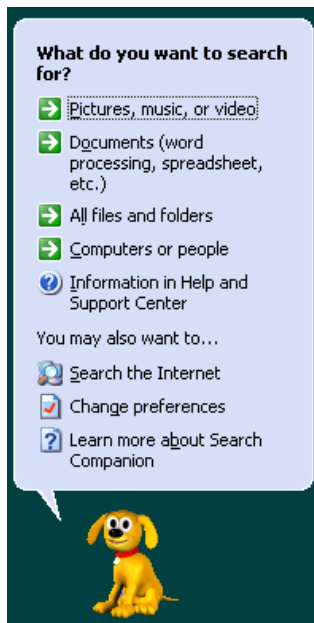
It is just a menu and a dialog box?

What does the living room add?

Magic Cap

Microsoft Bob

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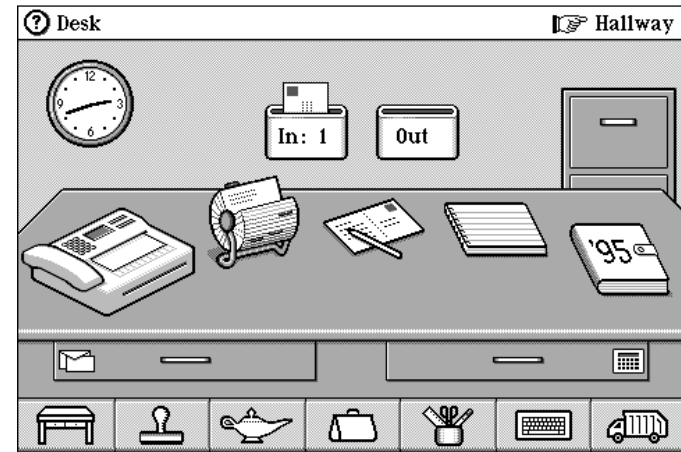
Mixed Metaphors

Two or more different metaphors coexist with some supposed relation

The desktop metaphor

Windows into content

Good? Bad?

Neither? Both?
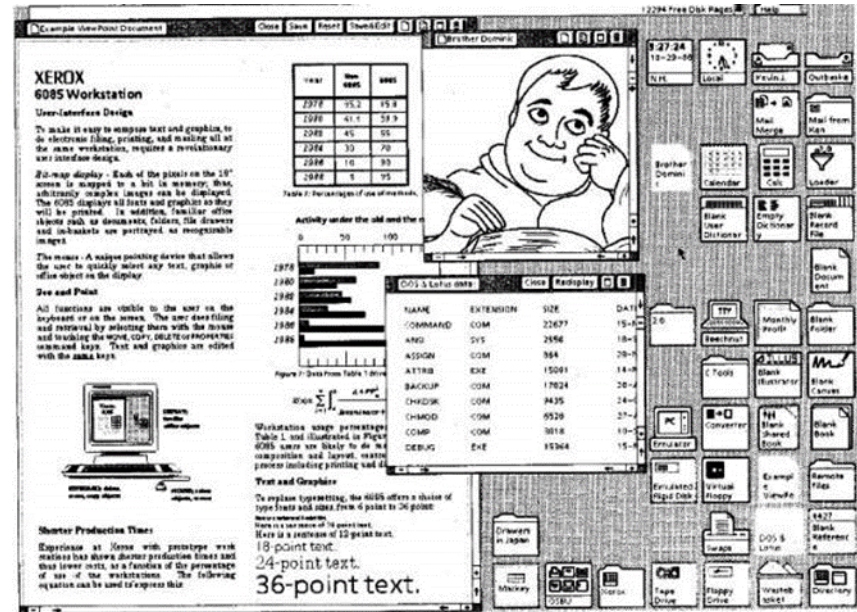
Windows are views into larger content regions

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
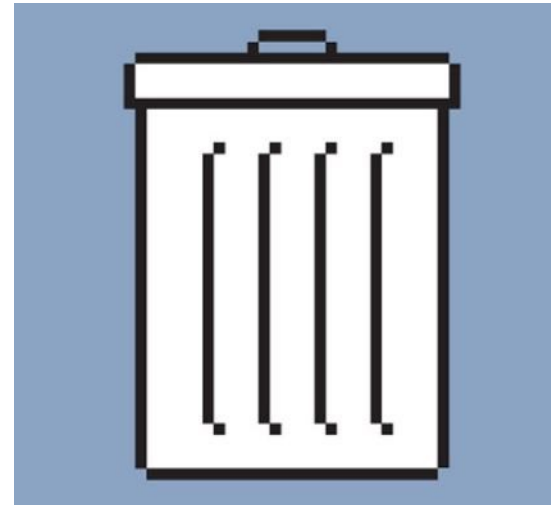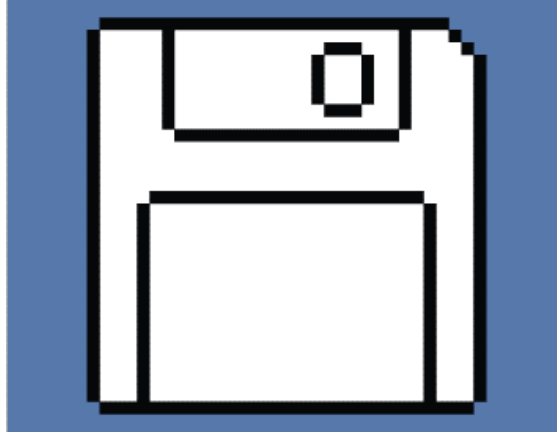
Mechanical-Age Metaphors

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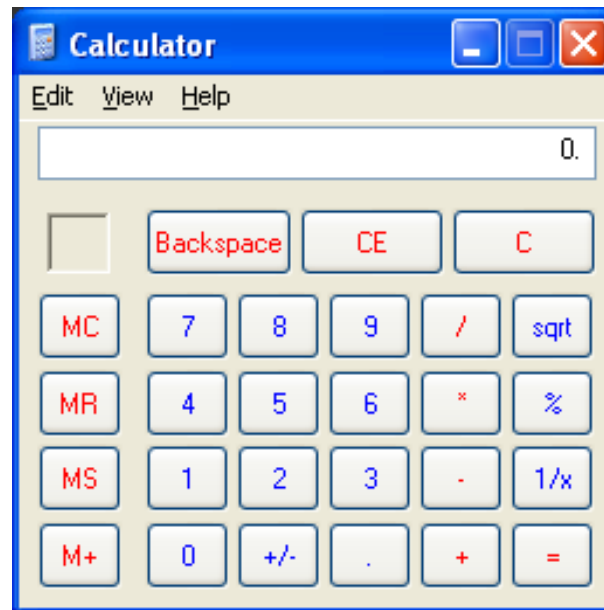
Dead Metaphors

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

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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

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Visibility

Phones

How do you

put somebody on hold

change volume

Visibility

Visibility

Changing Ringer Volume

Press "Program"

Press "6"

Set Volume

Low - Press "1"

Medium - Press "2"

High - Press "3"

Press "Program"

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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

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Knowledge in the World

Constraints

Prevent some actions while allowing others

Prevent errors before they can happen

Disruptive error messages are a last resort

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Constraints

Constraints

Constraints

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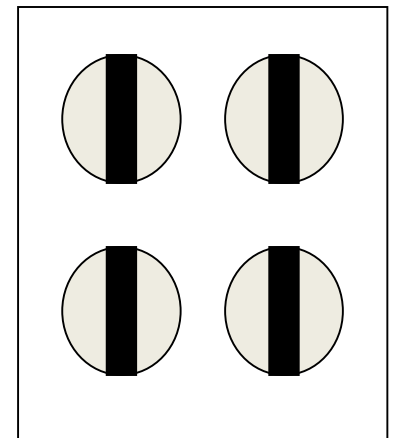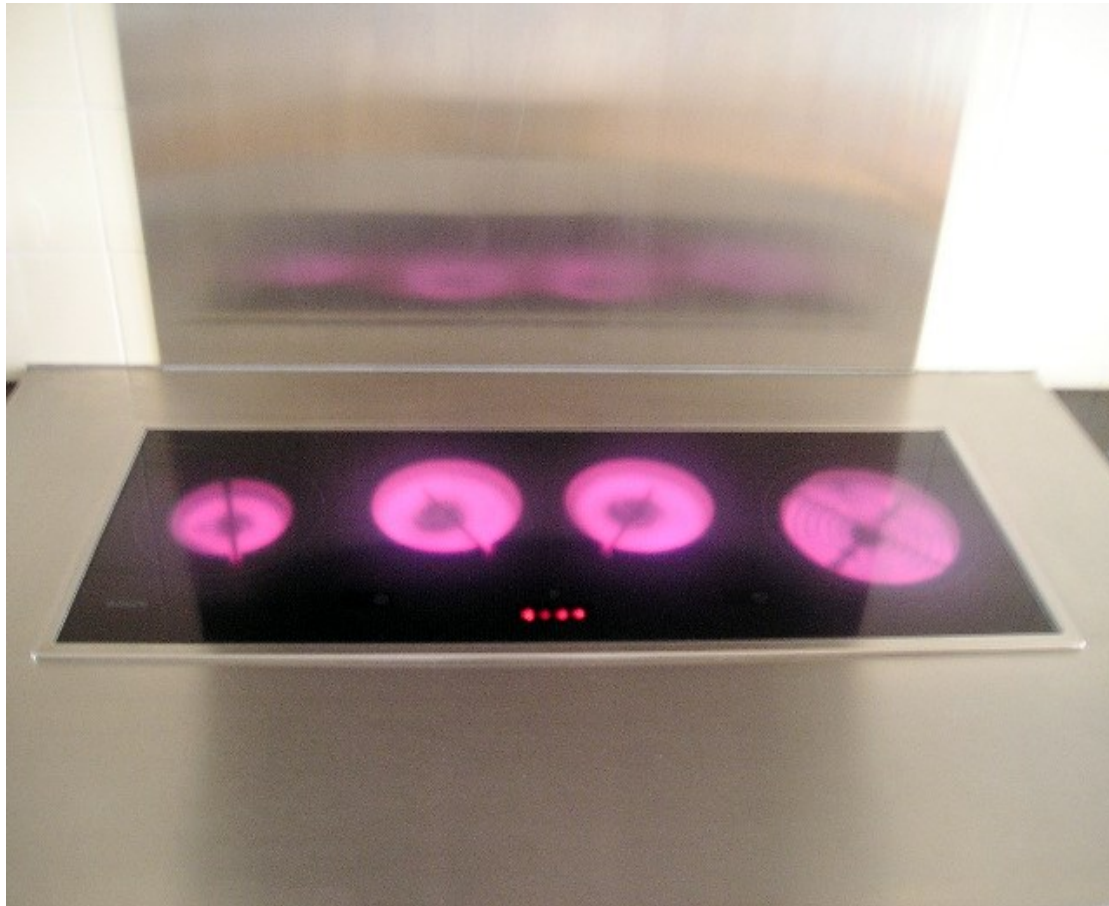
Correspondence between an interface and the corresponding action in 'the world'

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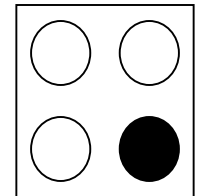
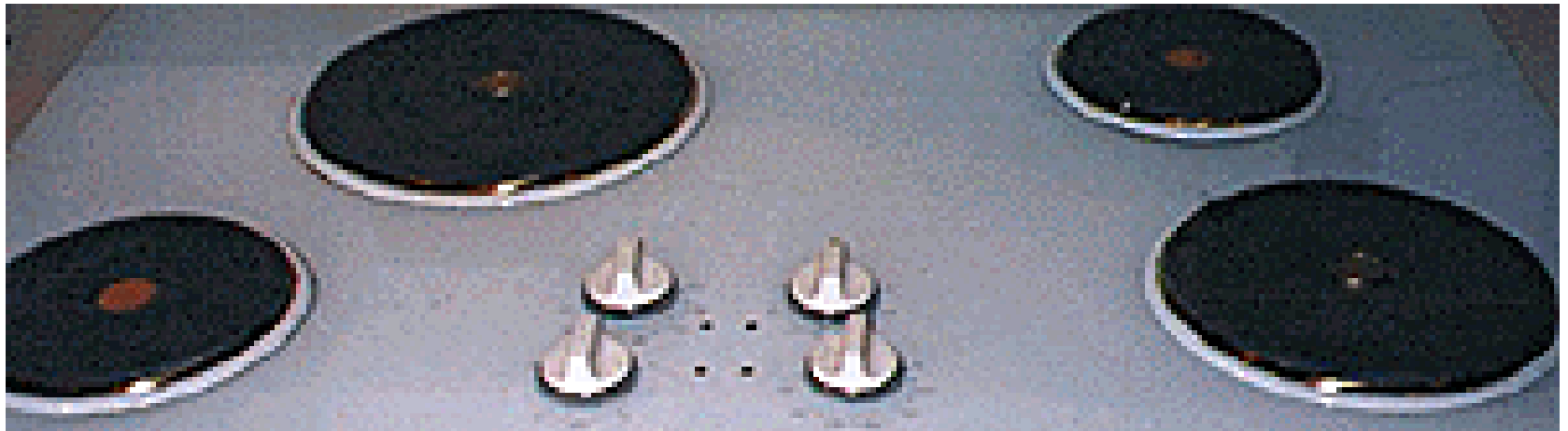# Very Bad Mapping
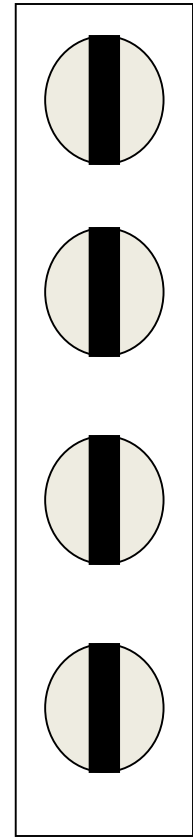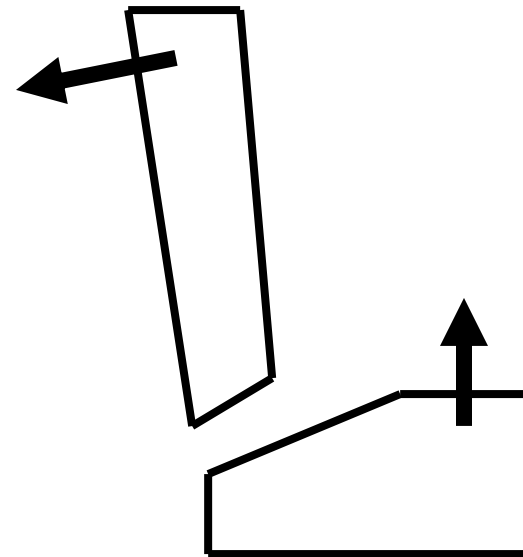
Slightly Better Mapping
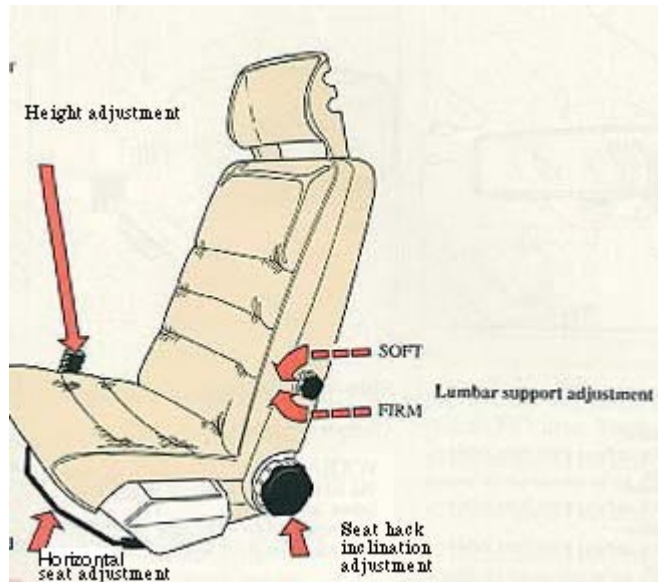
Good Mapping
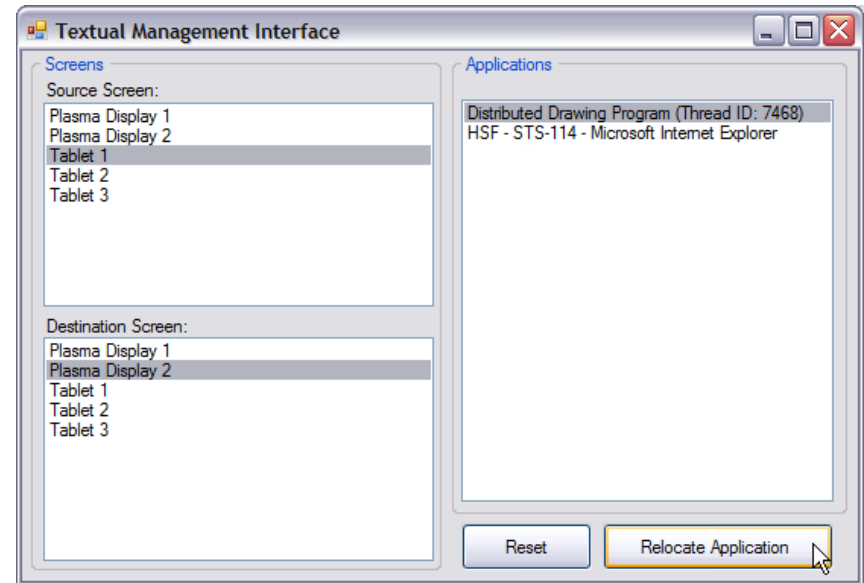
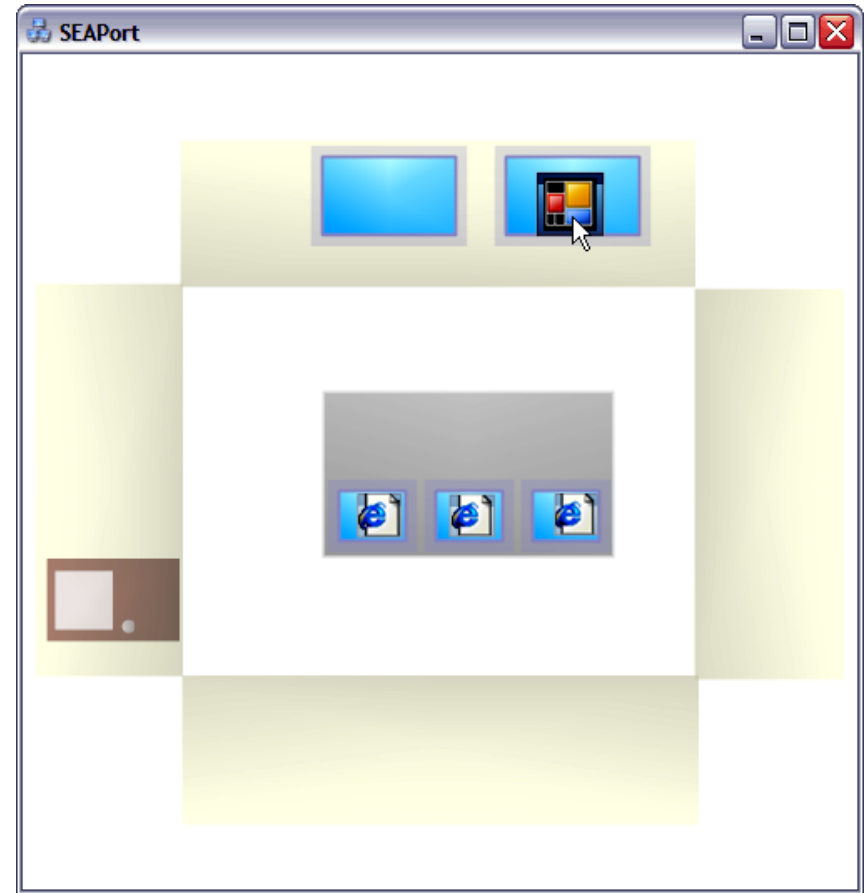# Not this Stove

Great Mapping

Mapping

Mapping

Mapping

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)

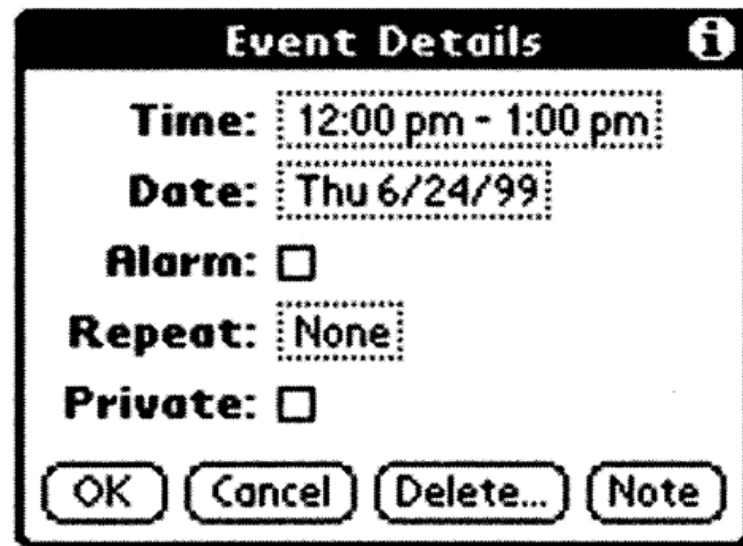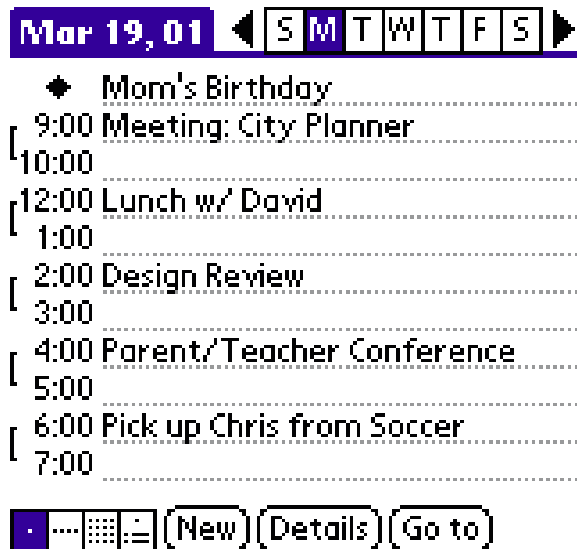e.g., same terminology and layout throughout

External (i.e., with other applications)

e.g., common widget appearance

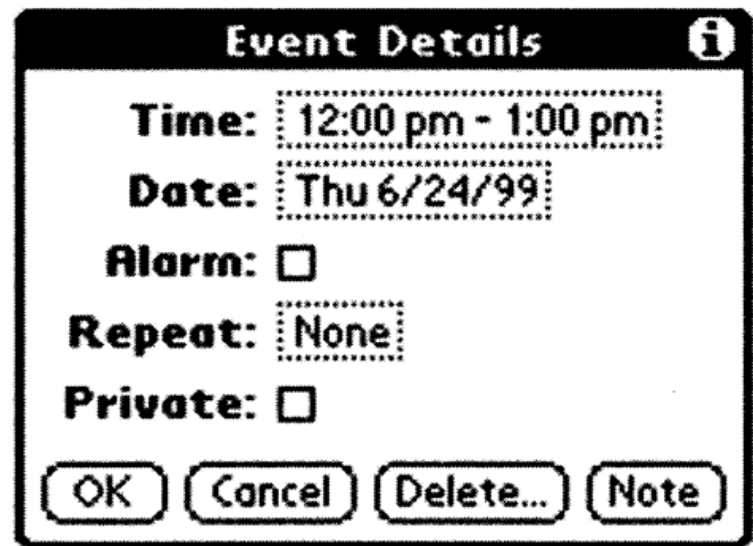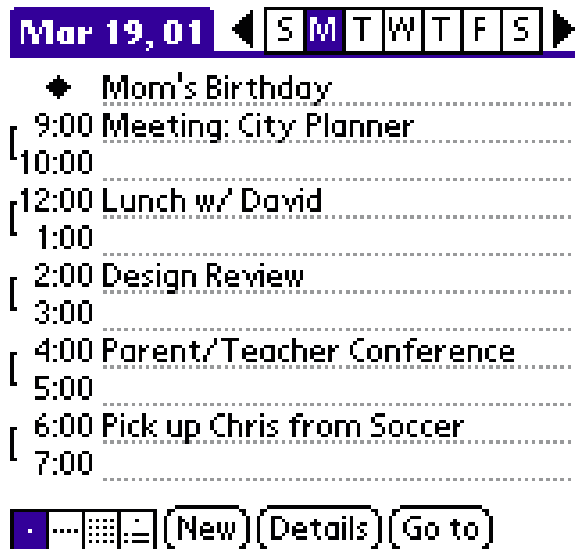e.g., design patterns common across applications

Is Consistent Always Better?

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

Is Consistent Always Better?

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

New is common, delete is not

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Is Consistent Always Better?

Is Consistency Always Better?

Is Consistency Always Better?

Modes

Modes force people to divide their model

Mode A_0

Mode B

Mode A_1
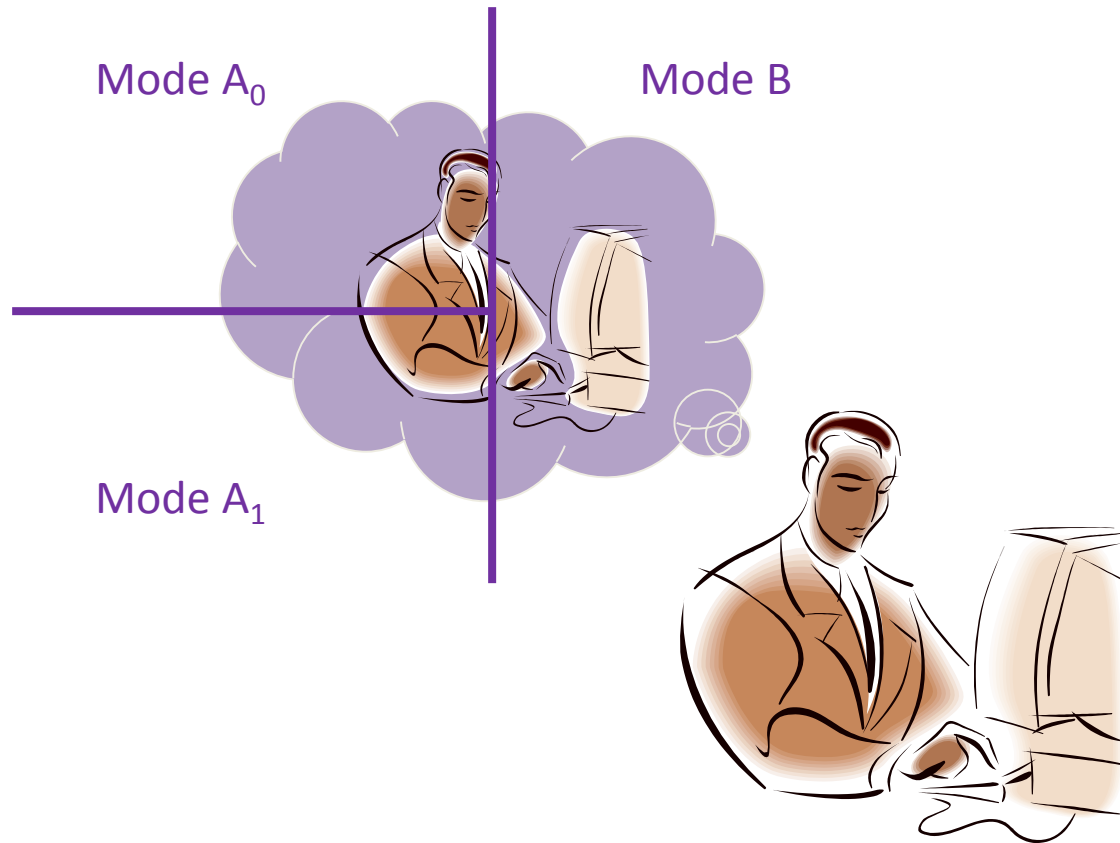
Active versus Passive Modes

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

CSE 440: Introduction to HCI

User Interface Design, Prototyping, and Evaluation

Lecture 02:
Design of Everyday Things

James Fogarty

Daniel Epstein

Brad Jacobson

King Xia

design:
use:
build:

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

University of Washington