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HUMAN ABILITIES

...and their implications for design

human-computer interaction

CSE 440 WINTER 2015

University of Washington

JAN 29 - WEEK 4 - THURSDAY

Today

- Re-cap for Assignment 2f and final report [10m]
  - sketches, storyboards, scenarios
- Re-cap design principles (cont'd from Tue) [30m]
- Human abilities [40m]
- Q&A about assignments [10m]

Calendar

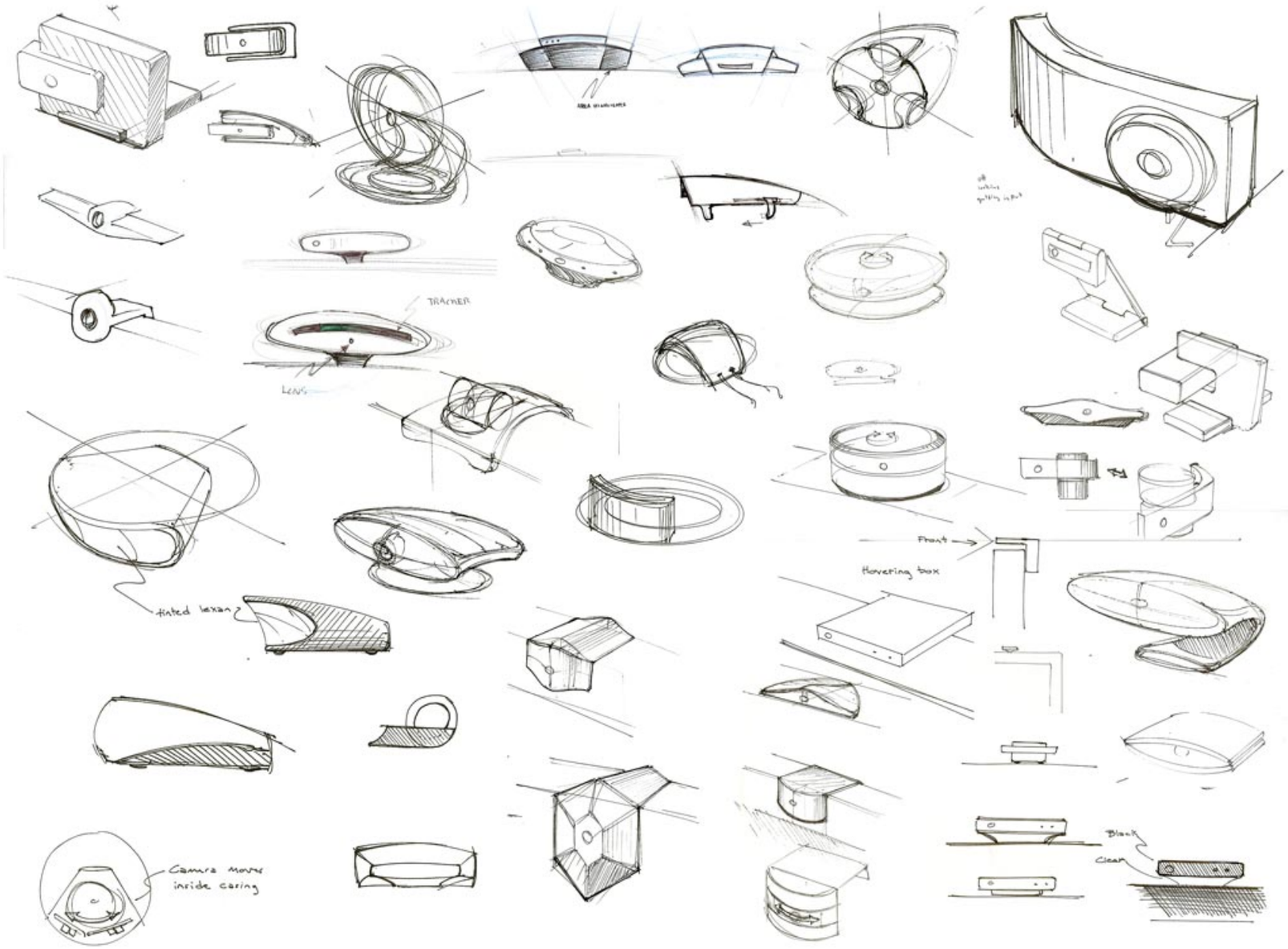
Jan 26	Jan 27	Jan 28	Jan 29	Jan 30
WEEK 4 Maya Office Hour 1:30 - 2:30 CSE 542	Design principles 10:30 - 11:50 EEB 045 2e - Task Review		Human Performance 10:30 - 11:50 EEB 045	**Sections** 10:30 - 11:20 MGH 287 1:30 - 2:20 MGH 254 2f - Design Check-in
Feb 2	**Feb 3**	**Feb 4**	**Feb 5**	**Feb 6**
Reading1: Research Paper Maya Office Hour 1:30 - 2:30 CSE 542	Paper prototyping 10:30 - 11:50 EEB 045 2g - Getting the Right Design Report		**Presentations** 10:30 - 11:50 EEB 045	**Presentations** 10:30 - 11:20 MGH 287 1:30 - 2:20 MGH 254

Assignment 2f: Design check-in

- Revise the tasks (if needed)
- Brainstorm three designs, describe and sketch
  - Should be significantly different

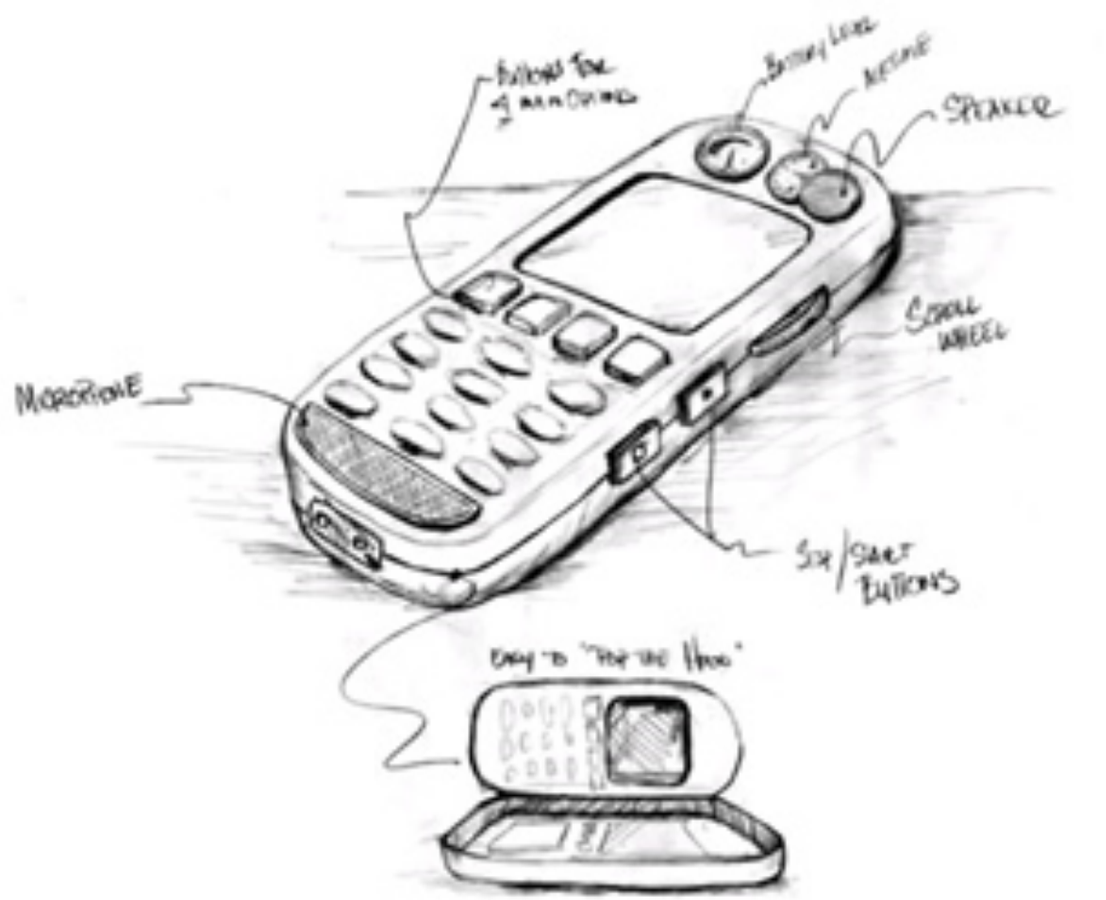
Design sketches

Communicating ideas visually



Design sketches

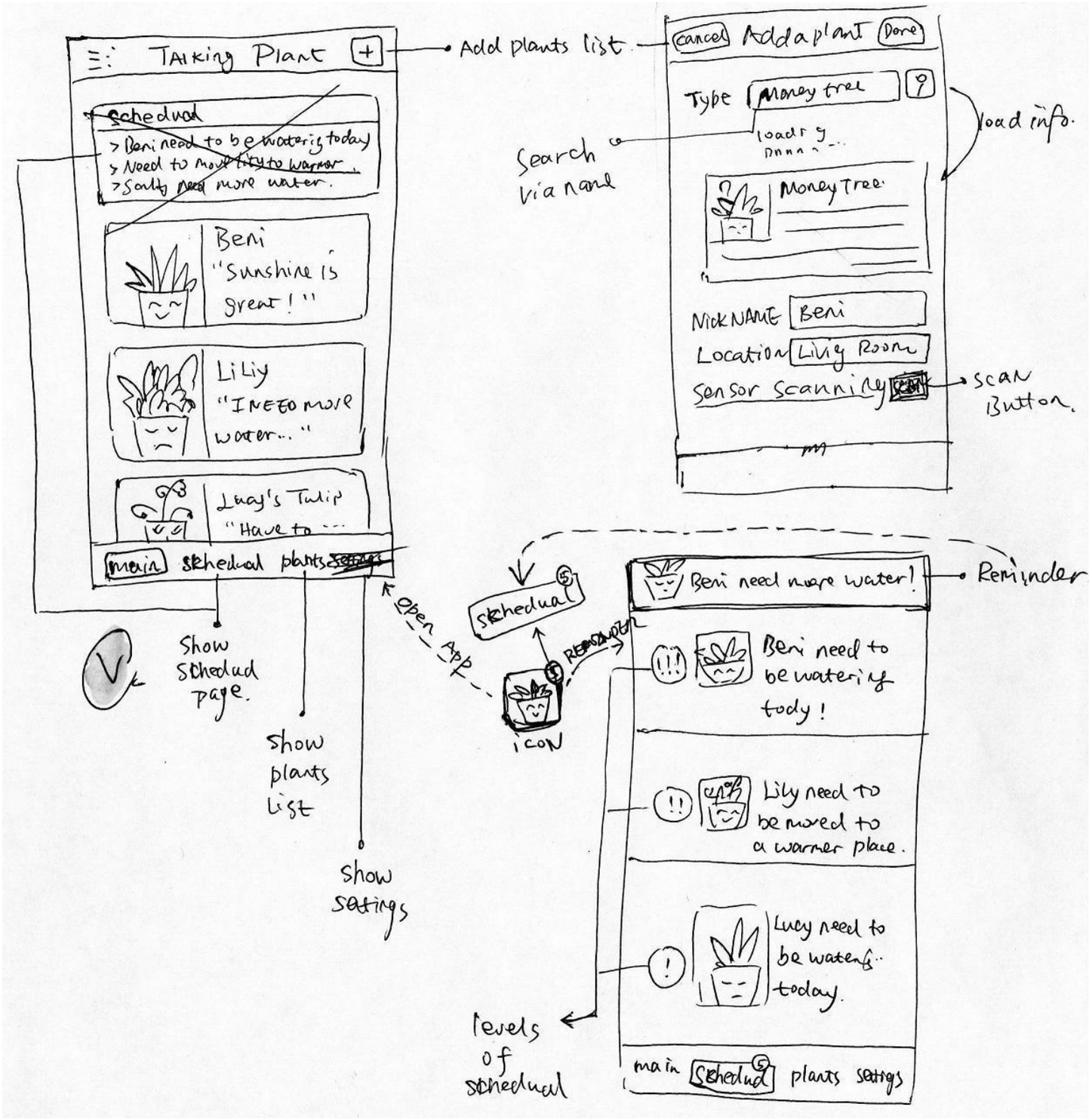
Include only what is required to render
the intended purpose or concept



Design sketches

Highlight relevant functionality

Show relations between different sketches



Design sketch example 1

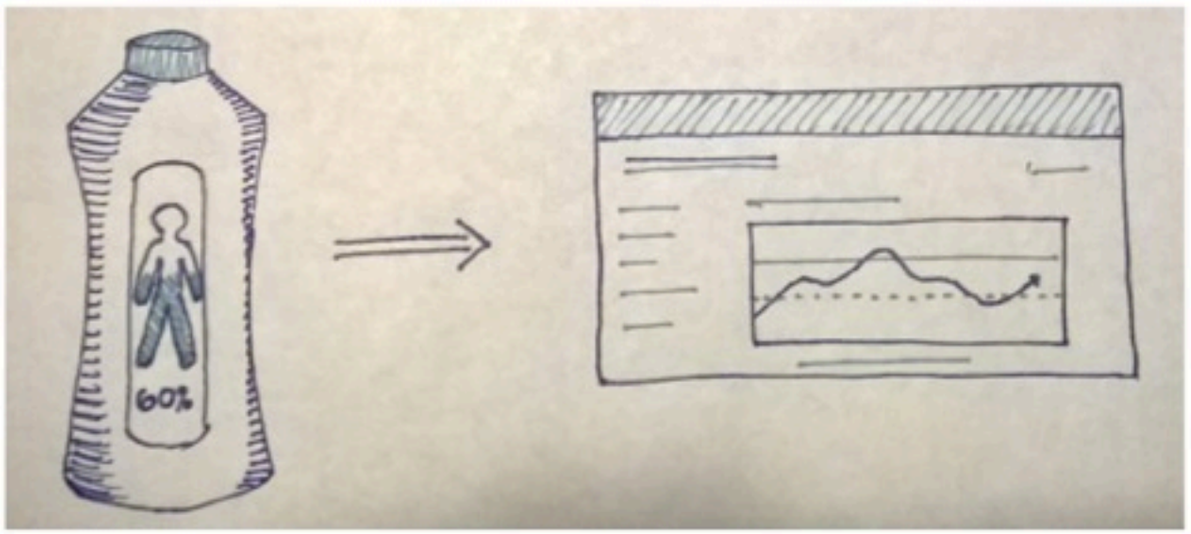


Figure 1: Tracking Liquid Intake Over Time

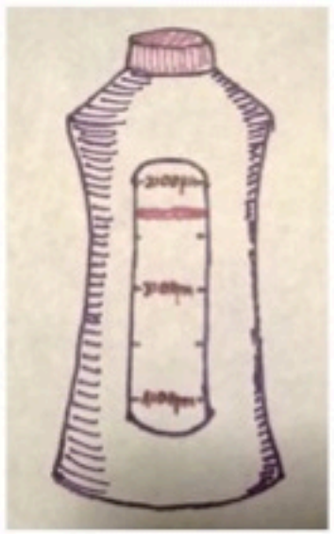


Figure 2: Finding Motivation for Proper Hydration

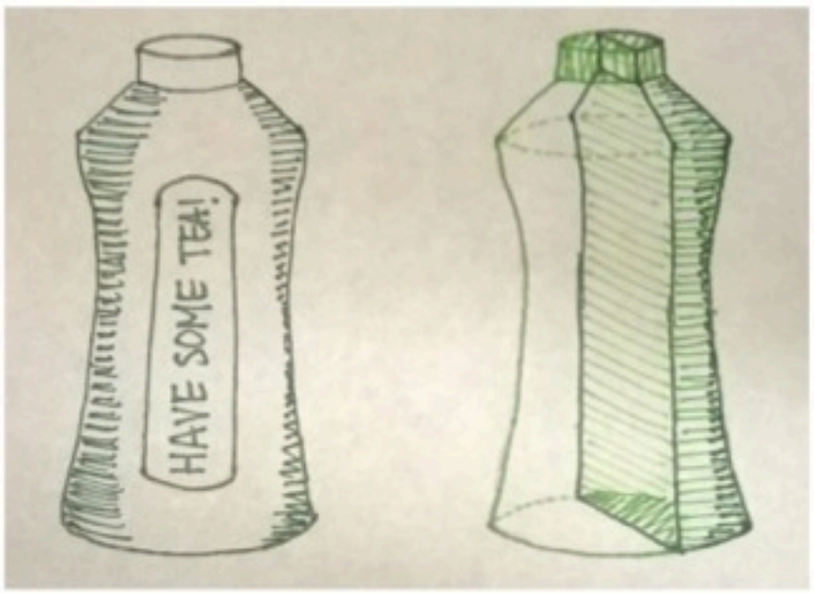


Figure 3: Smart Beverage Suggestions

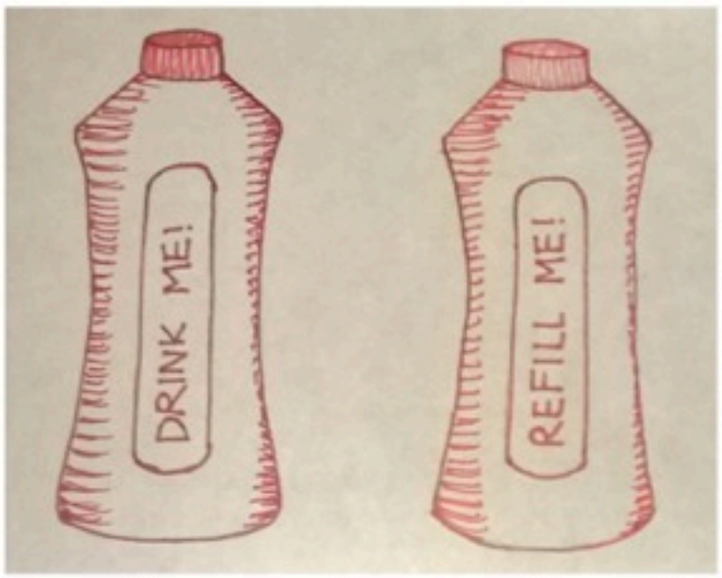


Figure 4: Convenient Reminders to Drink Water

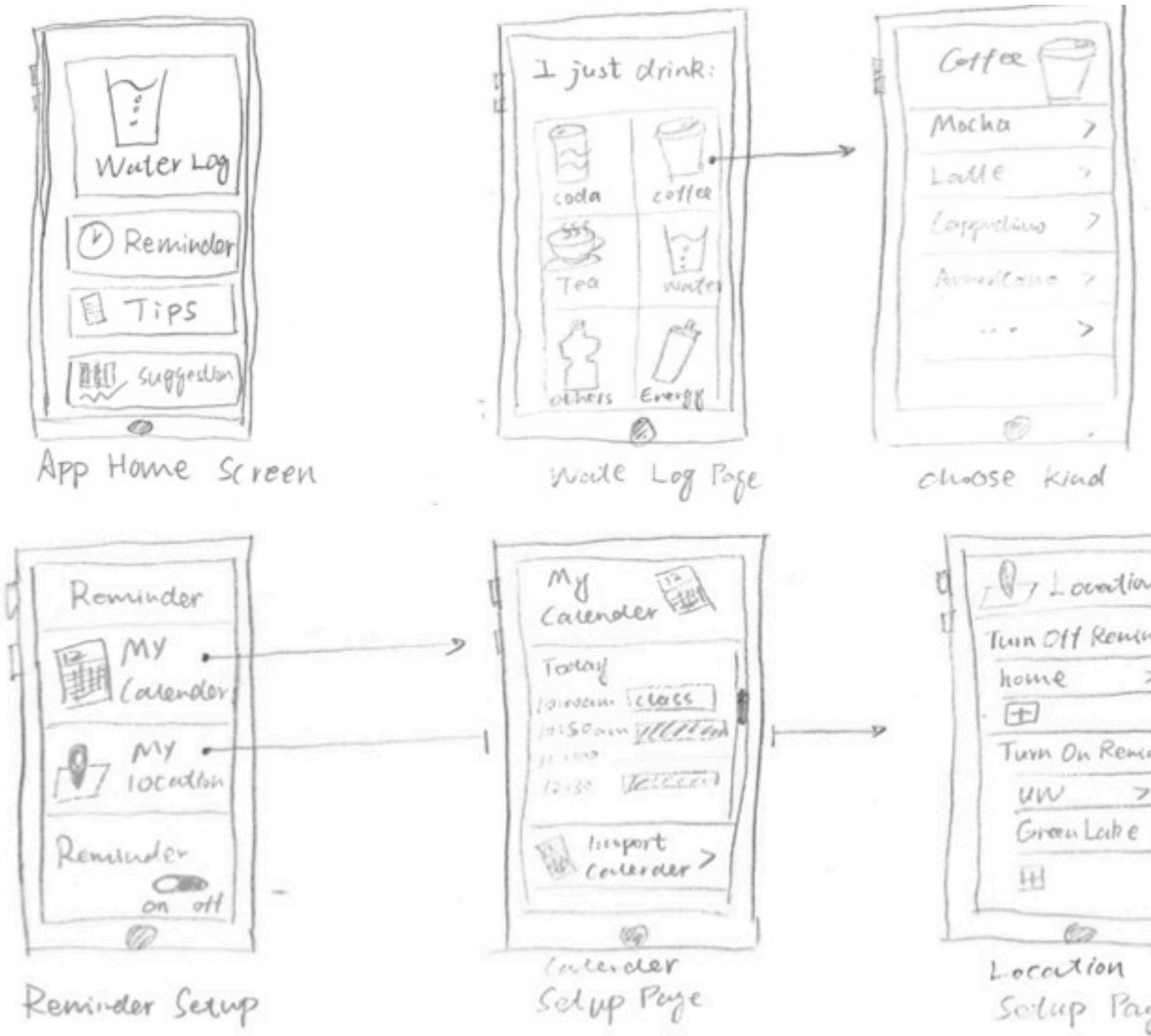
Design sketch example 2

Figure 1 Tracking Liquid Intake Over Time

Design sketch example 3

Tracking Liquid Intake Over Time

Smart Reminder Setup

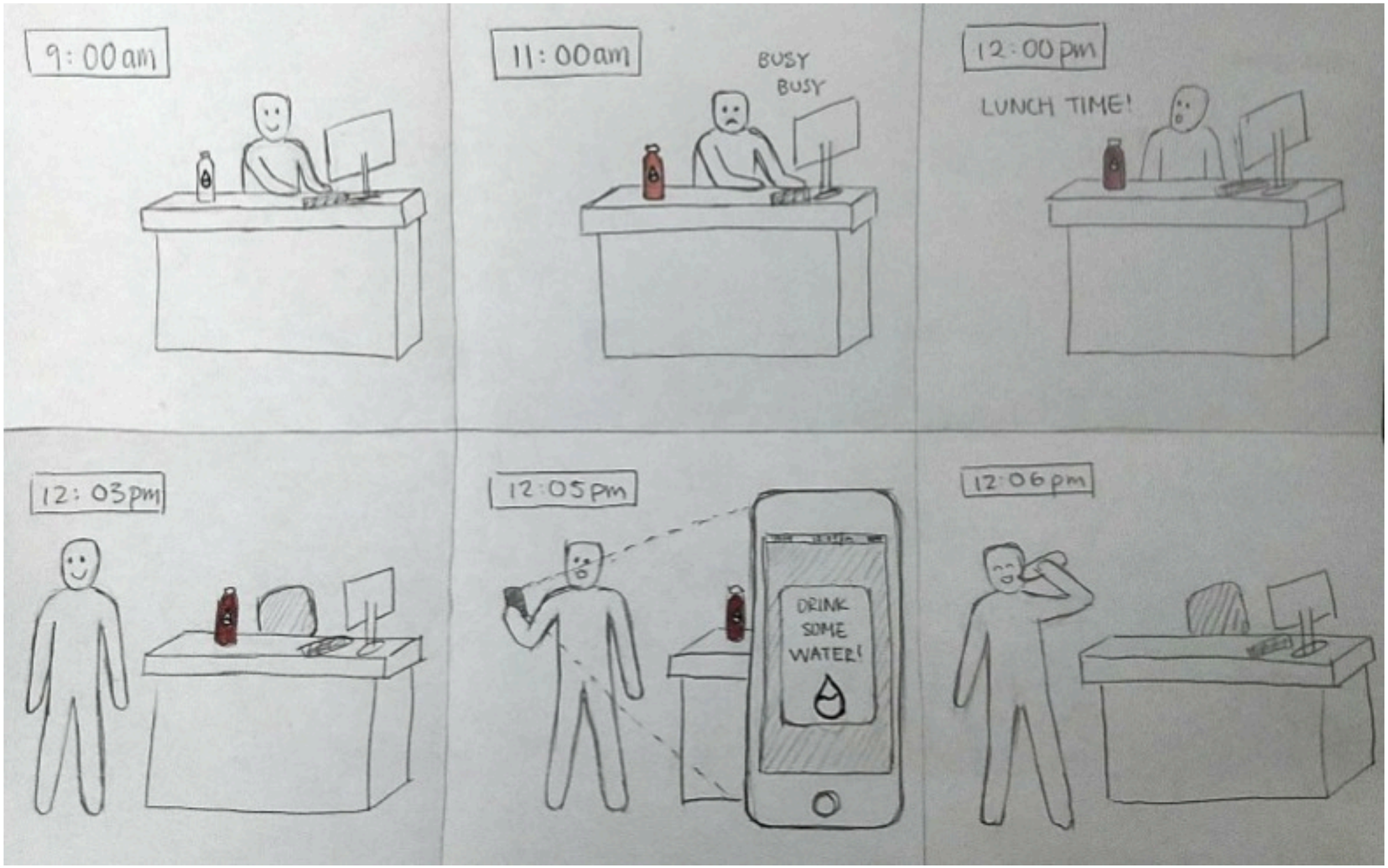


Storyboard

- You will do this for the final report, due next Tue.
- Can include some design details, but still focus is on the task.

Storyboard example 1

Storyboard example 2

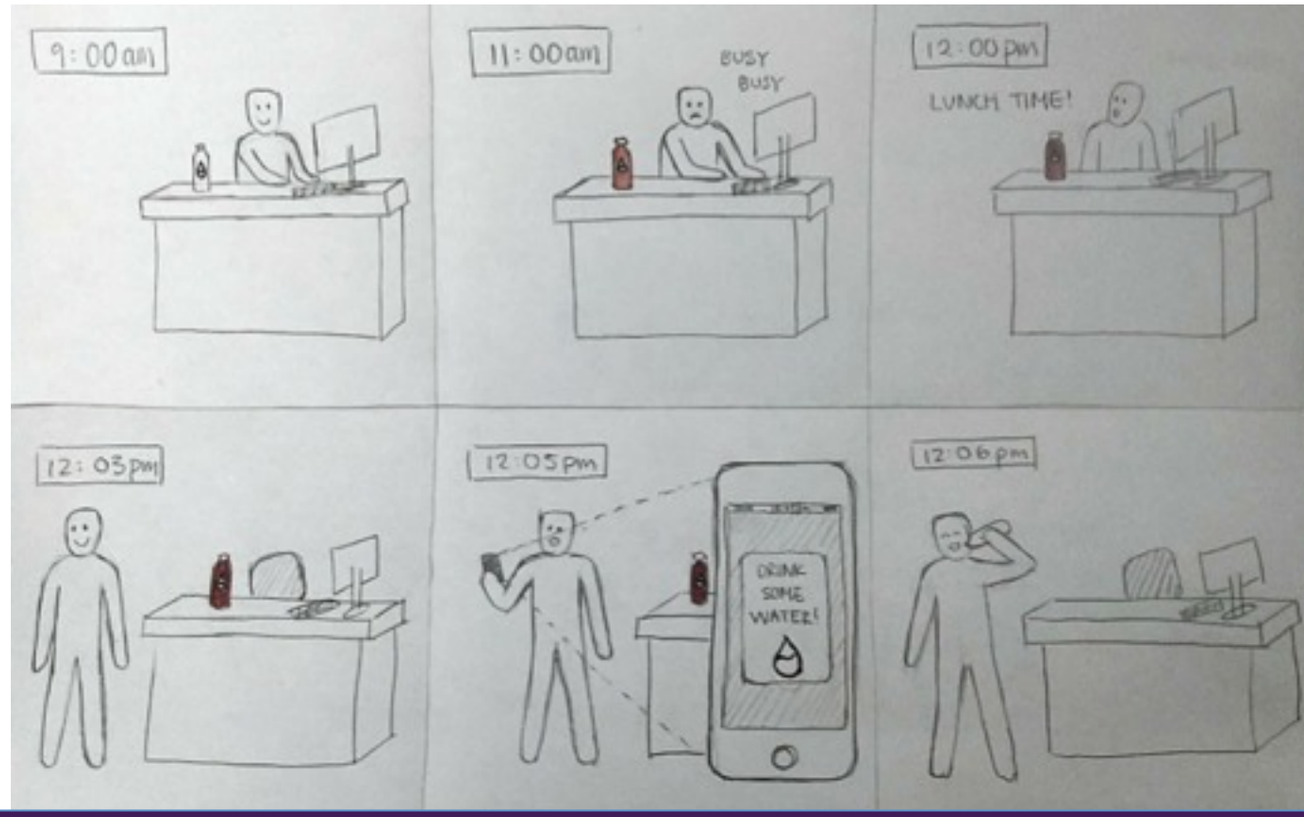


Scenario example 1

Annie is a junior student at University of Washington lives in an apartment in U-district. Annie wakes up at 8:00 AM, and drinks some water from her Aqueous water bottle. The bottle then sends a data to her mobile app about what kind of liquid she drinks and the amount. On her way to school, Annie stops by a coffee shop and gets a cup of Latte for herself. Since Annie doesn't want to pour the coffee to Aqueous bottle, she opens her Aqueous app and manually input her coffee drink for tracking. In the afternoon, Annie refills her bottle with orange juice. As she drinking the juice from the bottle, her phone app keeps tracking her beverage intake by data received from the bottle. Annie finishes her day in school, and she opens her Aqueous app as she is waiting for the bus. The app tells her that she has finished her liquid intake goal for today, and also shows a line chart of her weekly liquid intake.

Scenario example 2

Bob is a senior designer at Google. Bob starts working at 9:00AM with his design work. Bob has a Aqueous bottle with him at the office. Latter in the morning, the bottle turns red to remind Bob to drink some water. But Bob is too busy with his work, and just ignores the bottle. After three hours of working, it is 12:00 PM and Bob decides to get some lunch. Then, Bob's phone is vibrating and sending him a reminder to remind him take some water during lunch break. Bob then realizes that he didn't take any water for morning, and grabs his bottle to drink water.

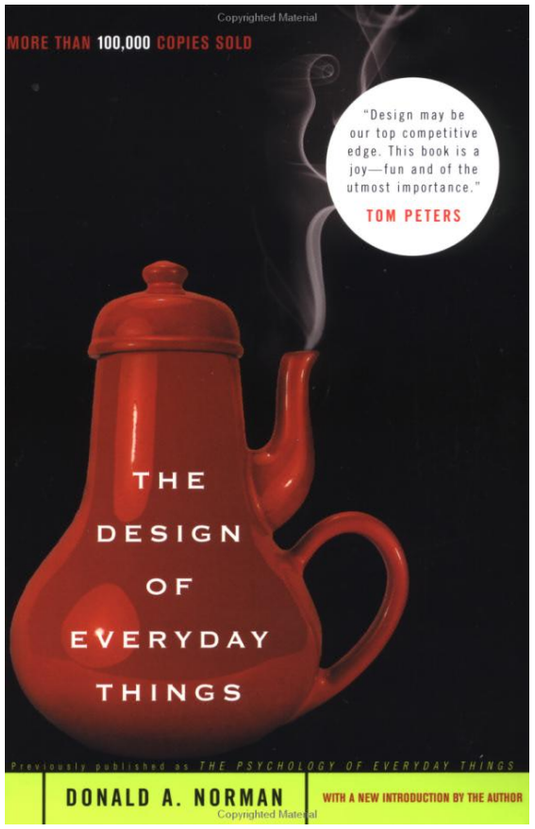


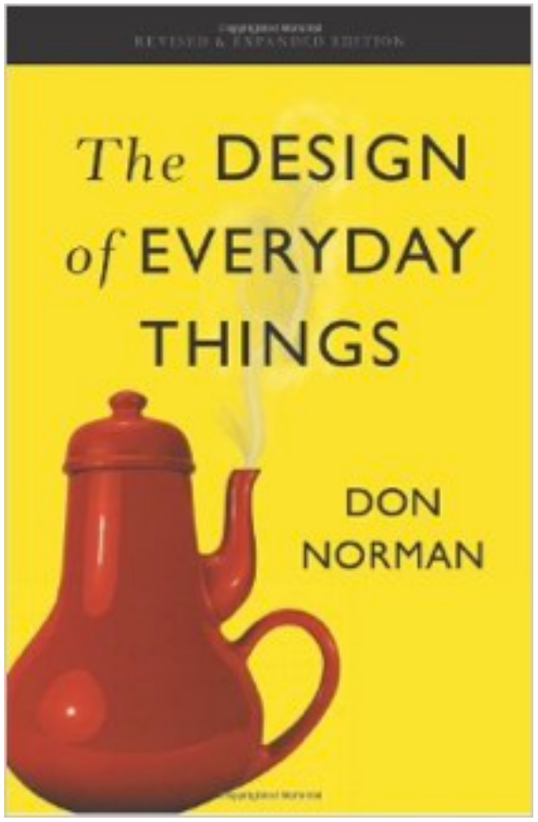
DESIGN PRINCIPLES

...continued

Design principles

Don Norman, Design of Everyday Things.





Fundamental concepts/principles

- Conceptual/mental models
- Affordances
- Signifiers
- Mappings
- Feedback
- Constraints

Conceptual model

problems occur when these do not match

system

INTERFACE

user

system

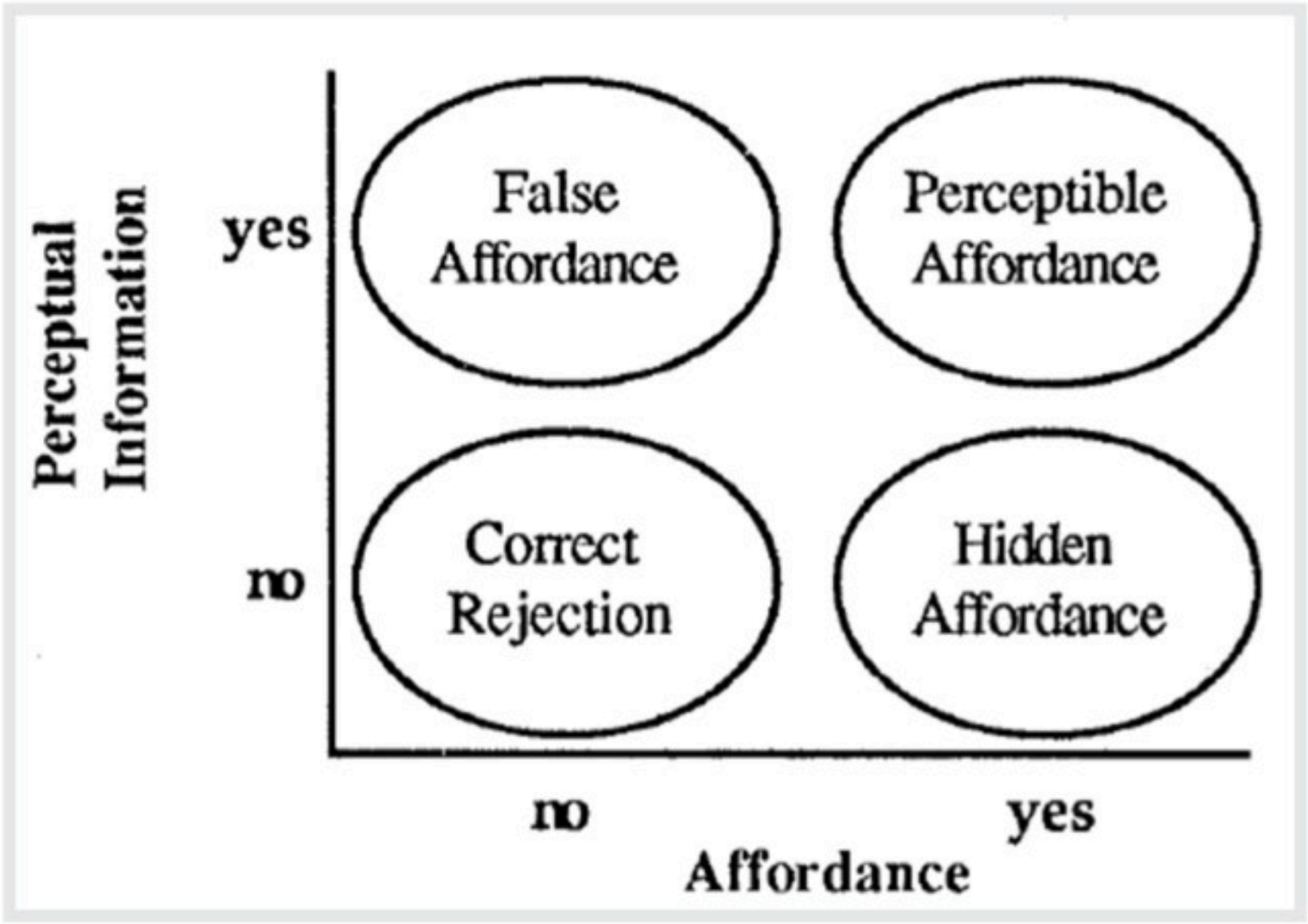
Conceptual models are mental representation of how something works

Affordances

Handles afford pulling

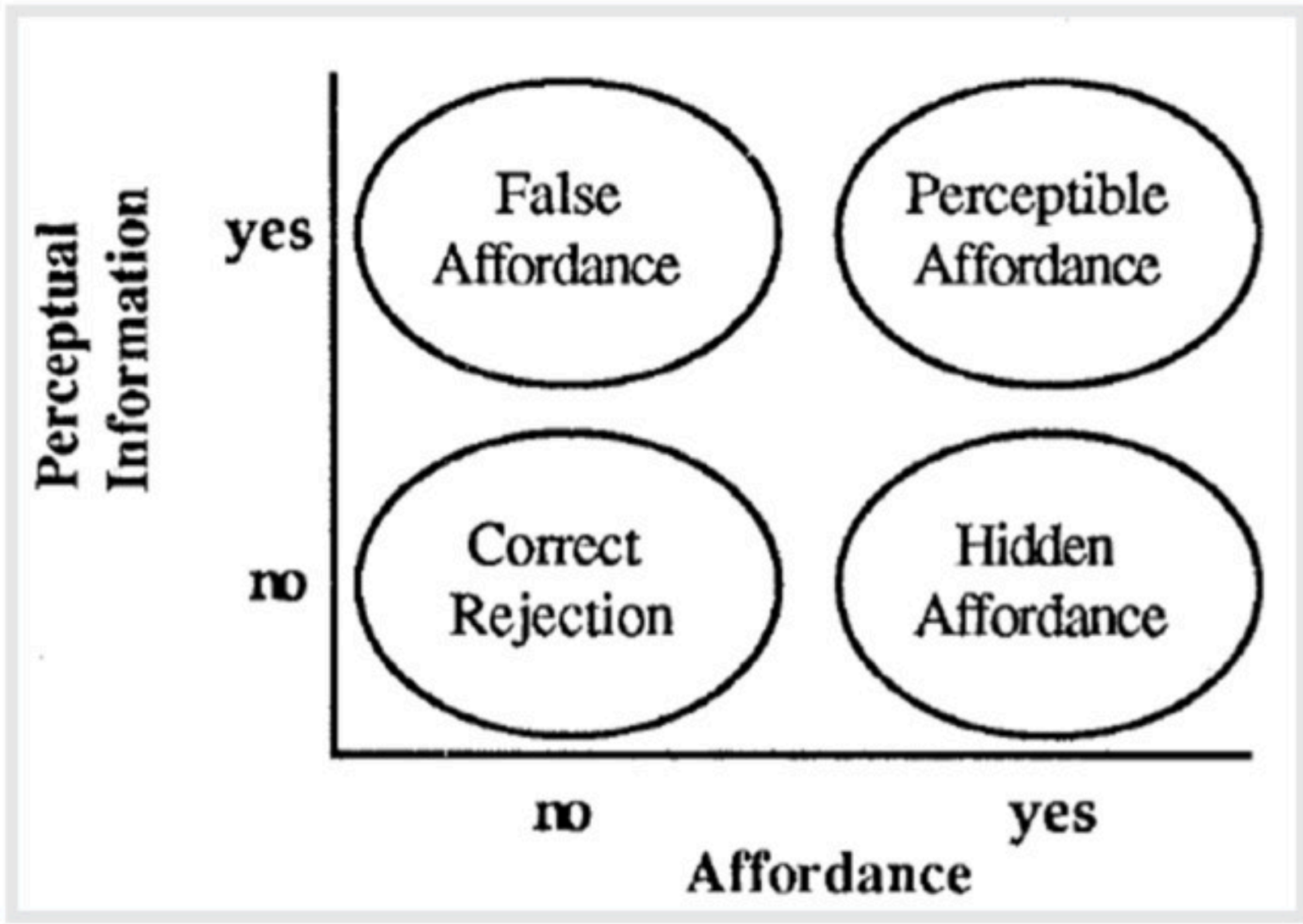
- Jointly determined by:
  - qualities of the object
  - abilities of the agent
- They exist even if they are not visible

Affordances



Affordances

signifiers



Signifiers *new!*

- Affordances determine what actions are possible
- Signifiers **communicate** what actions are possible and where/how the action should take place
  - Touch displays: which parts can be touched, tapped, slid up/down/sides...

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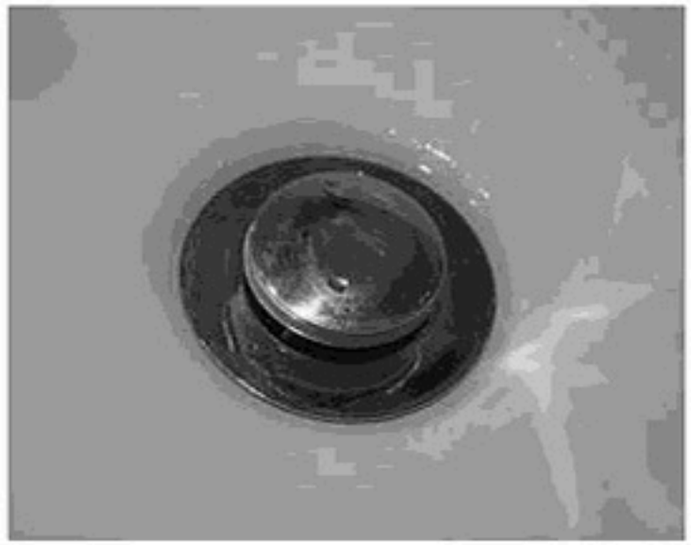
Signifiers *new!*

A.

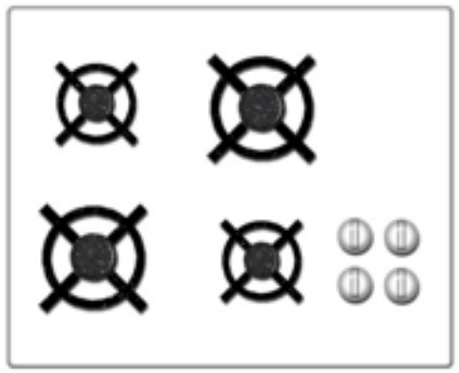
B.

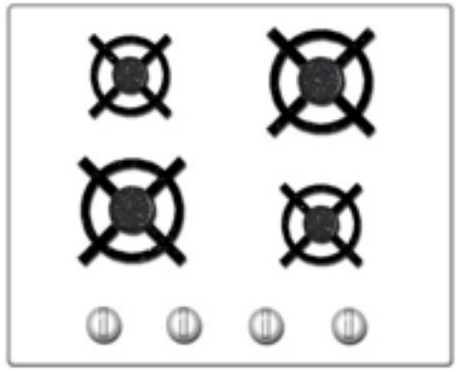
C.

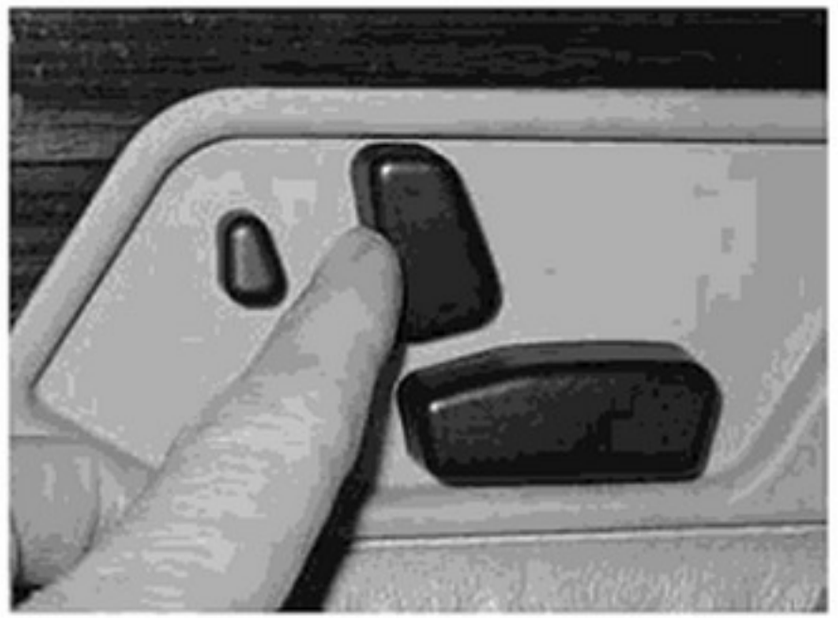
D.



Mappings







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Feedback


TO CROSS
PUSH BUTTON
START CROSSING
WATCH FOR
TURNING CARS
DON'T START
FINSH CROSSING
IF STARTED
FLASHING
PEDESTRIANS
SHOULD NOT BE
IN CROSSWALK
STEADY

Feedback


TO CROSS
PUSH BUTTON
START CROSSING
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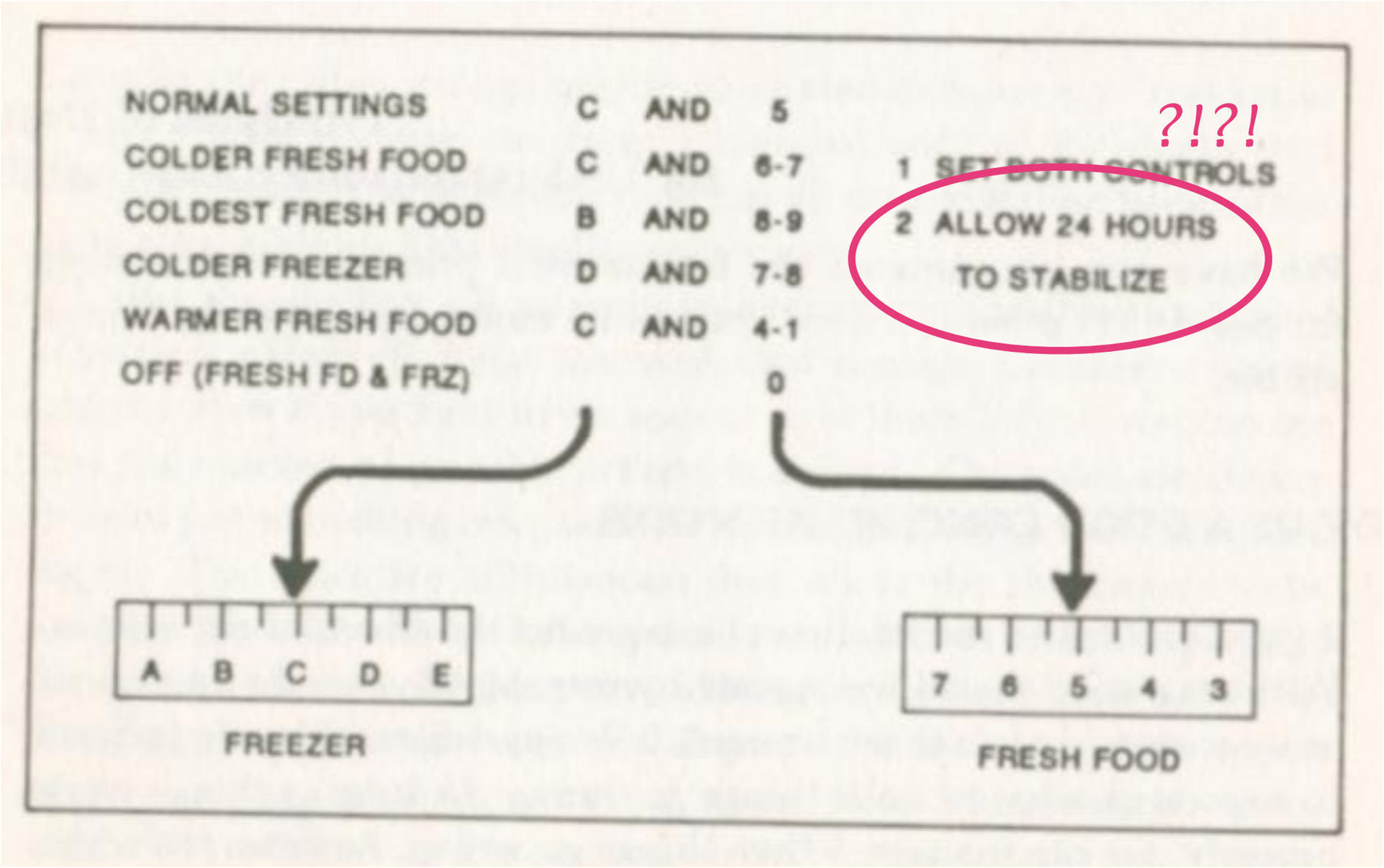
vs

Feedback


NORMAL SETTINGS C AND 5
COLDER FRESH FOOD C AND 6-7
COLDEST FRESH FOOD B AND 8-9
COLDER FREEZER D AND 7-8
WARMER FRESH FOOD C AND 4-1
OFF (FRESH FD & FRZ) 0
?!?!
1 SET BOTH CONTROLS
2 ALLOW 24 HOURS
TO STABILIZE
A B C D E
FREEZER
7 6 5 4 3
FRESH FOOD

Feedback

- We are very sensitive to contingency

Feedback

- We are very sensitive to contingency

Feedback

- Beeps
- Sounds
- Lights
- Progress bars

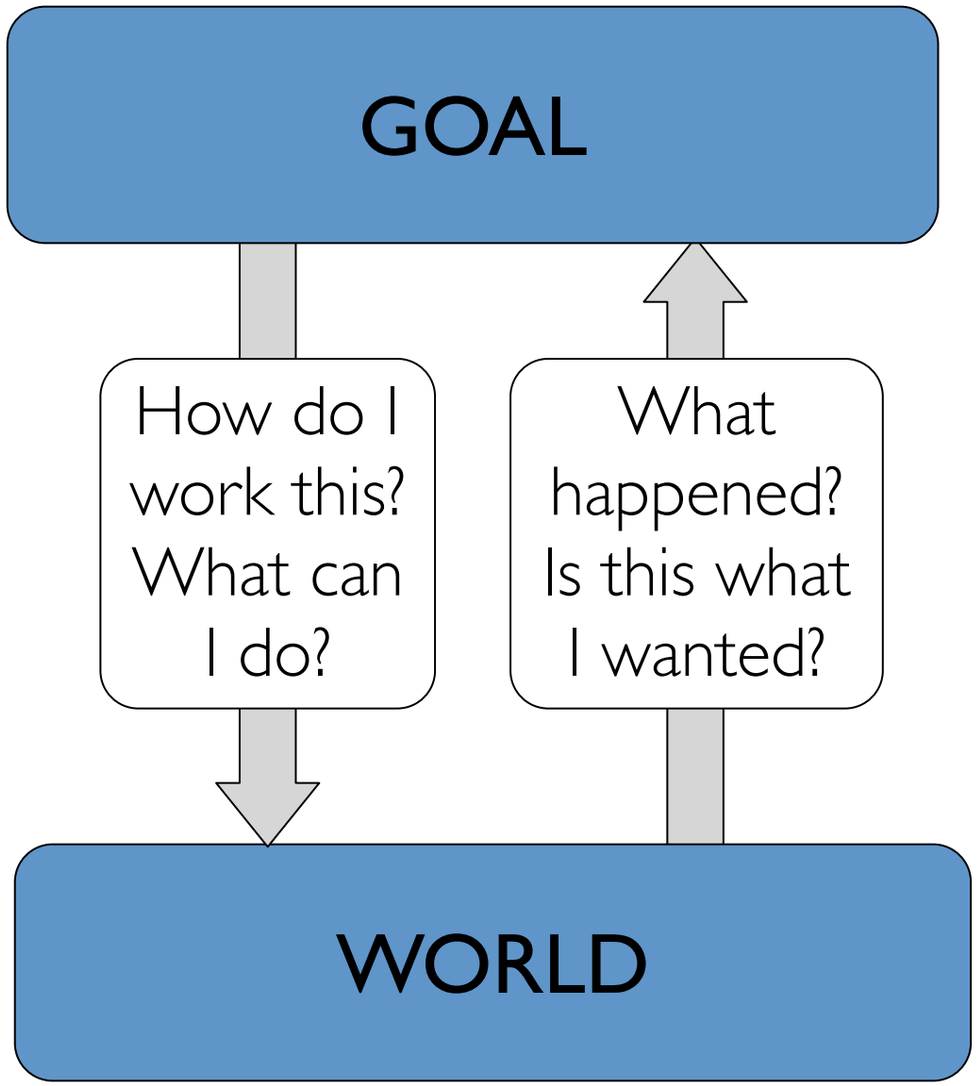
Feedback

- Beeps
- Sounds
- Lights
- Progress bars

Neilsen's heuristics:
- Good error messages
- Visibility of system status

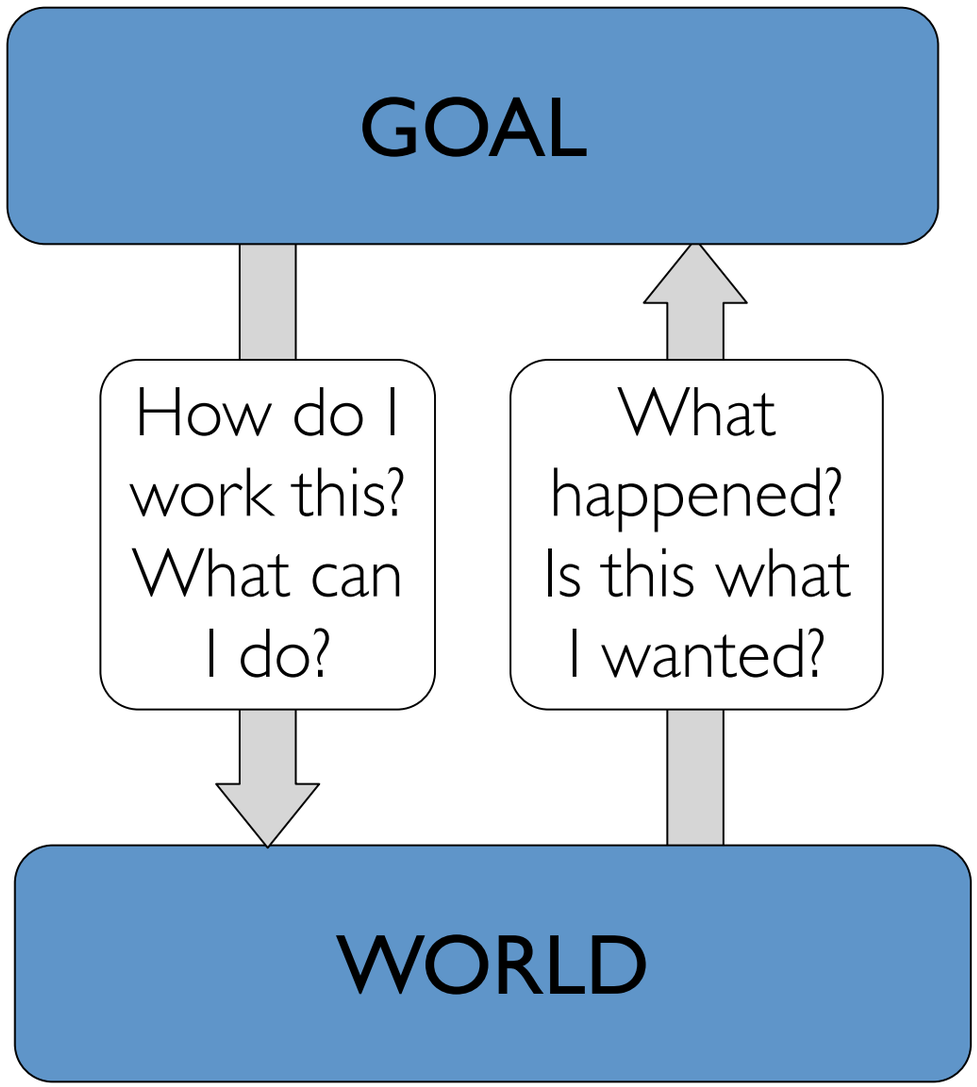
Everyday actions

Gulf of execution and evaluation

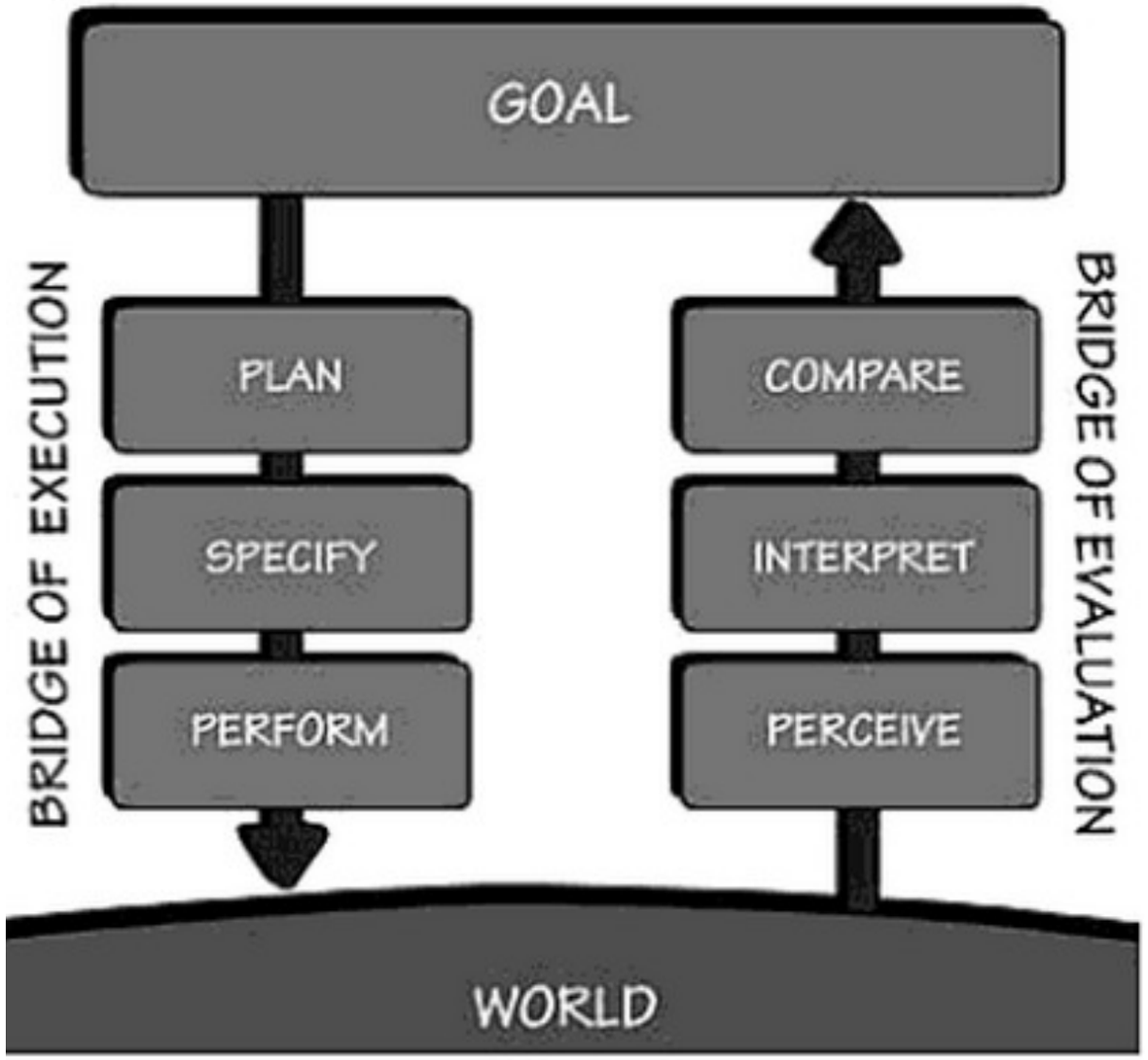


Everyday actions

Gulf of execution and evaluation



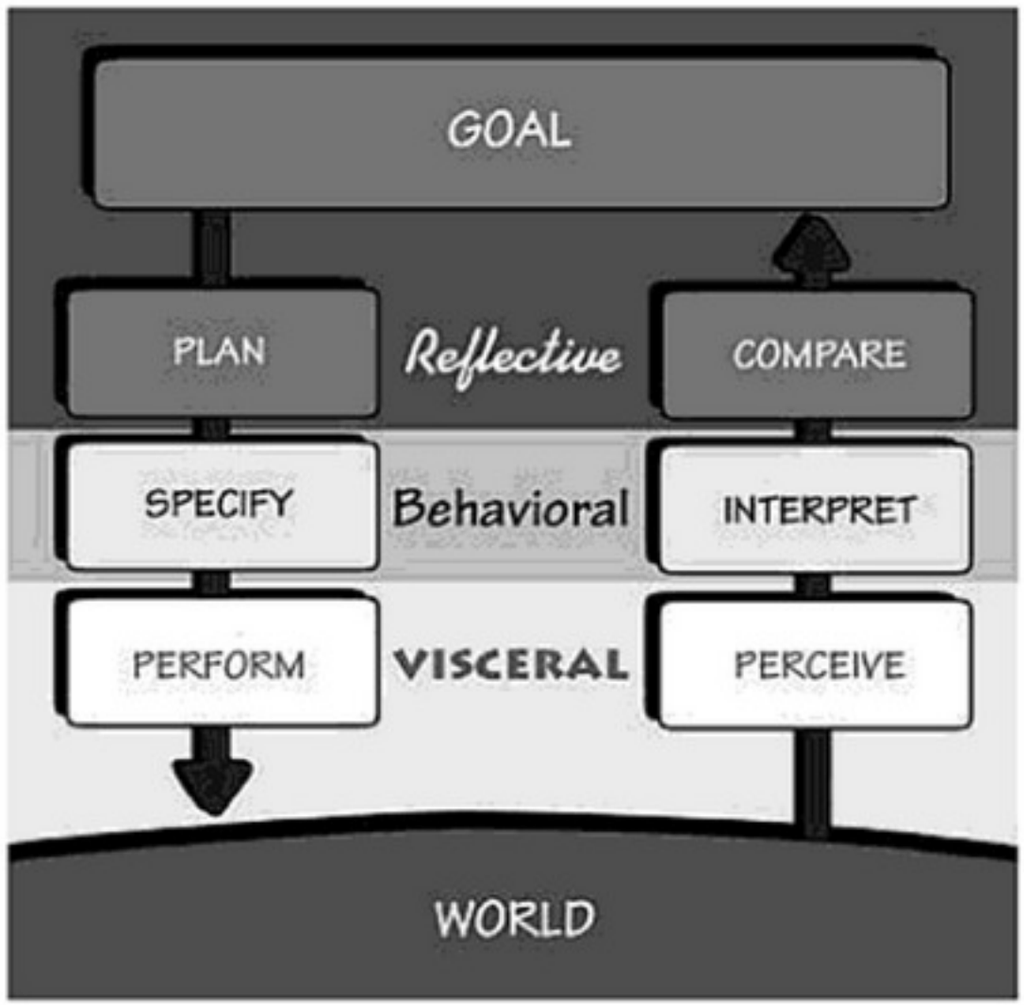
Bridge of execution and evaluation



Everyday actions

Bridge of execution and evaluation

Three levels of processing

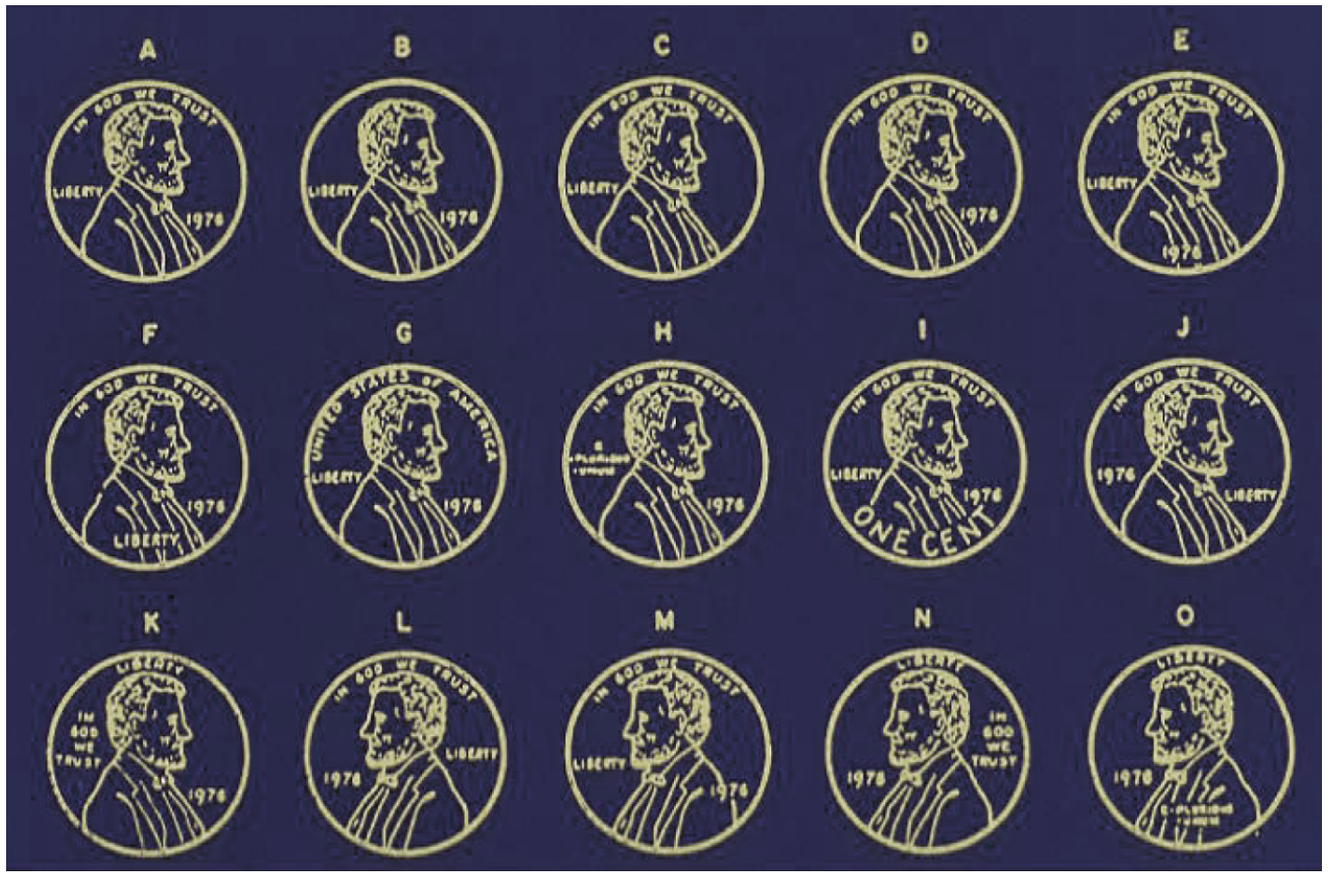


Seven principles

- Conceptual model
- Discoverability
- Feedback
- Affordances
- Signifiers
- Mappings
- Constraints

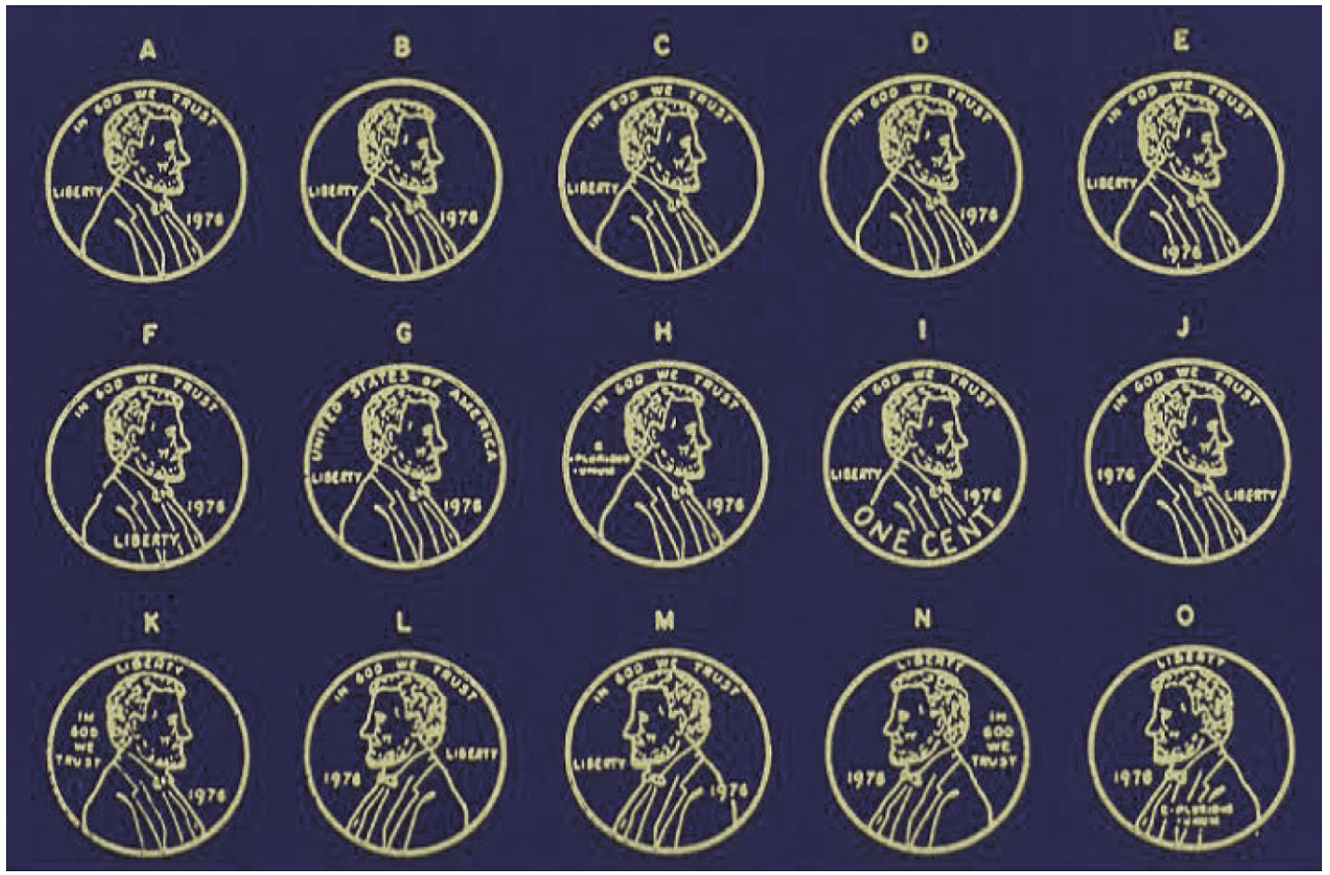
Knowledge in the world

- Precise behavior from imprecise knowledge



Knowledge in the world

- Precise behavior from imprecise knowledge



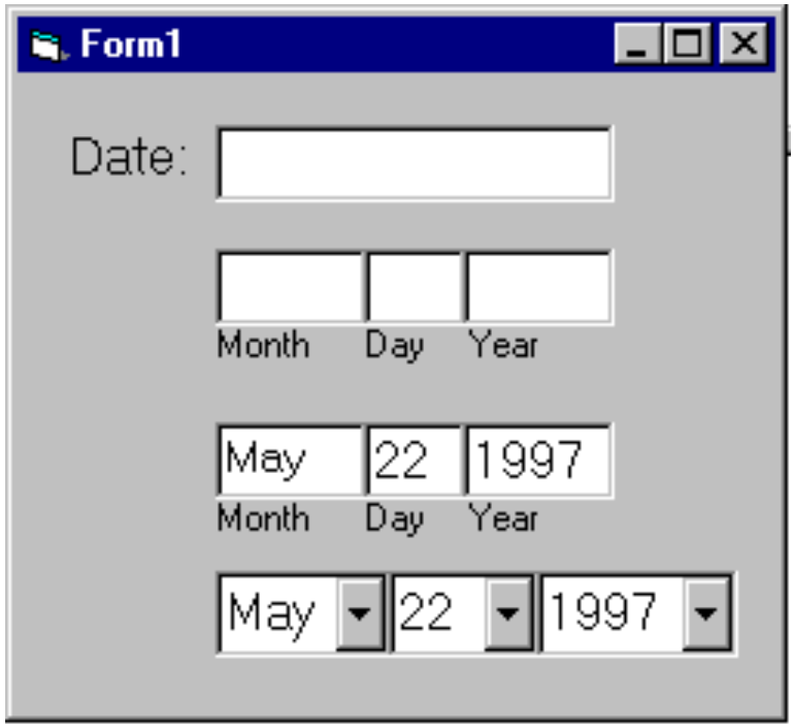
Neilsen's heuristics:
- Recognition rather than recall

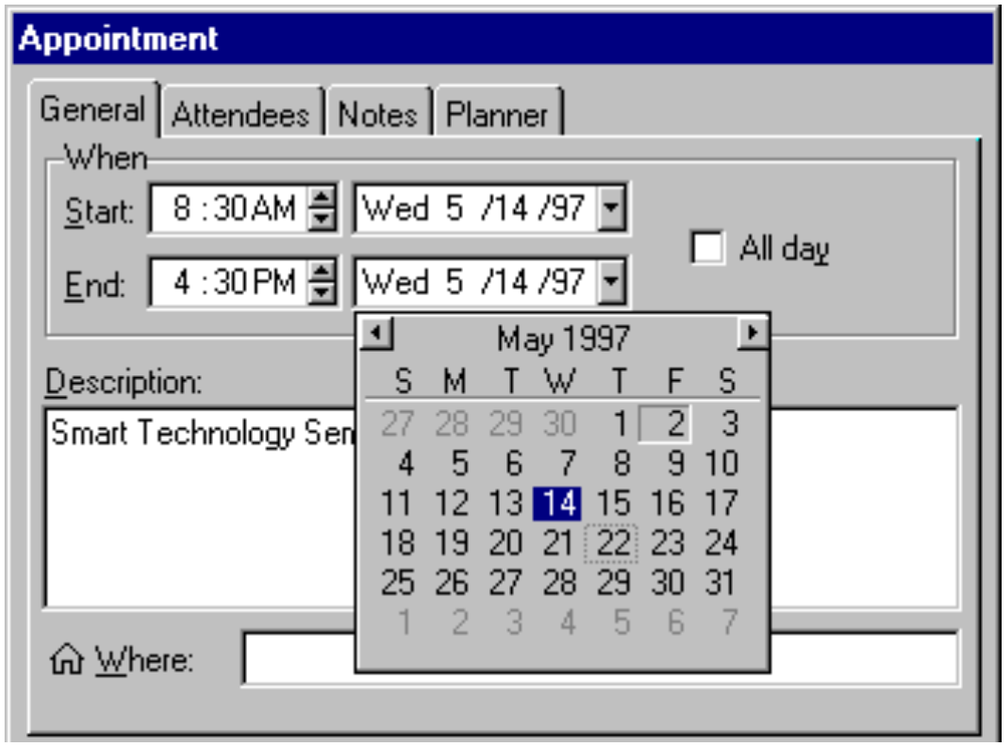
Errors: Slips vs. Mistakes

MISTAKES
errors in **choosing** an objective or **specifying** a method of achieving it

SLIPS
errors in **carrying out** an intended method for reaching an objective

Constraints

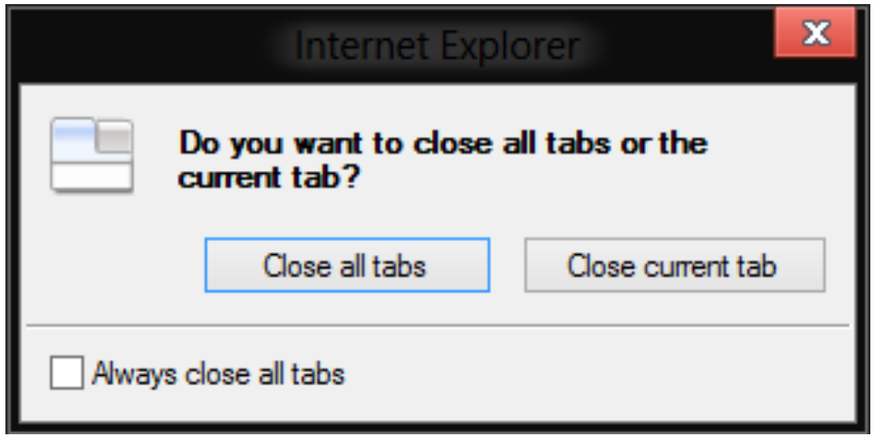




Neilsen's heuristics:
- Error prevention

Error prevention

```
% rm -rf *
%
```

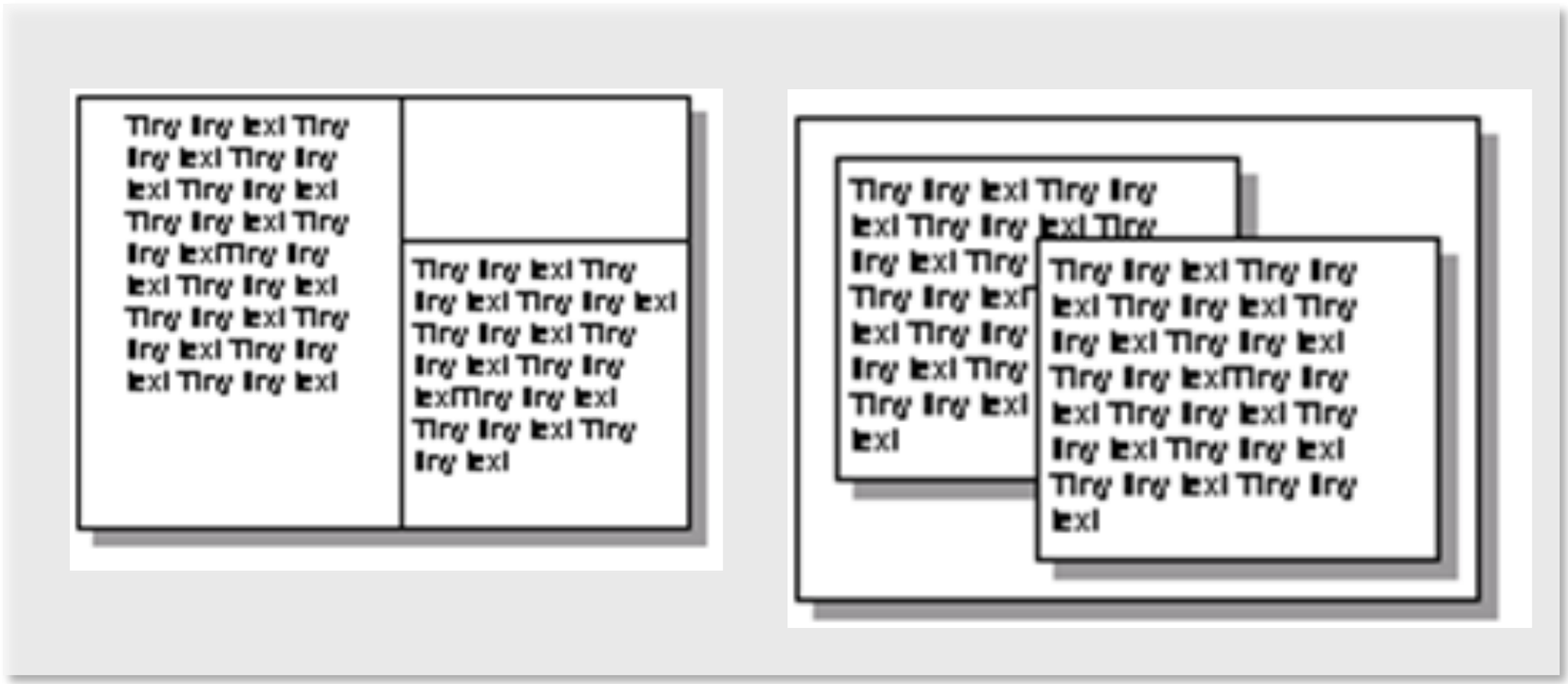


Metaphors

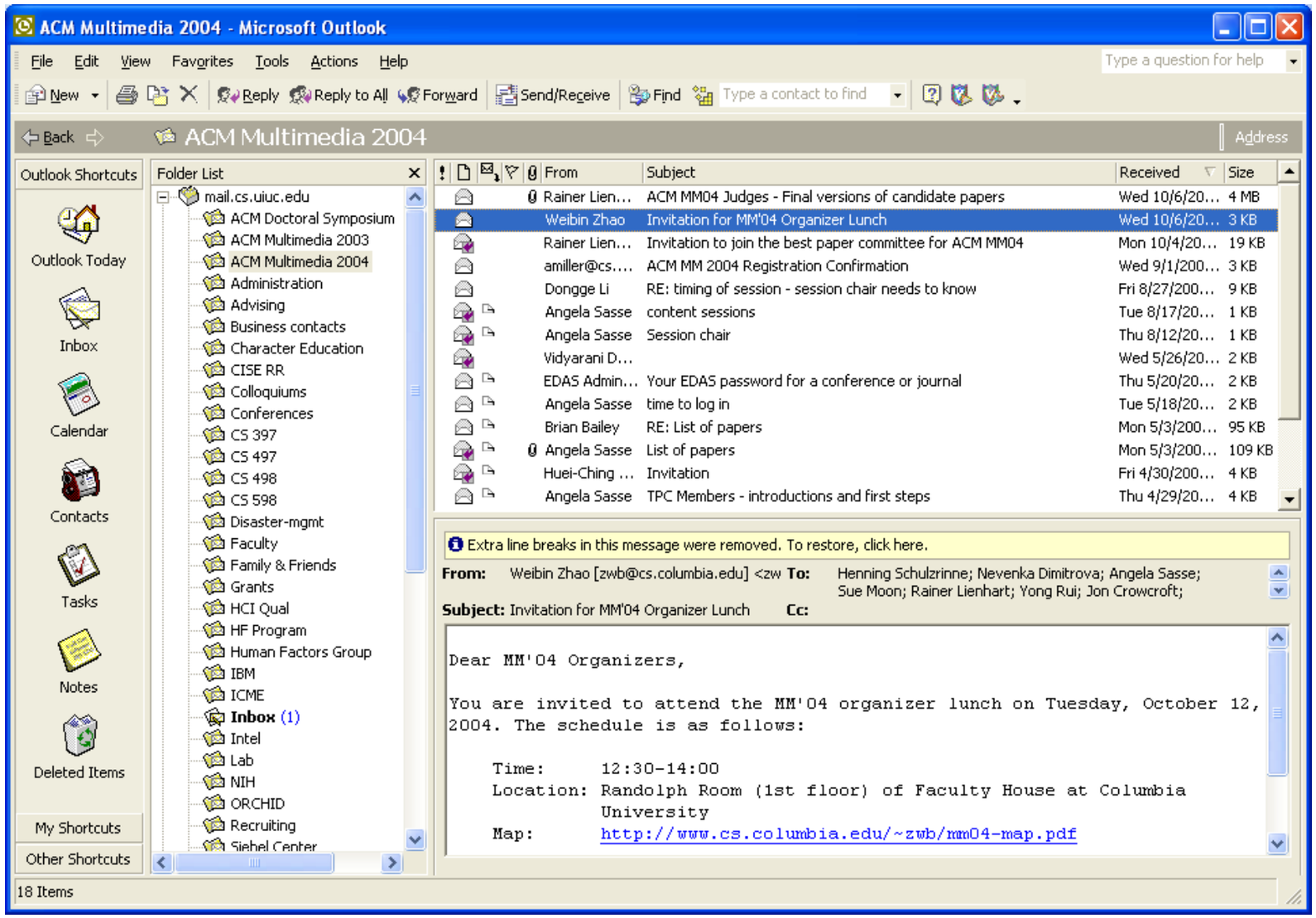
- Familiar example: the desktop metaphor
  - Not an attempt to simulate a real desktop
  - Leverage knowledge of files, folders, trash
  - Explains why some windows seem hidden

Neilsen's heuristics:
- Match between system and real world

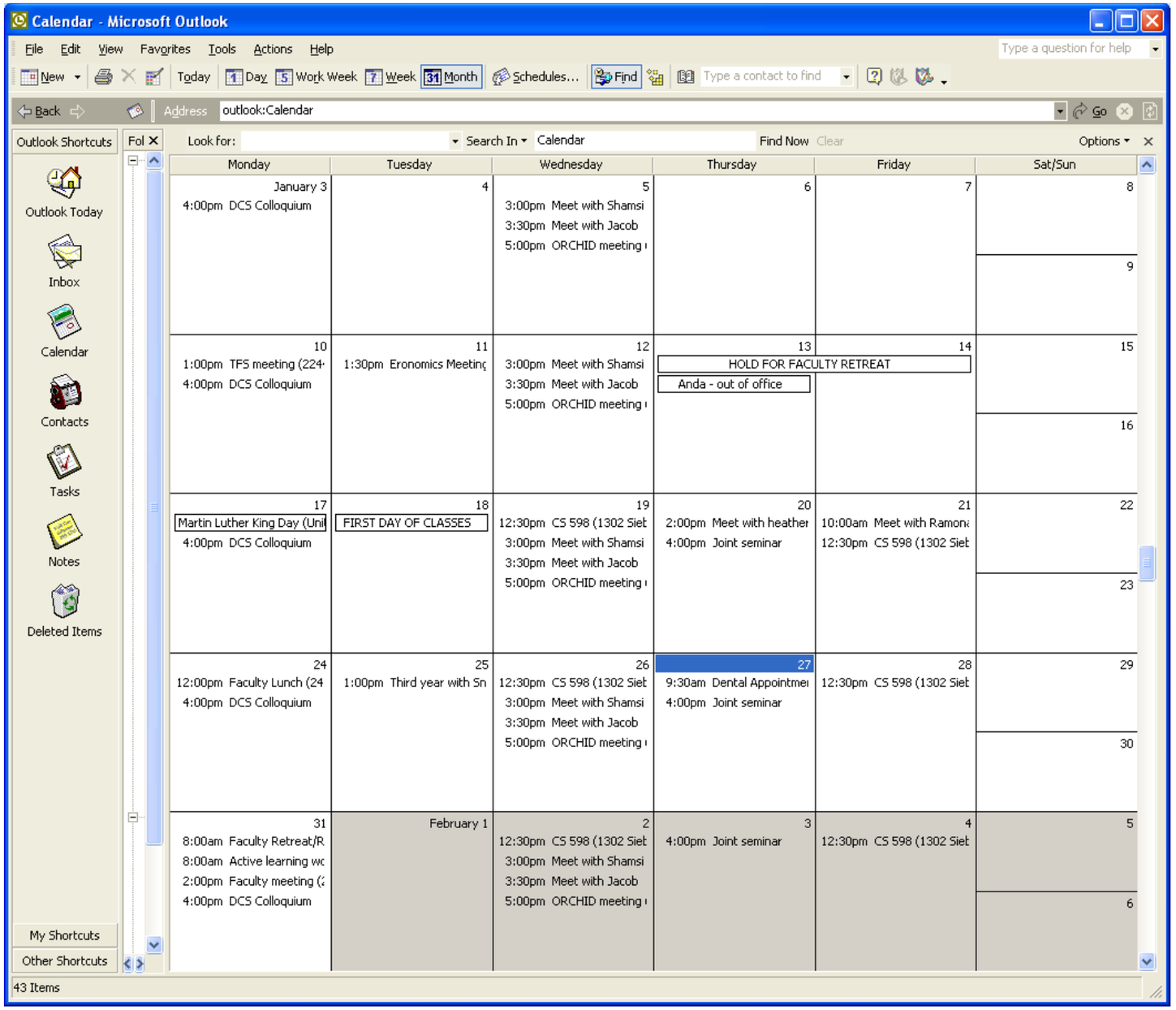
Metaphors



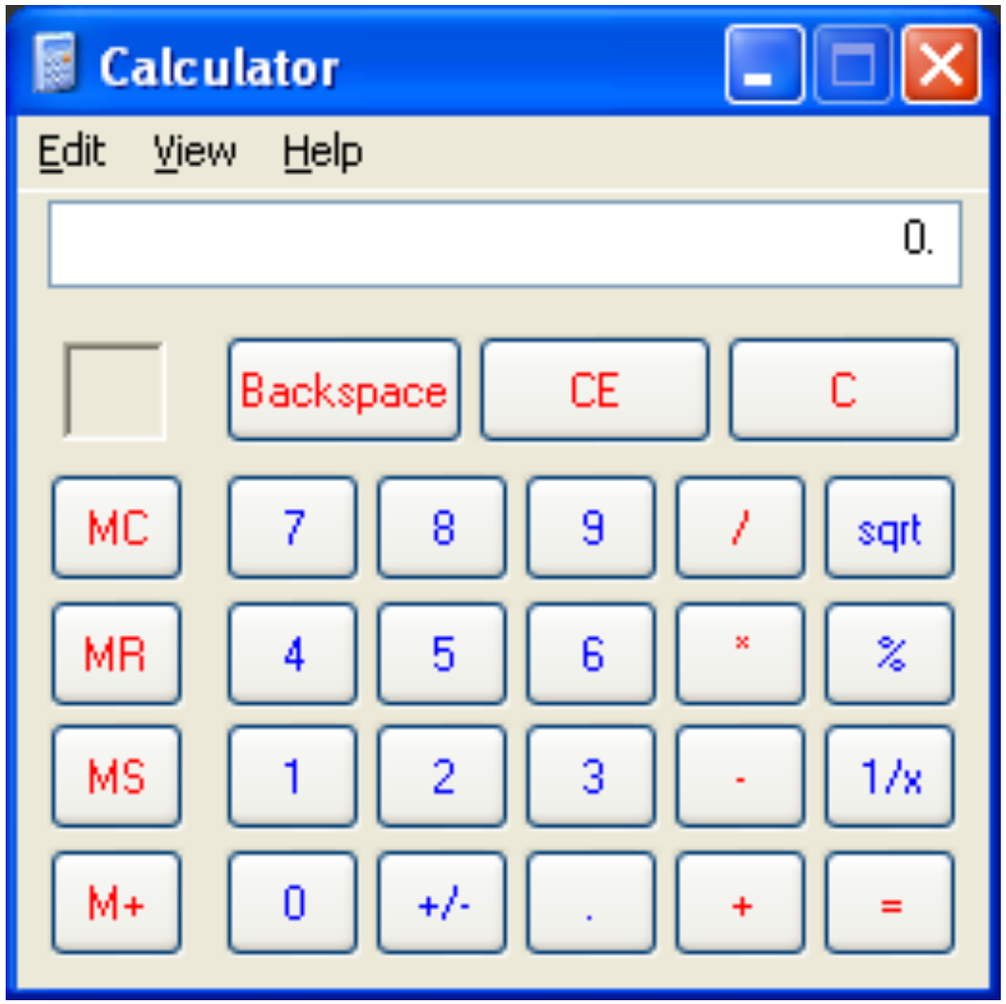
Mail metaphor



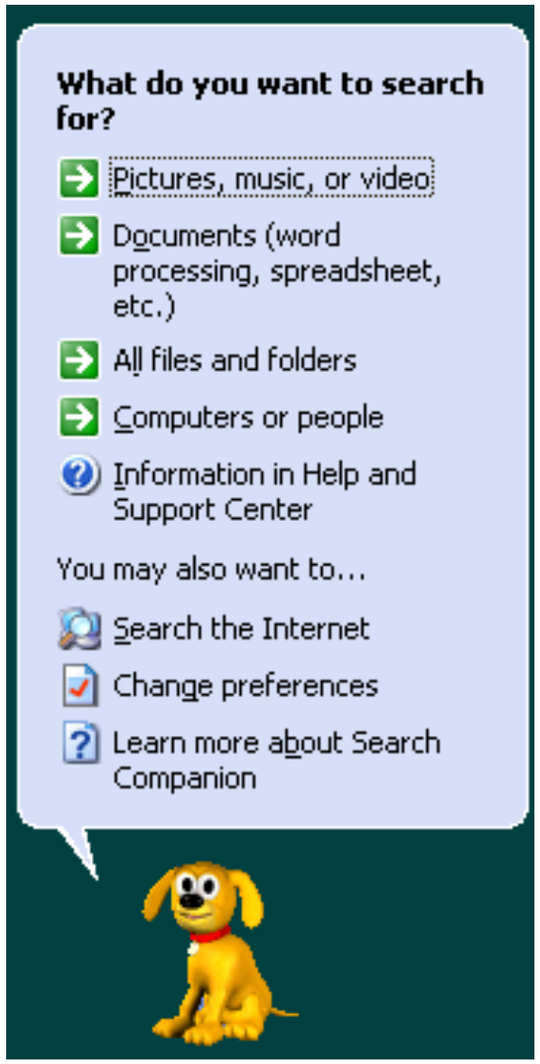
Calendar metaphor



Mechanical-Age Metaphors

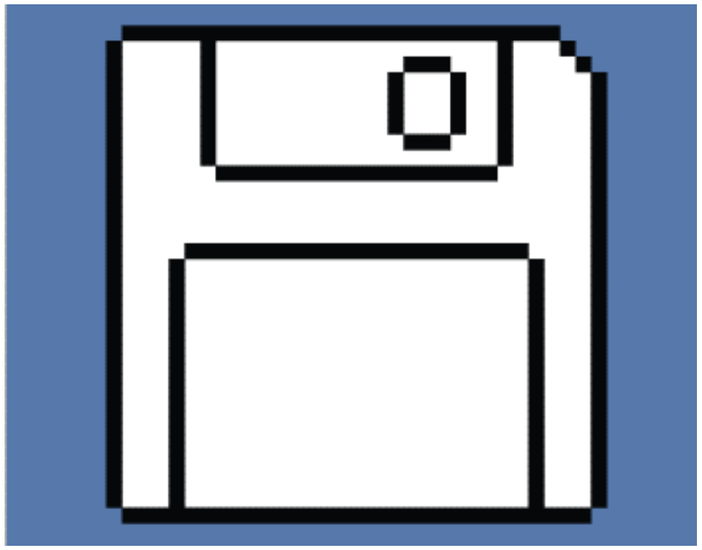


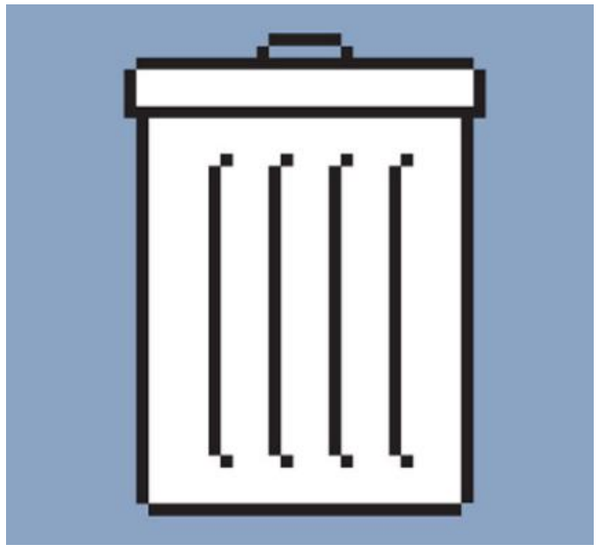
Shallow/inappropriate metaphors



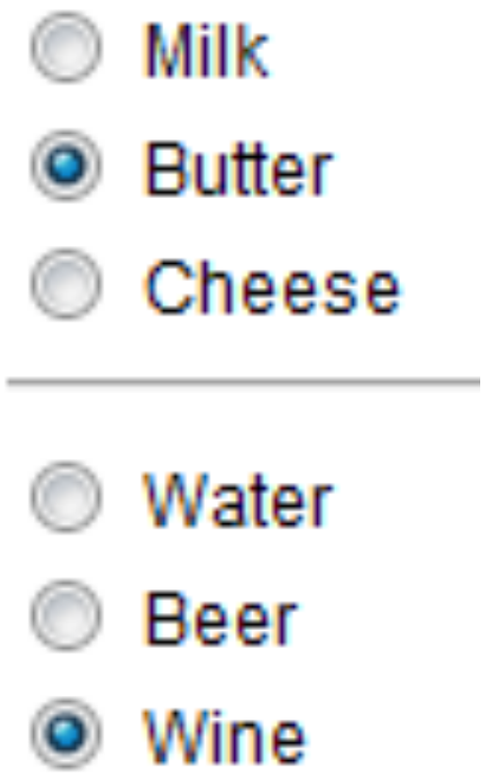
Microsoft Bob

Broken metaphors





Dead metaphors



Exercise

- Comment on design principles

EE/CSE elevators

HUMAN ABILITIES

...and their implications for design

dub

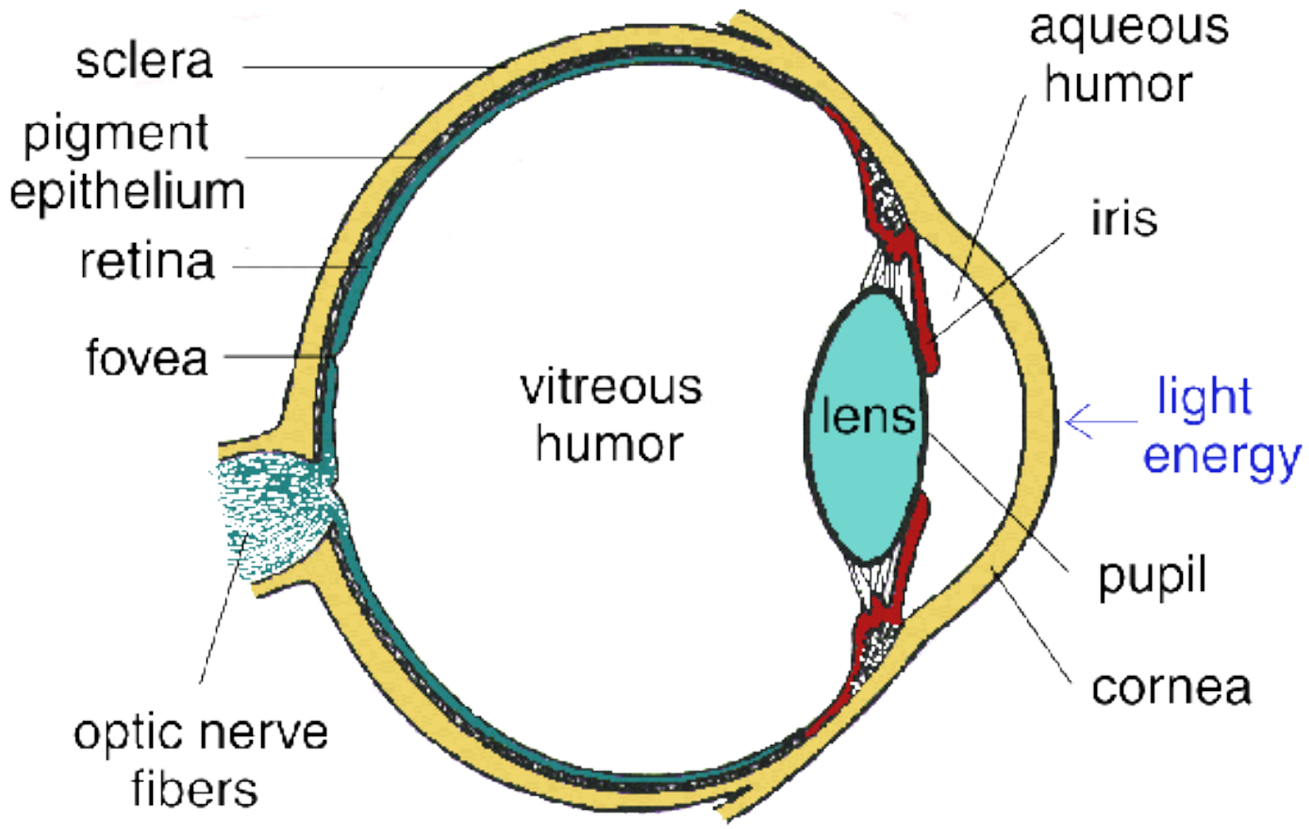
University of
Washington

Human abilities

Every artifact is the way it is because of human morphology or physiology.

- Humans:
  - Perception
    - Color, shape
    - Patterns (Gestalt principles)
  - Memory
  - Motor
    - Movement speed/precision (Fitt's law)

Human visual system



Light passes through lens
Focussed on retina

Human visual system

- Retina covered with light-sensitive receptors
  - rods
    - primarily for night vision & perceiving movement
    - sensitive to broad spectrum of light
    - can't discriminate between colors
    - sense intensity or shades of gray
  - cones
    - used to sense color

Human visual system

- Center of retina has most of the cones
  - allows for high acuity of objects focused at center

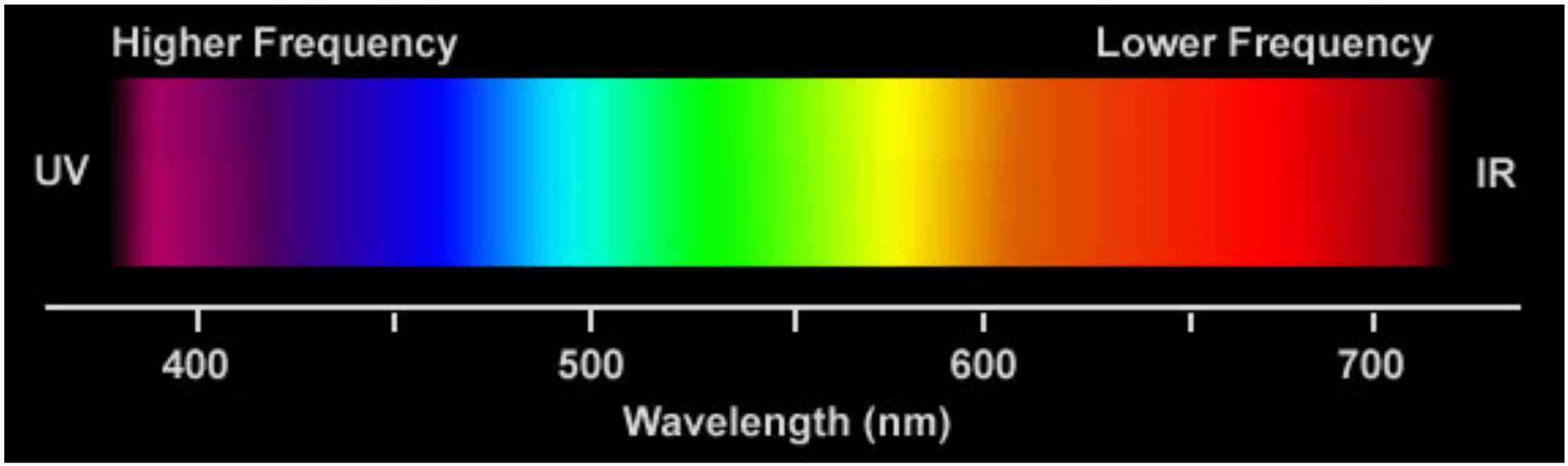
- Edge of retina is dominated by rods
  - allows detecting motion of threats in periphery

Color

- Powerful tool to improve user interfaces by communicating key information

- Inappropriate use can severely reduce the performance of systems

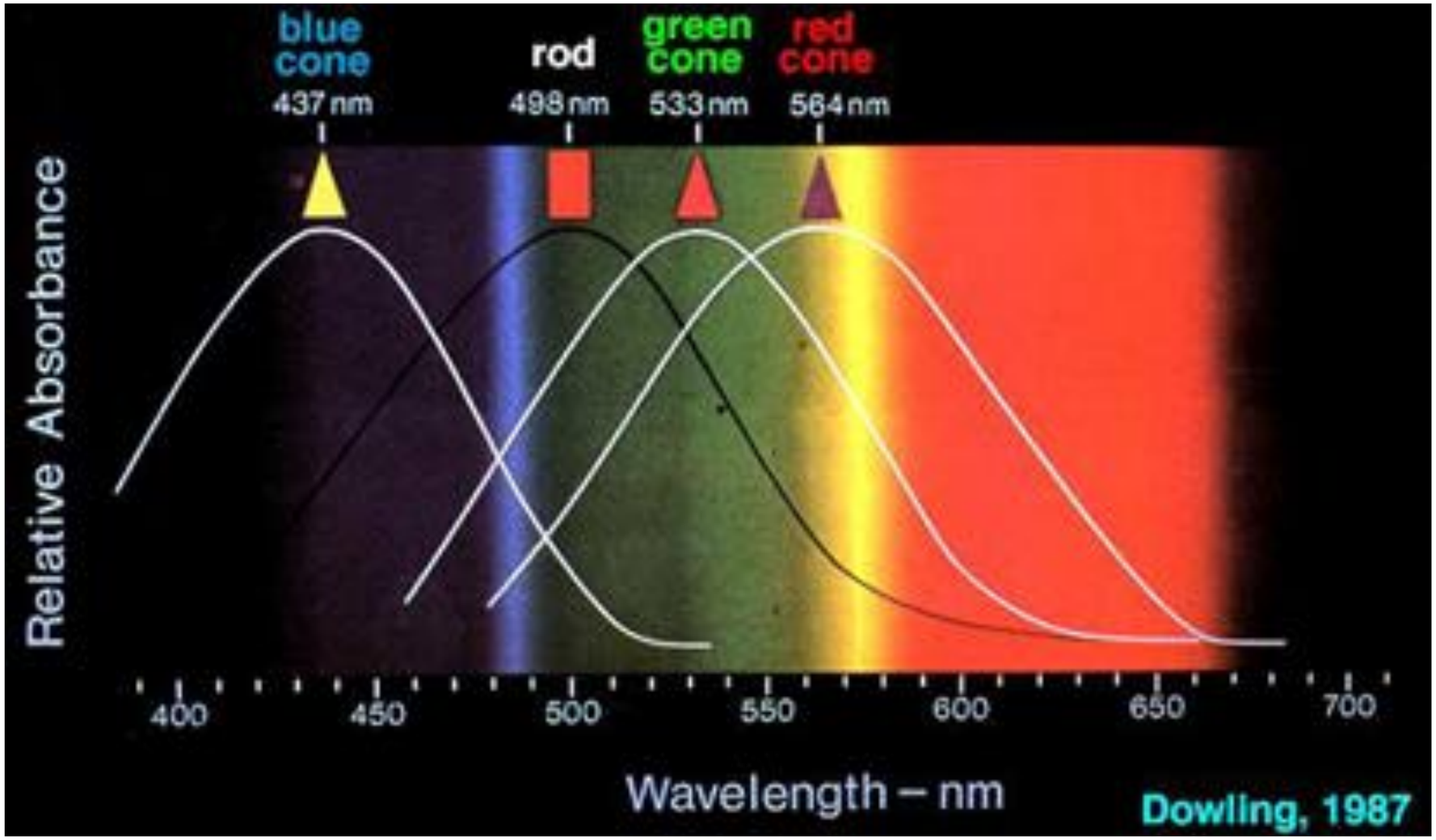
Visible spectrum



Color perception

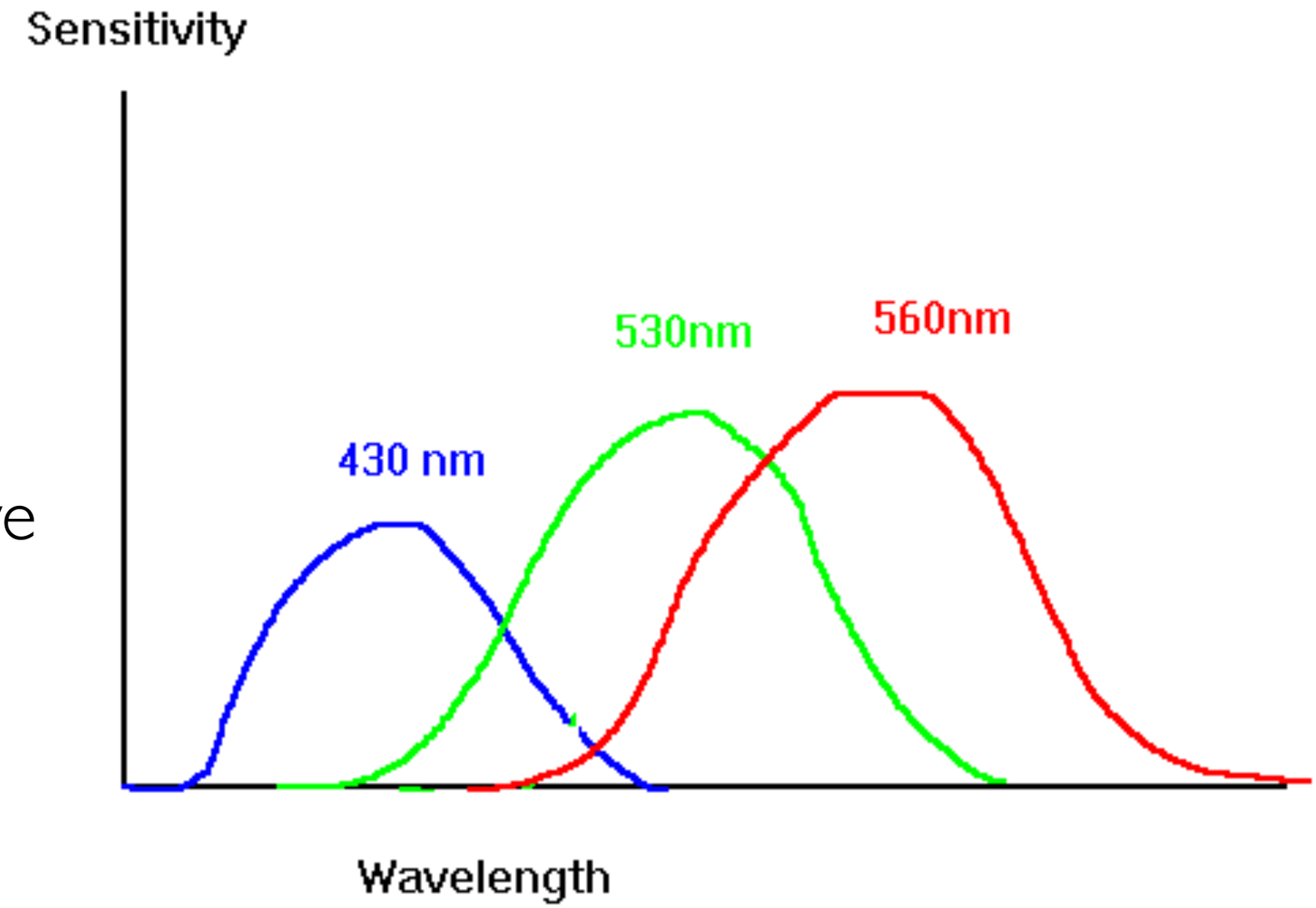
- "Photopigments" used to sense color
- 3 types: blue, green, "red" (really yellow)
  - each sensitive to different band of spectrum
  - ratio of neural activity of the 3 determines color
- other colors are perceived by combining stimulation

Color perception



Color sensitivity

not as sensitive to blue!



Color sensitivity

- Not distributed evenly
  - mainly reds (64%) & very few blues (4%)
  - insensitivity to short wavelengths (blue)
- No blue cones in retina center (high acuity)
  - "disappearance" of small blue objects you fixate on
  - As we age lens yellows & absorbs shorter wavelengths, sensitivity to blue is even more reduced

Color sensitivity

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- No blue cones in retina center (high acuity)
  - "disappearance" of small blue objects you fixate on
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Design implication:

don't rely on blue for text or small objects

Focus

- Different wavelengths of light focused at different distances behind eye's lens
  - need for constant refocusing
  - causes fatigue
- Pure (saturated) colors require more focusing then less pure (desaturated)

Focus

- Different wavelengths of light focused at different distances behind eye's lens
  - need for constant refocusing
  - causes fatigue
- Pure (saturated) colors require more focusing then less pure (desaturated)

Design implication:

be careful about color combinations

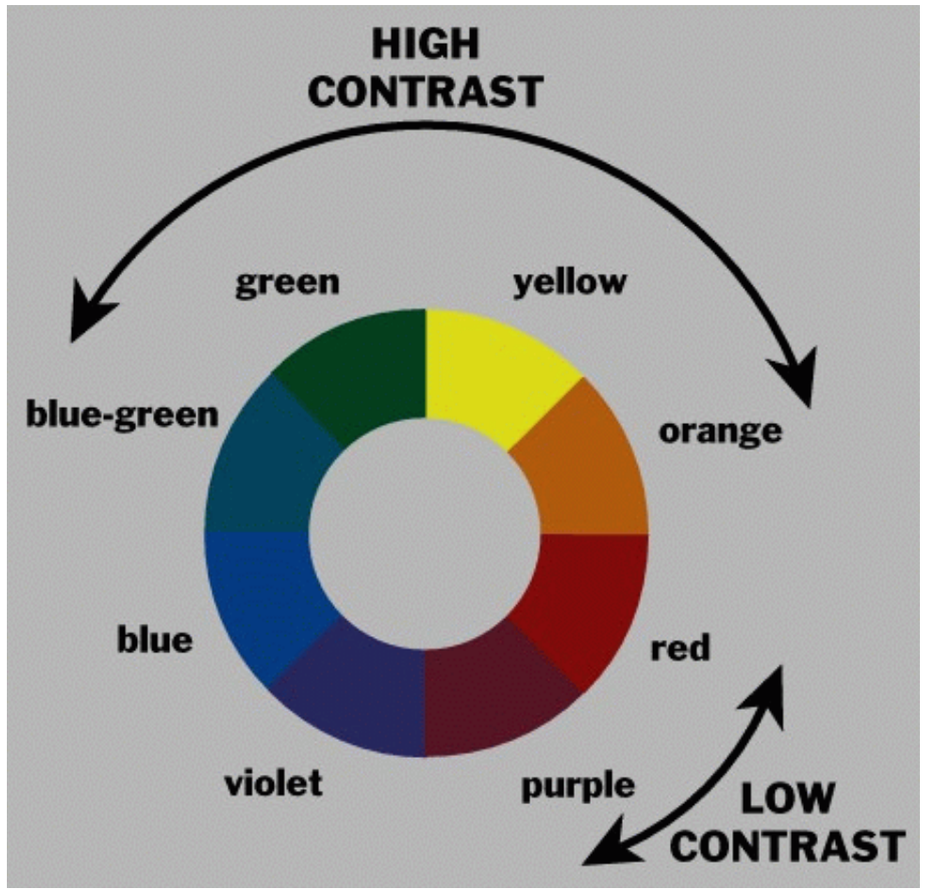
don't use saturated colors in UIs unless you really need something to stand out (stop sign)

Color guidelines

- Avoid simultaneous display of highly saturated, spectrally extreme colors
  - e.g. no cyans/blues at the same time as reds, why?
    - refocusing!
    - desaturated combinations are better (pastels)

Color guidelines

- Using the hue circle: Pick non-adjacent colors
  - opponent colors create contrast
    - (red & green) or (yellow & blue)



Color guidelines

- Size of detectable changes in color varies
  - hard to detect changes in reds, purples, & greens
  - easier to detect changes in yellows & blue-greens
- Hard to focus on edges created by only color
  - use both brightness & color differences
- Avoid red & green in the periphery (no RG cones)
- Older users need higher brightness levels

Color guidelines

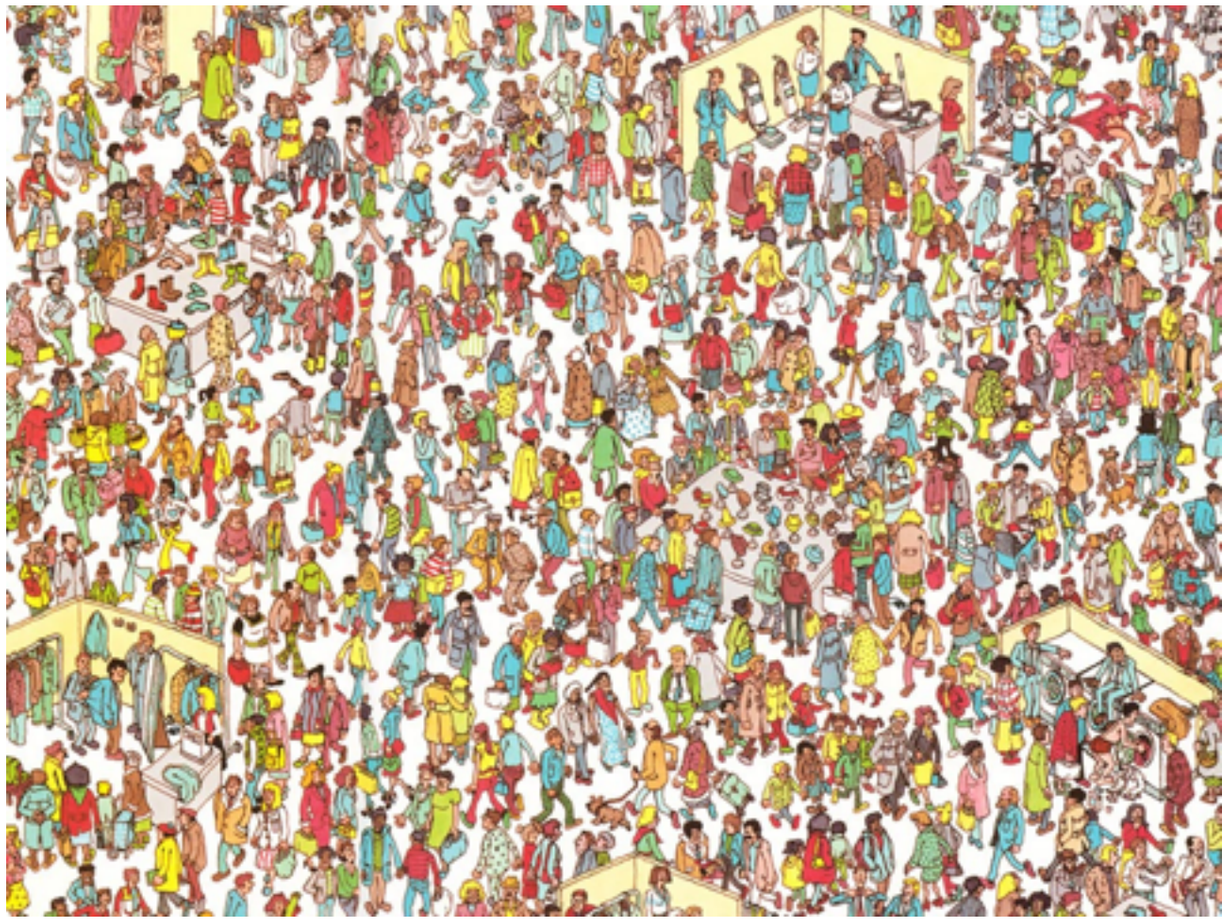
- Avoid pure blue for text, lines, & small shapes
  - –also avoid adjacent colors that differ only in blue
- Avoid single-color distinctions
  - –mixtures of colors should differ in 2 or 3 colors
  - –helps color-deficient observers

Color blindness

- Trouble discriminating colors
  - besets about 9% of population
- Two main types
  - different photopigment response most common
    - reduces capability to discern small color diffs
  - red-green deficiency is best known
    - lack of either green or red photopigment
      can't discriminate colors dependent on R & G

Attention/saliency

Attention/saliency



Patterns

dub

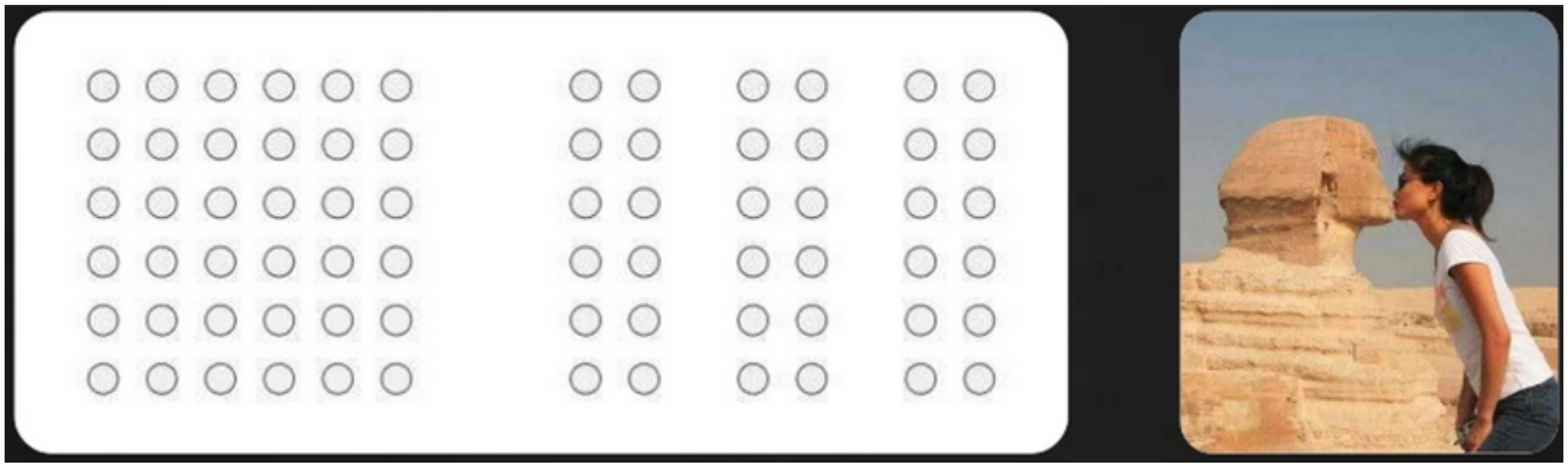
University of Washington

Gestalt principles

- Closure
- Good continuation
- Proximity
- Similarity

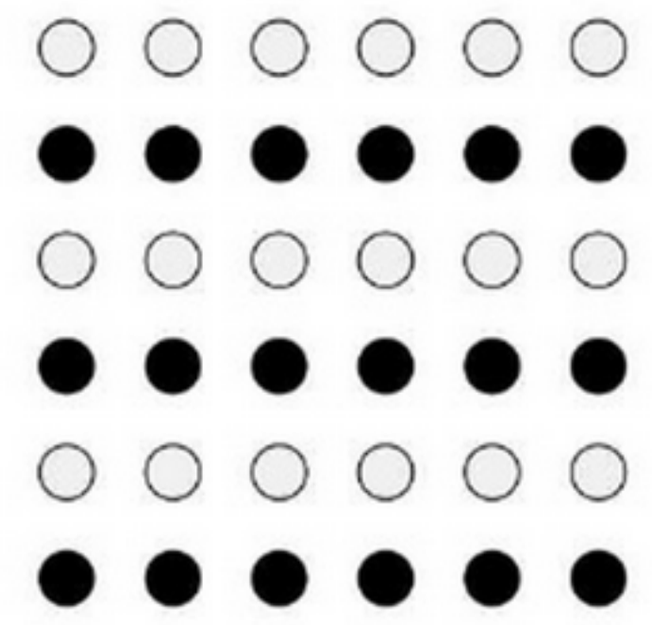
Gestalt principles - proximity

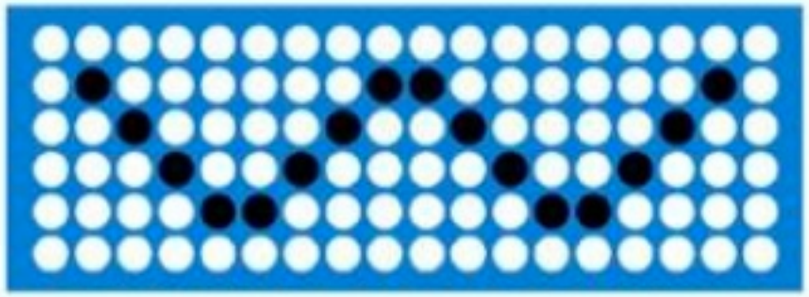
Elements that are **closer together are perceived to be more related** than elements that are farther apart.



Gestalt principles - similarity

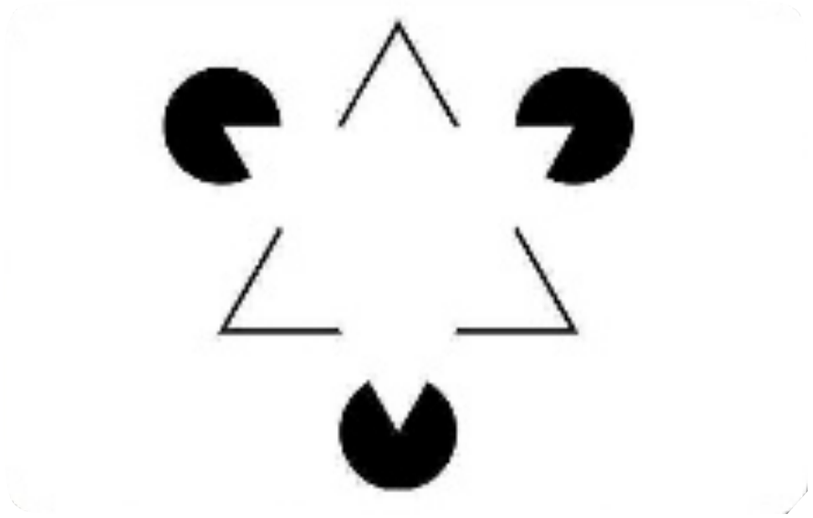
Elements are **similar are perceived to be more related** than elements that are dissimilar.





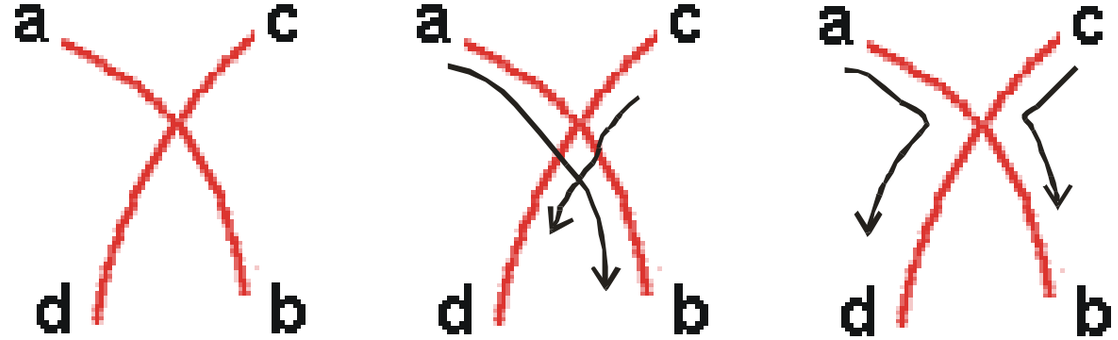
Gestalt principles - closure

A tendency to perceive a **set of individual elements as a single, recognizable pattern**, rather than **multiple, individual elements**.



Gestalt principles - good continuation

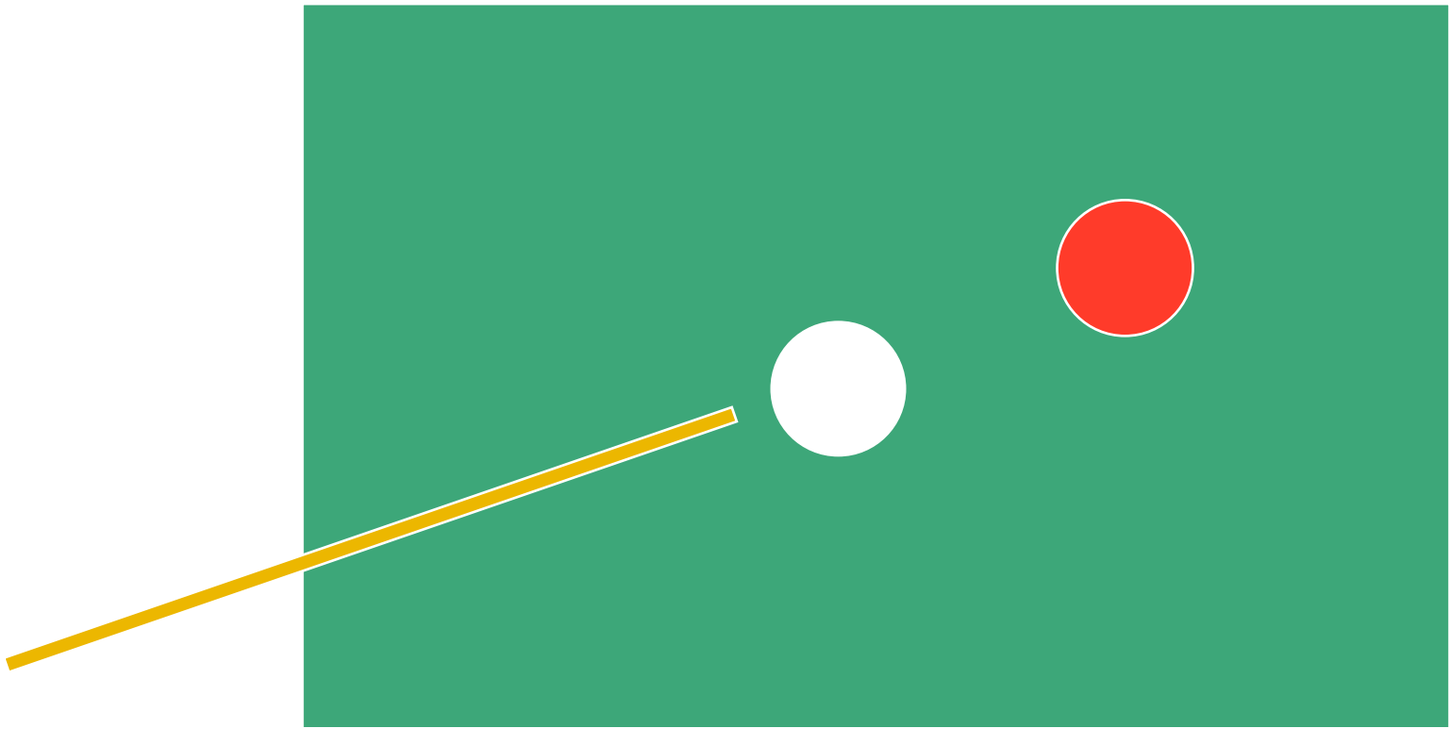
Elements arranged in a **straight line or a smooth curve** are perceived as a group and are interpreted as being more related than elements not on the line or curve.



Exercise

- Comment on Gestalt principles
  - Closure
  - Good continuation
  - Proximity
  - Similarity

Perception of time/change



How soon must red ball move after cue ball collides with it?

must move in < Tp (100 msec)

Perception of time/change

- Stimuli that occur within one cycle fuse into a single concept
  - frame rate needed for movies to look real?
  - time for 1 frame < Tp (100 msec); that is10 frame/sec.
- Perceptual causality
  - two distinct stimuli can fuse if the first event appears to cause the other
  - events must occur in the same cycle

Memory

- Working memory (short term)
  - small capacity (7 ± 2 "chunks")
  - 6174591765 vs. (617) 459-1765
  - DECIBMGMC vs. DEC IBM GMC
  - rapid access (~ 70ms) & decay (~200 ms)
  - pass to LTM after a few seconds of continued storage
- Long-term memory
  - huge (if not "unlimited")
  - slower access time (~100 ms) w/ little decay

Speed of accessing memory

Paper
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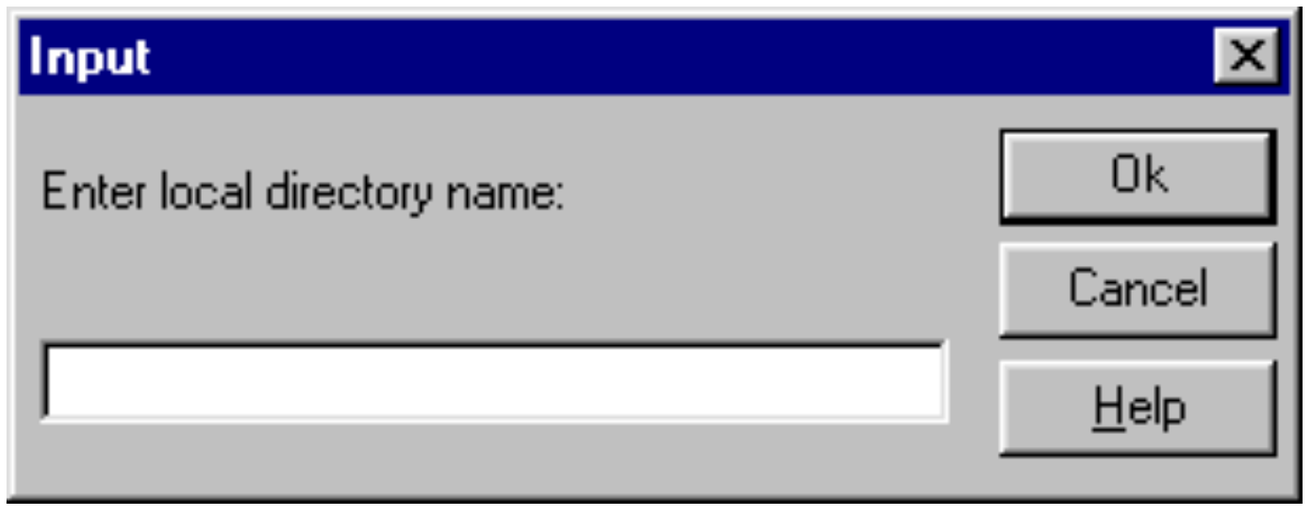
Change

Yellow
White
Black
Blue
Red
Green

Speed of accessing memory

- Interference
  - –two strong cues in working memory
  - –link to different chunks in long term memory
- Why learn about memory?
  - –know what's behind many HCI techniques
  - –helps you understand what users will "get"
  - –aging population of users

Recall versus recognition



Recall

reproduce information from memory

Recognition

discriminate among provided info