

THE DESIGN OF EVERYDAY THINGS AND INTERACTIVE SYSTEMS

By David Ledo



THE PSYCHOPATHOLOGY OF EVERYDAY THINGS

How some things went wrong

*Bad designs are everywhere.
Sometimes it's cumbersome,
sometimes it's funny, and
sometimes it's fatal.*

EARLY TRACTORS



High centre of gravity

Narrow front wheel base

Farmers work long hours
and quickly

Terrain is uneven

... high number of fatalities

MODERN TRACTORS



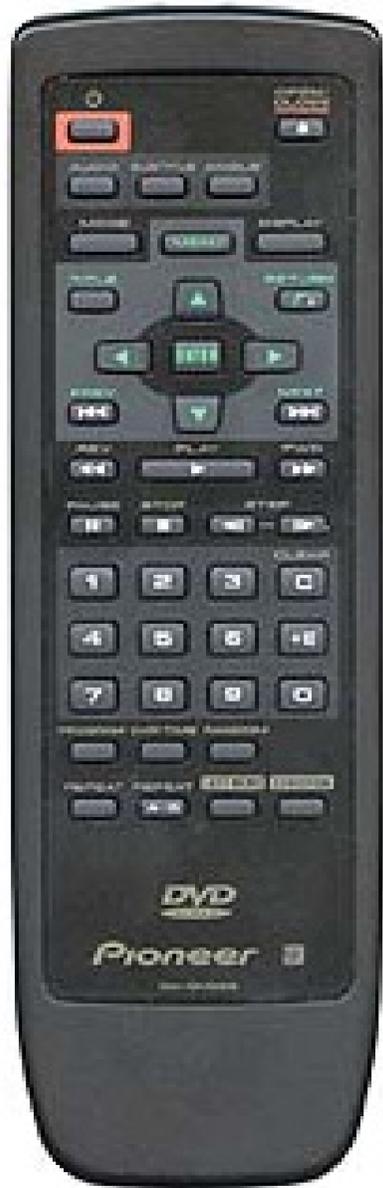
Roll cage

Low centre of gravity

Wider wheel bases

... less accidents now, used to be called *driver's error*

REMOTE CONTROLS



Your phone rings when watching a movie...

Quick! Hit pause!

REMOTE CONTROLS - TAKE 2



Your phone rings when watching a movie...

Quick! Hit pause!

WHY IS THIS EASIER?



Big button easier to hit (Fitt's Law)

Visually distinctive:
Colour, location, shape.

Easier to find without looking

TiVo designed it for usability



Image from Nielsen and Norman Group: Remote Control Anarchy (2004)

THE “GRANDMA” REMOTE



Image from College Humor

HAWAII FALSE ALARM

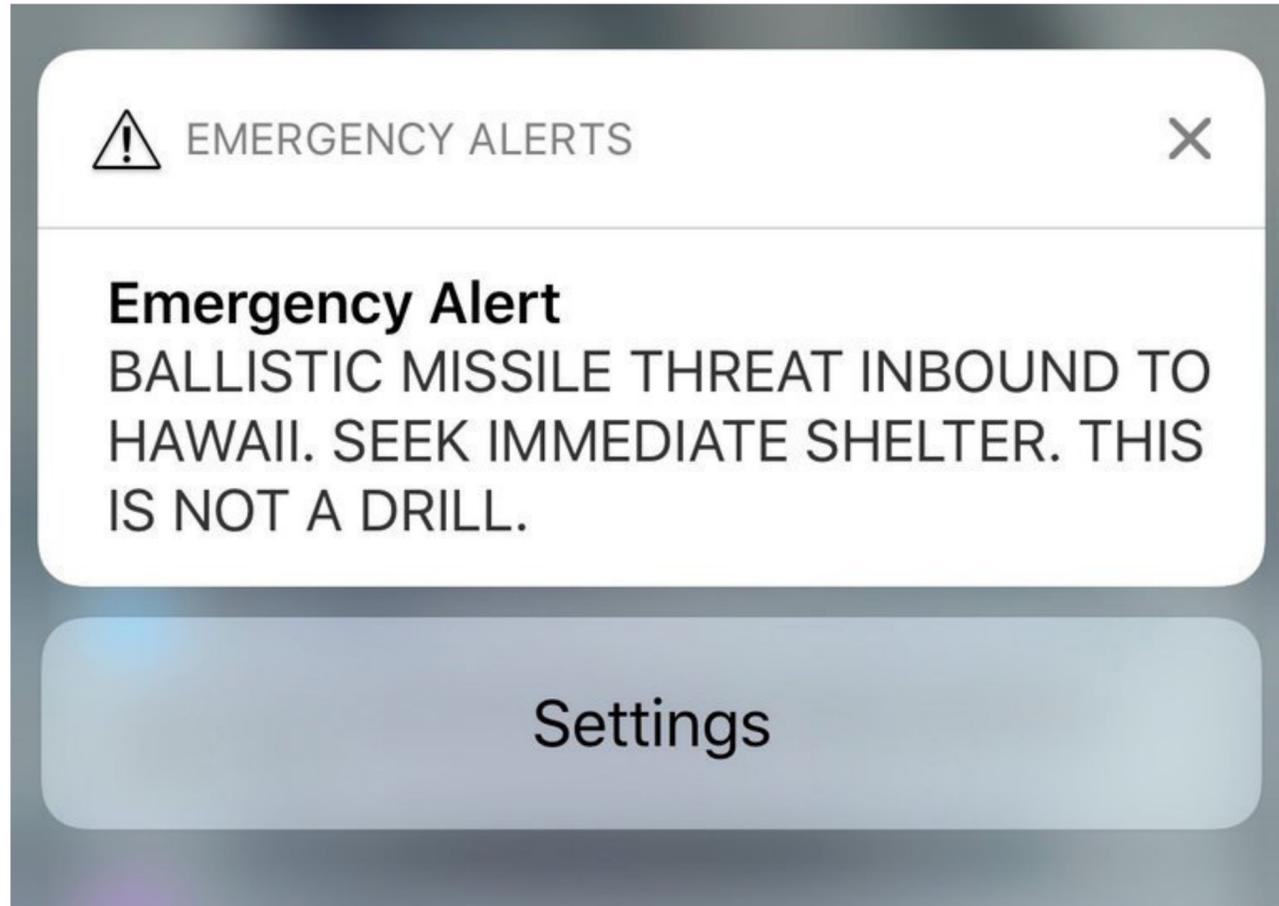
The New York Times

Hawaii Panics After Alert About Incoming Missile Is Sent in Error

By ADAM NAGOURNEY, DAVID E. SANGER and JOHANNA BARR JAN. 13, 2018



HAWAII FALSE ALARM



<https://www.nytimes.com/2018/01/13/us/hawaii-missile.html>

HAWAII FALSE ALARM

“From a drop-down menu on a computer program, he saw two options: “Test missile alert” and “Missile alert.” He was supposed to choose the former; as much of the world now knows, he chose the latter, an initiation of a real-life missile alert.”

- Washington Post

https://www.washingtonpost.com/news/post-nation/wp/2018/01/14/hawaii-missile-alert-how-one-employee-pushed-the-wrong-button-and-caused-a-wave-of-panic/?utm_term=.8322cf450104

HAWAII FALSE ALARM

1. State EOC

1. TEST Message

DRILL-PACOM (DEMO) STATE ONLY

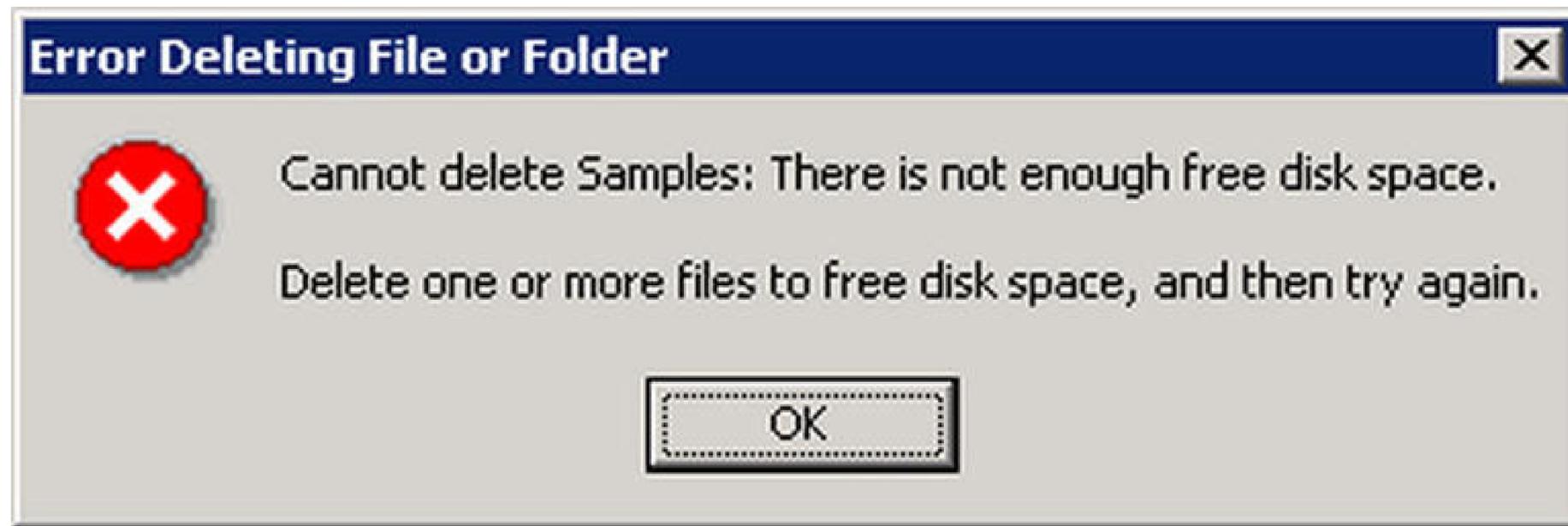
False Alarm BMD (CEM) - STATE ONLY

Monthly Test (RMT) - STATE ONLY

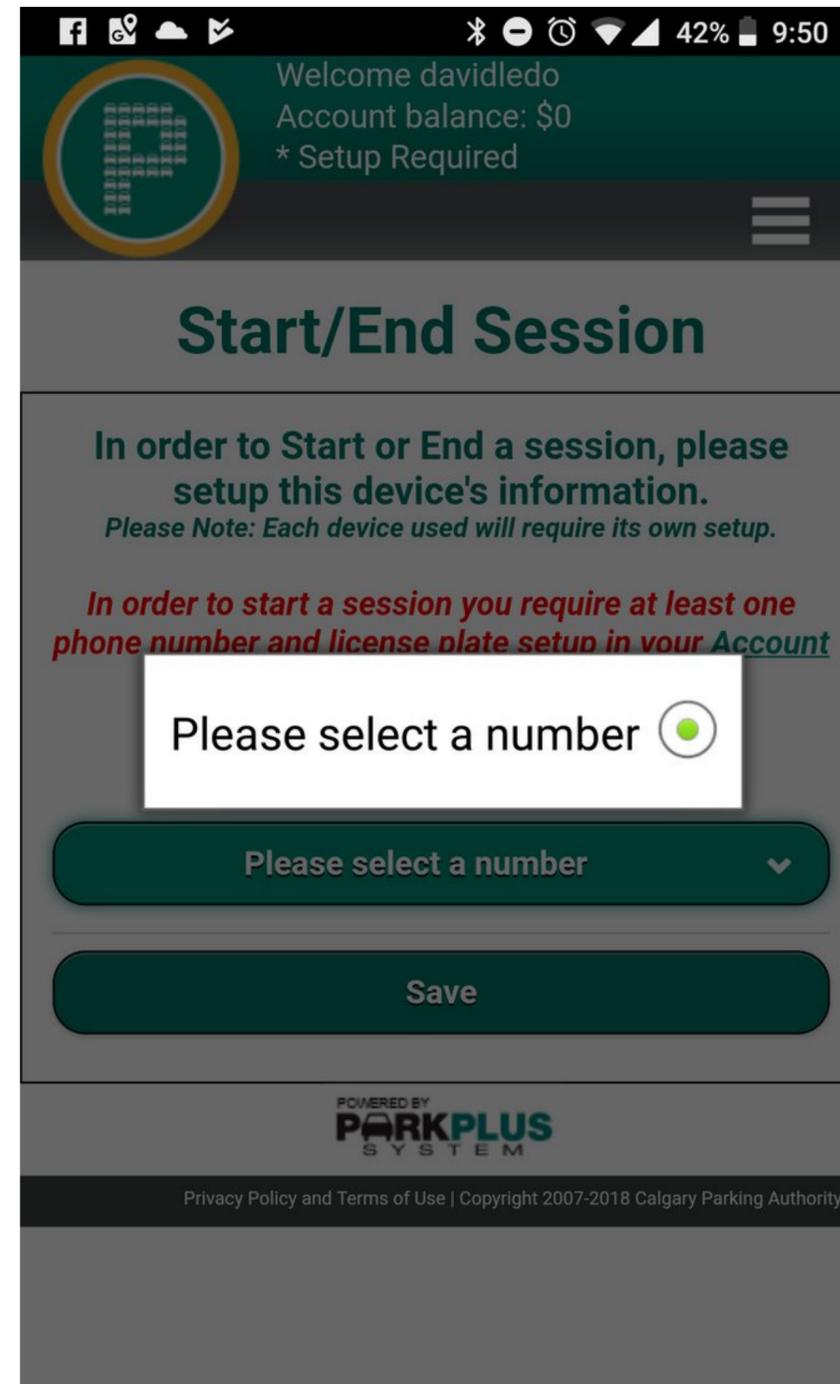
PACOM (CDW) - STATE ONLY

<https://theoutline.com/post/2954/user-interface-designers-are-horrified-by-hawaii-s-missile-alert-system?zd=1&zi=vosurkrx>

MY STRUGGLES AS AN 8 YEAR OLD

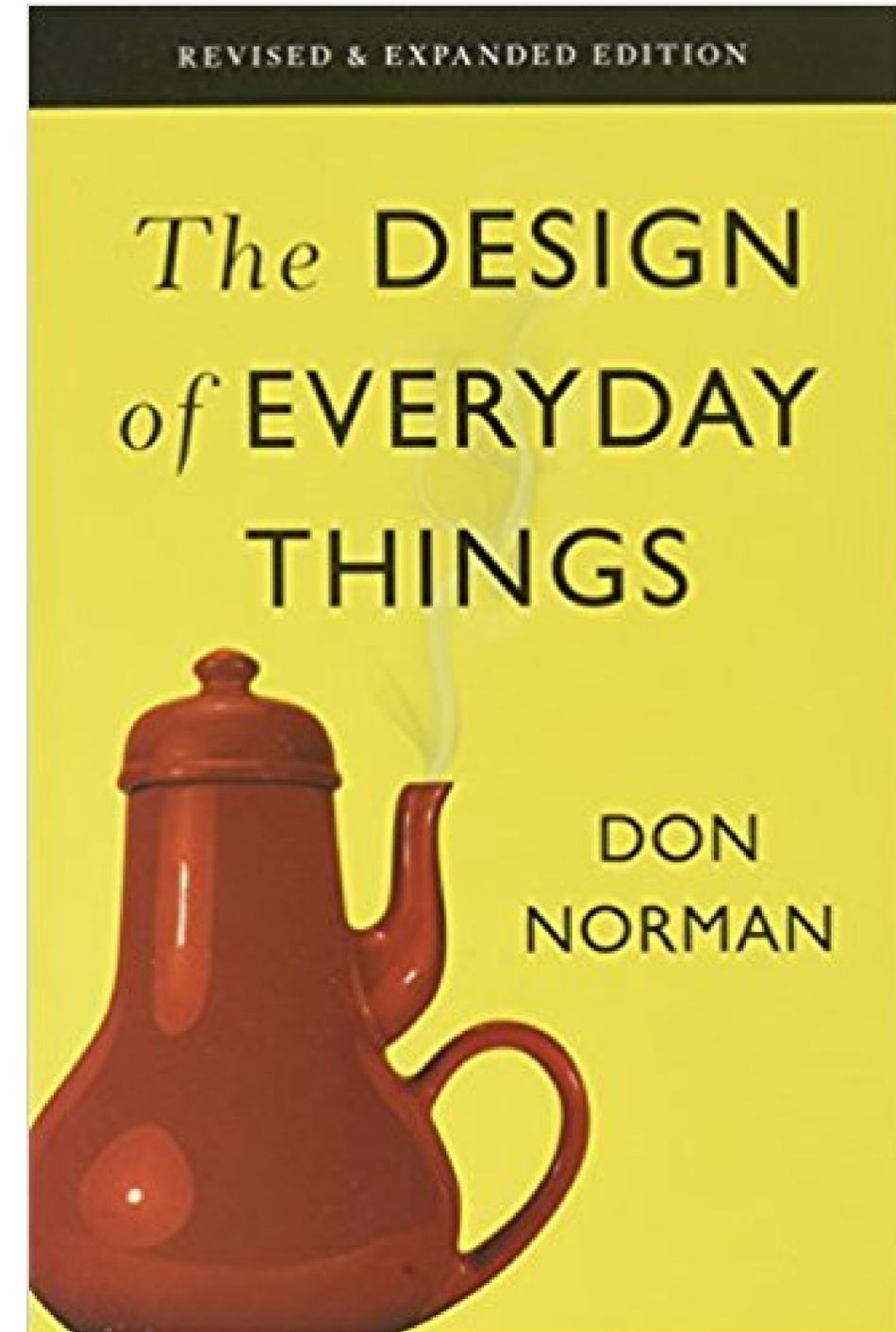


MY STRUGGLES TODAY



THE DESIGN OF EVERYDAY THINGS

Don Norman



AFFORDANCES

MAPPINGS

SIGNIFIERS

**CONCEPTUAL
MODELS**

AFFORDANCES

MAPPINGS

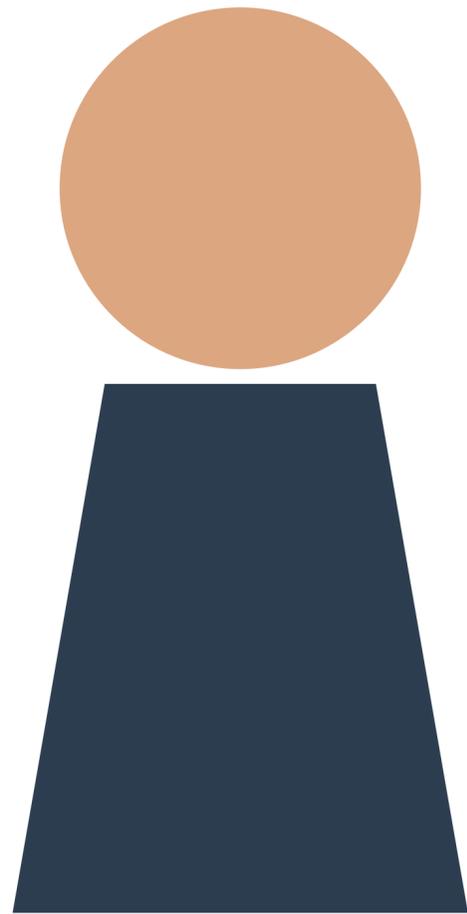
SIGNIFIERS

**CONCEPTUAL
MODELS**

GESTALT PSYCHOLOGY AND AFFORDANCE

1935 Simplified

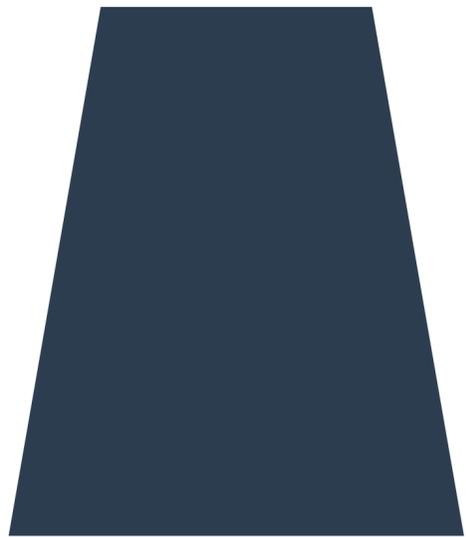
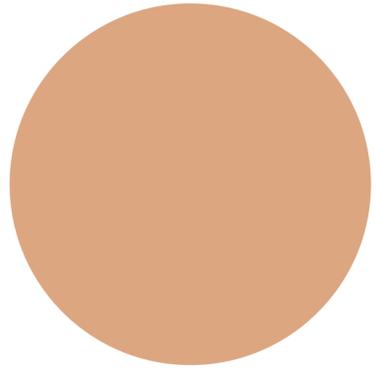
GESTALT AND ACTION



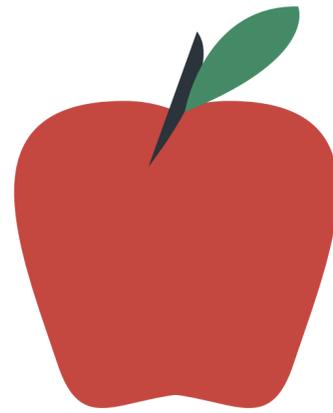
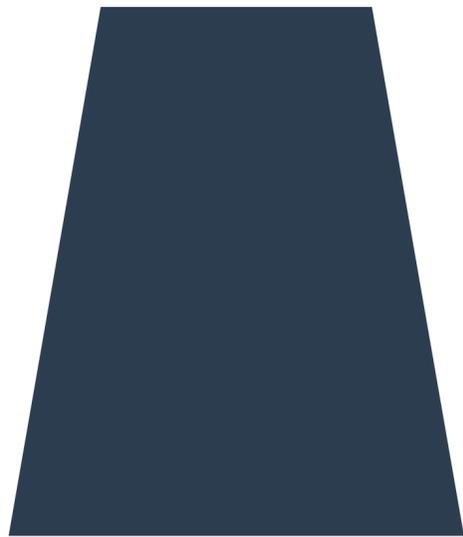
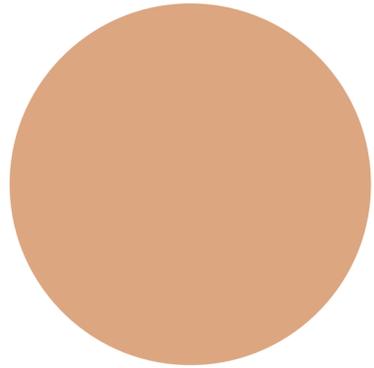
***Action** is the relieving of tension.*

Depending on tension, objects may attract us, repel us or be indifferent.

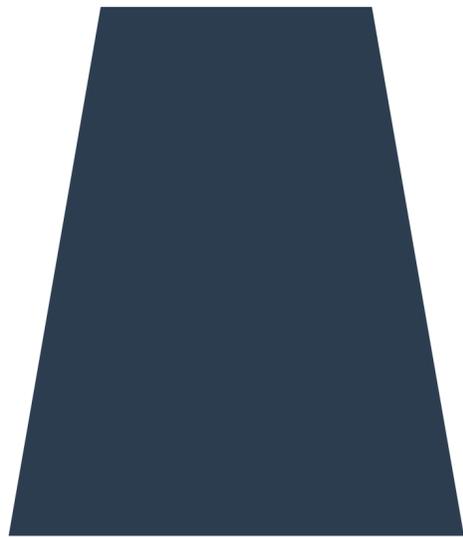
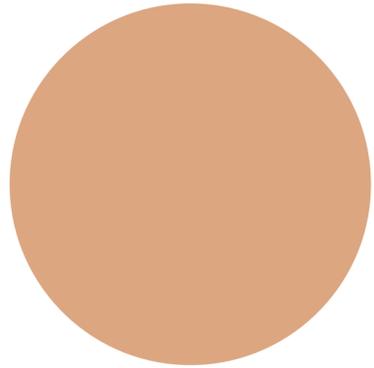
hungry



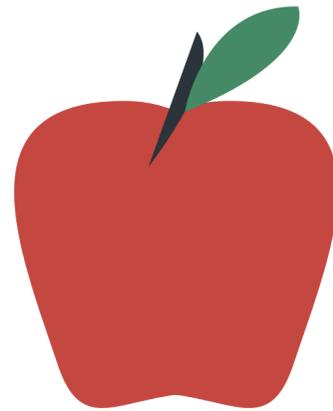
hungry



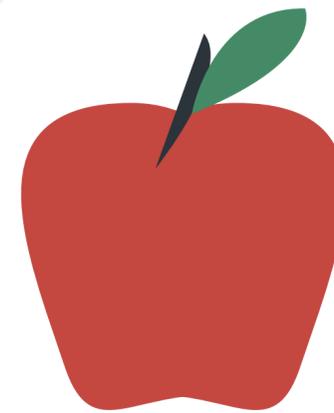
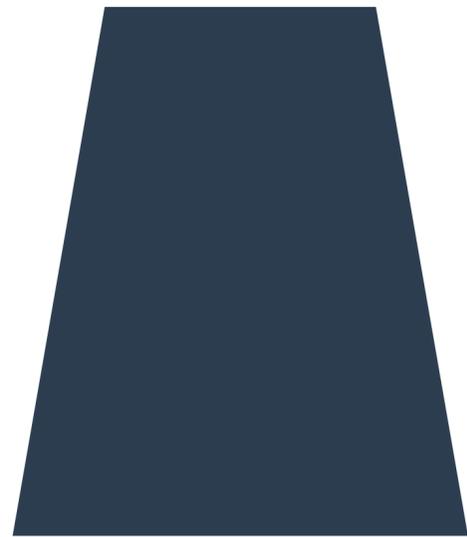
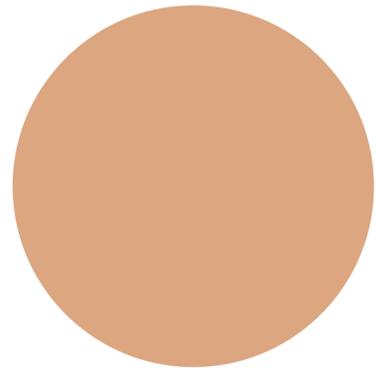
hungry



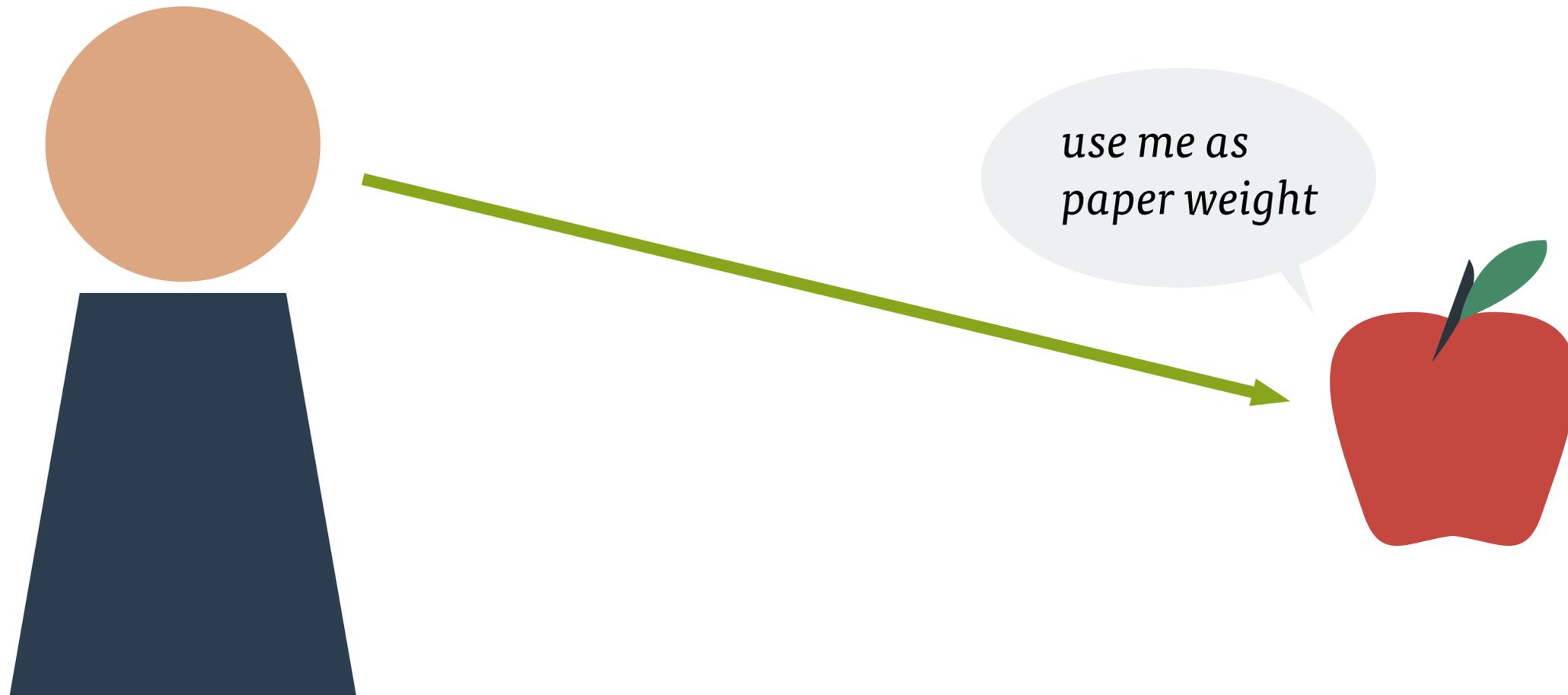
eat me



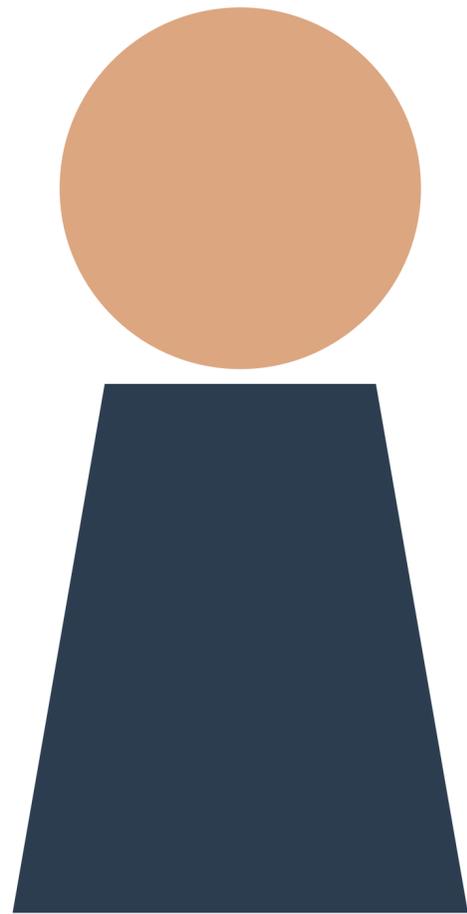
not hungry



*there's wind and papers
are flying all over*

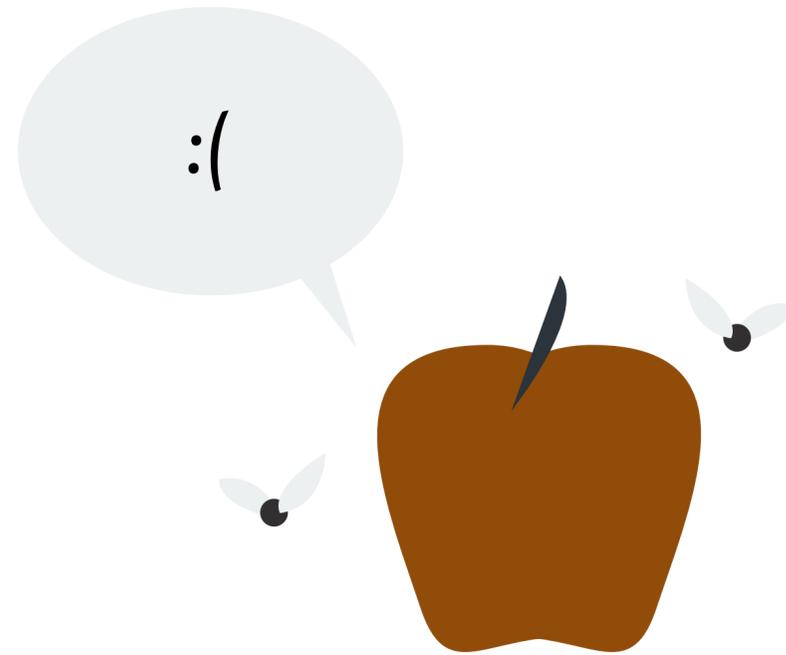
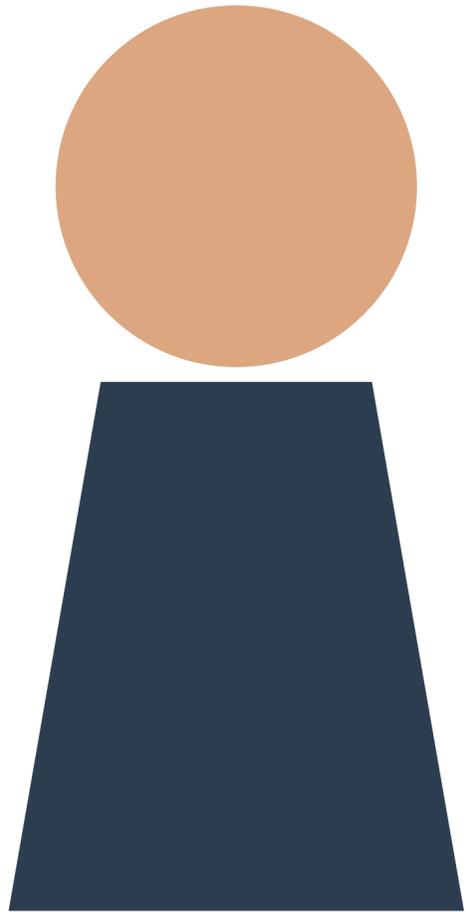


GESTALT AND ACTION

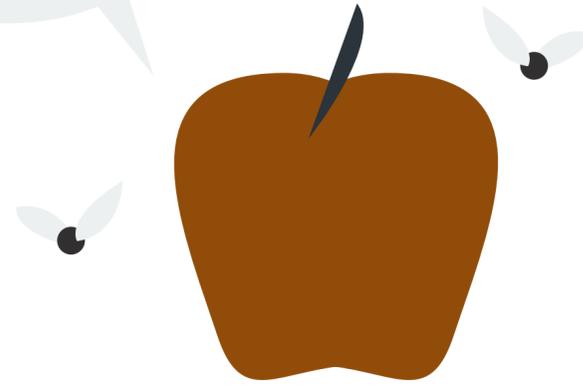
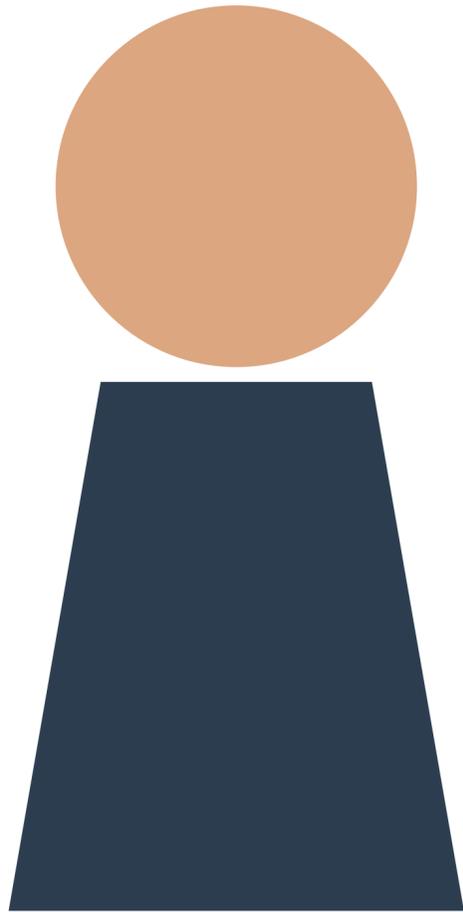


Characteristics of the object might affect that attraction/repulsion

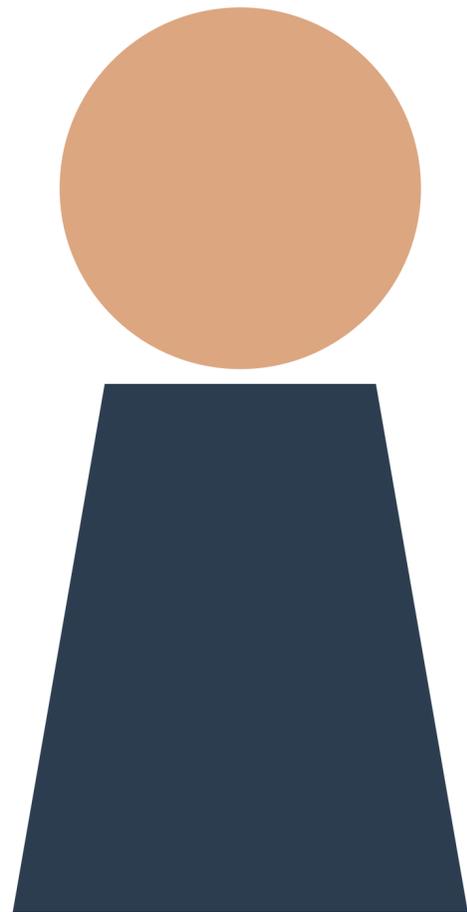
hungry



hungry

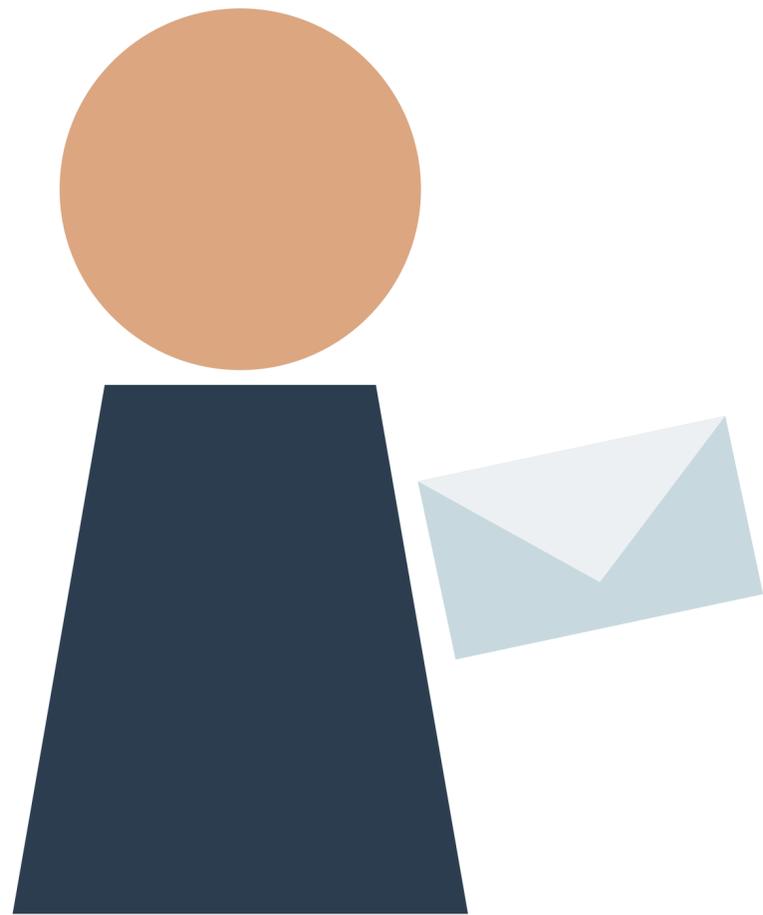


GESTALT AND ACTION

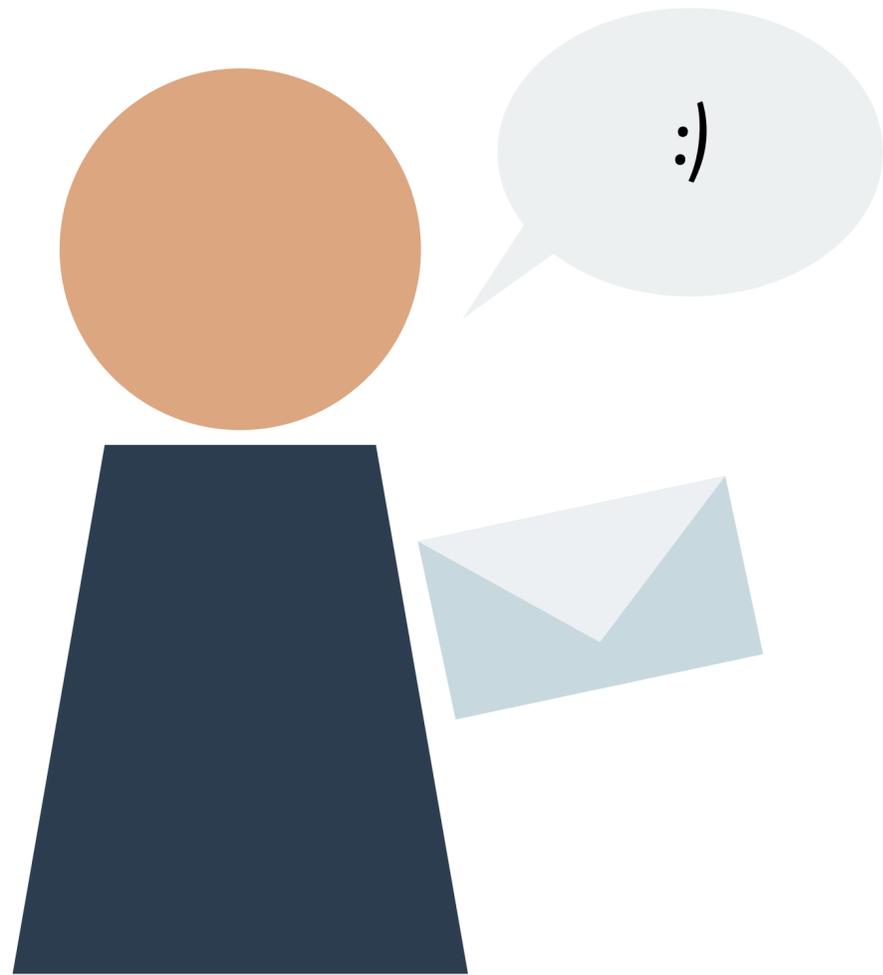


Relationship with object is tied to the current condition

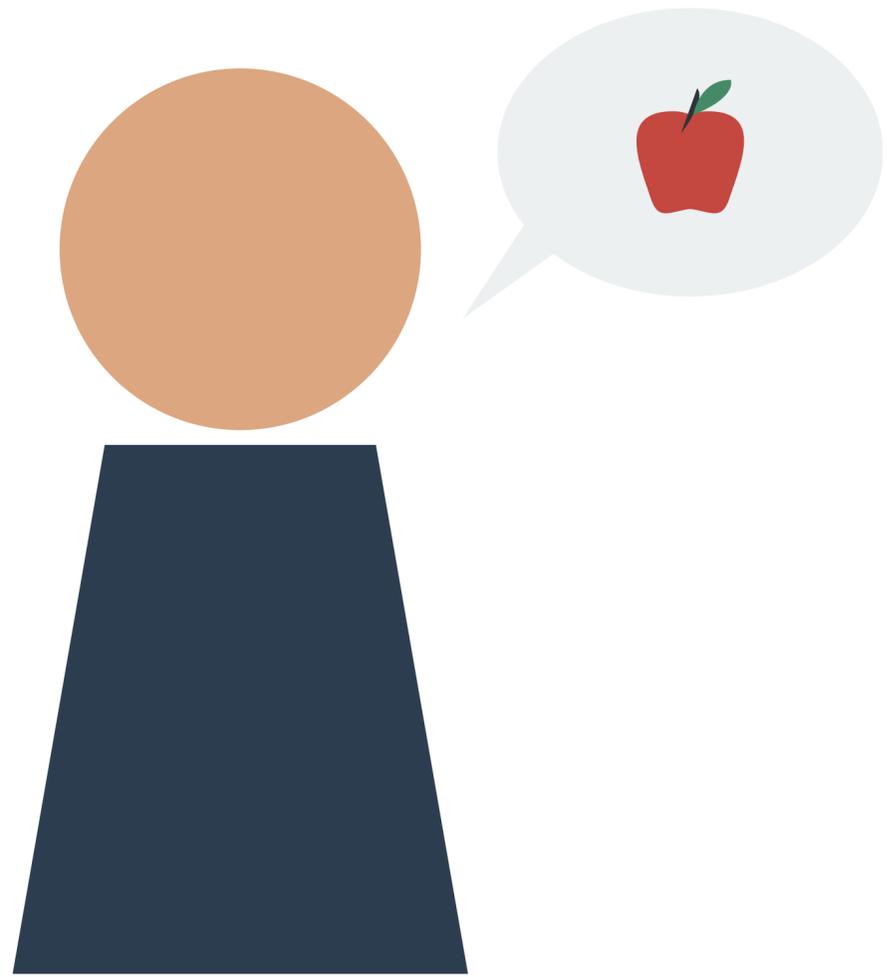


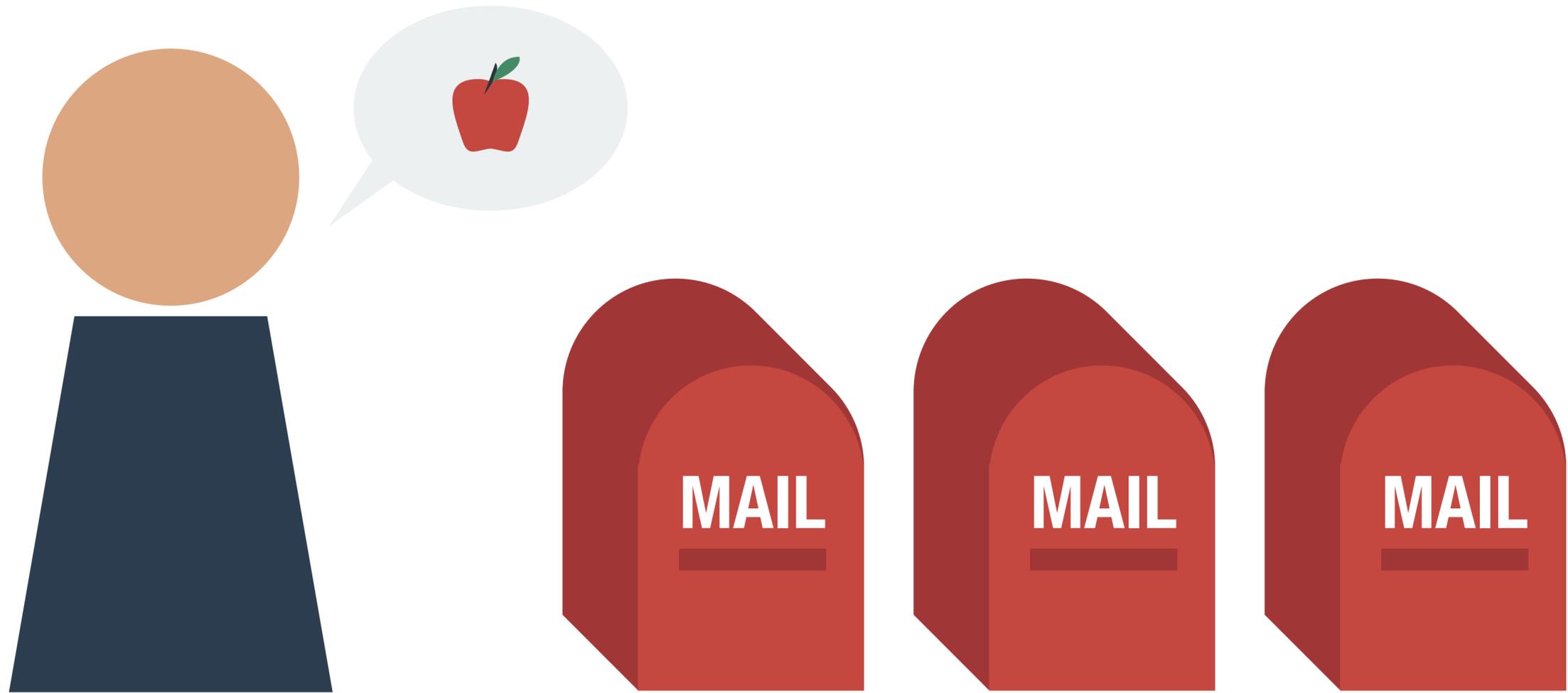




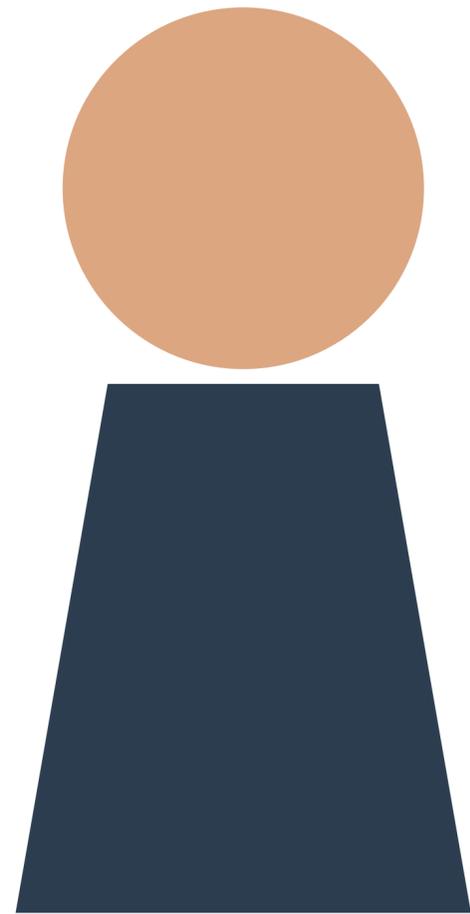


... days later





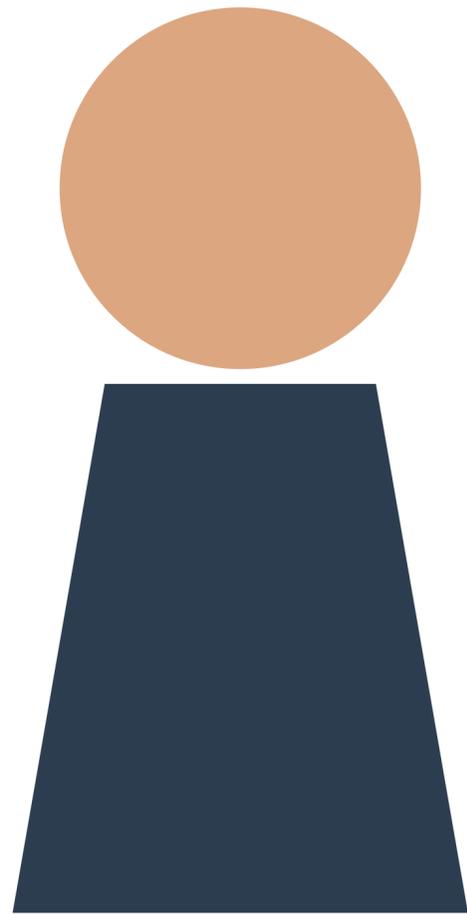
GESTALT AND ACTION



Stimulus might “stick around” after



GESTALT AND ACTION



Relationships are learned or chosen (when an object demands attention, e.g. phone ringing)

**GIBSON
AND AFFORDANCE**

1954

AFFORDANCE

Set of action possibilities an individual (human or animal) can accomplish. Such actions are relative to that particular individual.

AFFORDANCE

“The affordances of the environment are what it offers the animal, what it provides or furnishes, either for good or ill. The verb to afford is found in the dictionary, but the noun affordance is not. I have made it up.”

AFFORDANCE

Set of action possibilities an individual (human or animal) can accomplish. Such actions are relative to that particular individual.

AFFORDANCE

An elongated object affords wielding

A rigid object with a sharp edge affords cutting

A graspable object of moderate size and weight affords throwing

AFFORDANCE



*What does this
chair afford?*

AFFORDANCE



It affords...

Sitting

Standing on it

Throwing (if it's light)

Self-defense

AFFORDANCE

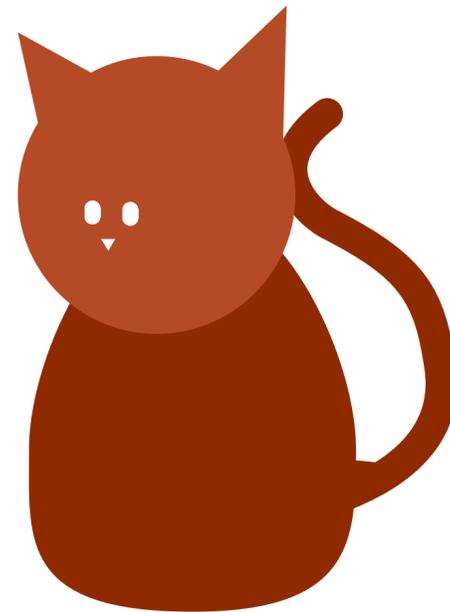
Set of action possibilities an individual (human or animal) can accomplish. Such actions are relative to that particular individual.

AFFORDANCE

*rock affords
hiding*



*rock affords
providing food*



**NORMAN'S
PERCEIVED AFFORDANCES**

Shifting to design

PERCEIVED AFFORDANCE

An invitation to action

Typically designed

Suggests how the object *might* be used

PERCEIVED AFFORDANCE



Creates issues when the perceived affordance is not the same as the actual affordance



PERCEIVED AFFORDANCE



Switch suggests toggling



knob suggests turning



button suggests pressing



slot suggests inserting, handle suggests turning

SKEUOMORPHISM

Making virtual items resemble physical counterparts



SKEUOMORPHISM



Image credit: Steven Houben

SKEUOMORPHISM



IBM Real Objects (1998)

SKEUOMORPHISM



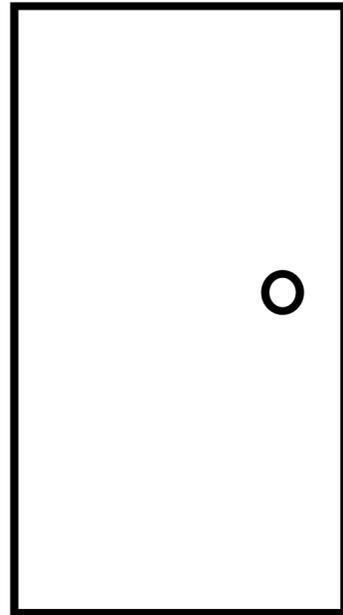
BumpTop (Agarawala and Balakrishnan, 2006)

VISIBLE CONSTRAINTS

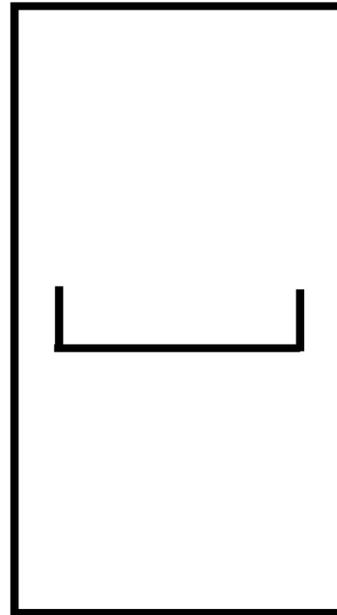
Limiting possible actions through appearance



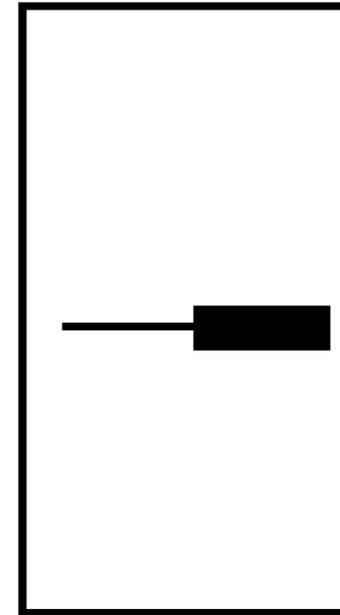
VISIBLE CONSTRAINTS



PUSH OR PULL?



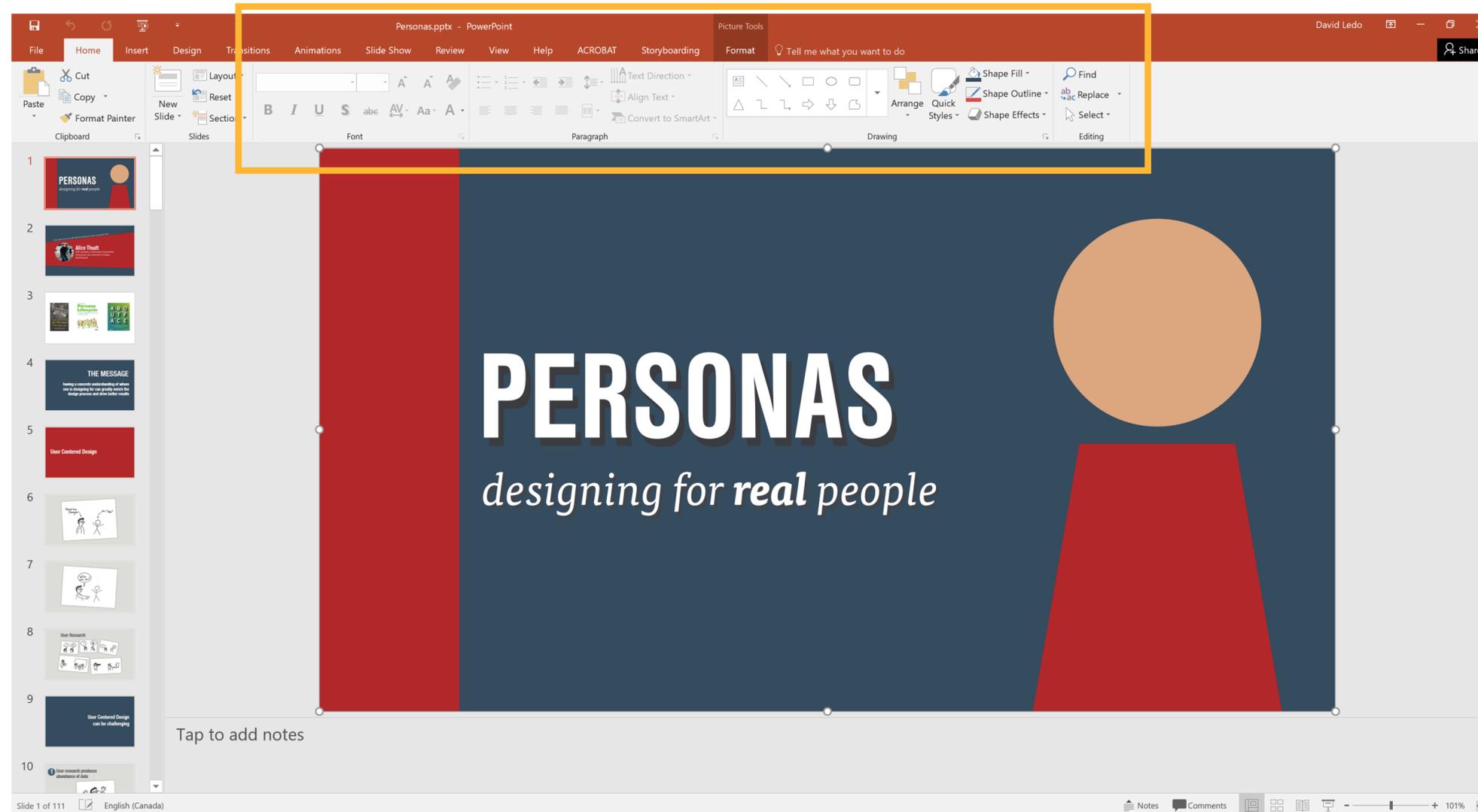
WHICH SIDE?



CAN ONLY PUSH,
SIDE TO PUSH
CLEARLY VISIBLE

VISIBLE CONSTRAINTS

Controls disabled when an image is selected



AFFORDANCES

MAPPINGS

SIGNIFIERS

**CONCEPTUAL
MODELS**

MAPPINGS

“What does this button do?”

MAPPING

The set of possible relations between objects



CONTROL-DISPLAY COMPATIBILITY

How controls relate to displays



Design of Everyday Things (1988)

CONTROL-DISPLAY COMPATIBILITY



David's thermostat...

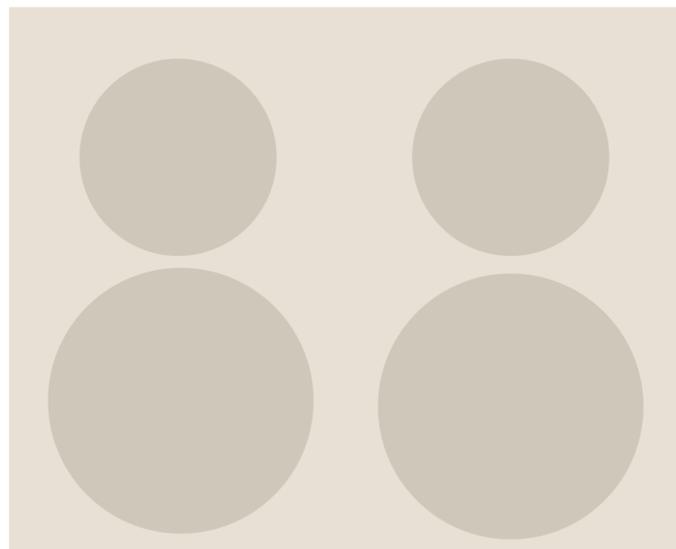
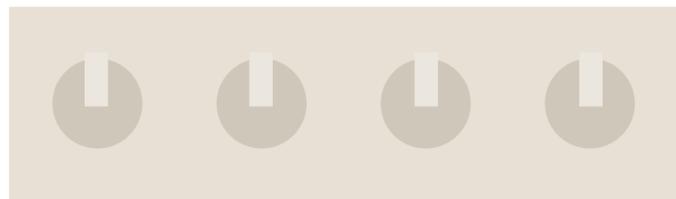
Controls are inverted,
Reading the temperature is not

CONTROL-DISPLAY COMPATIBILITY

How controls relate to displays

ARBITRARY

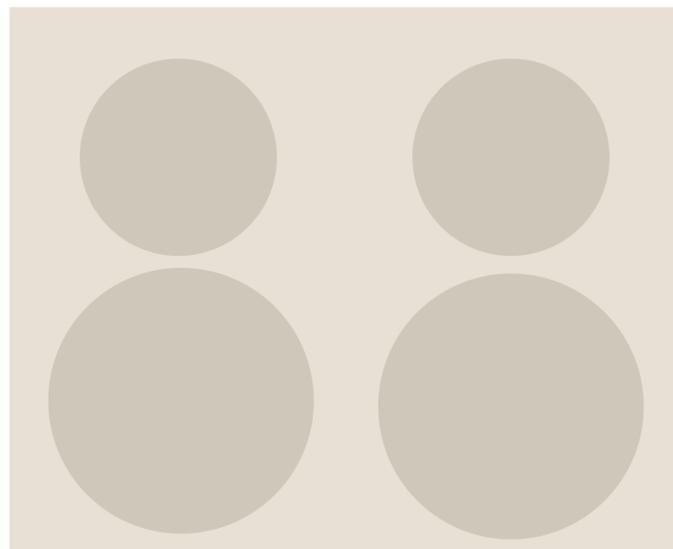
front right front left front right back right



24 Possibilities (requires labels + memory)

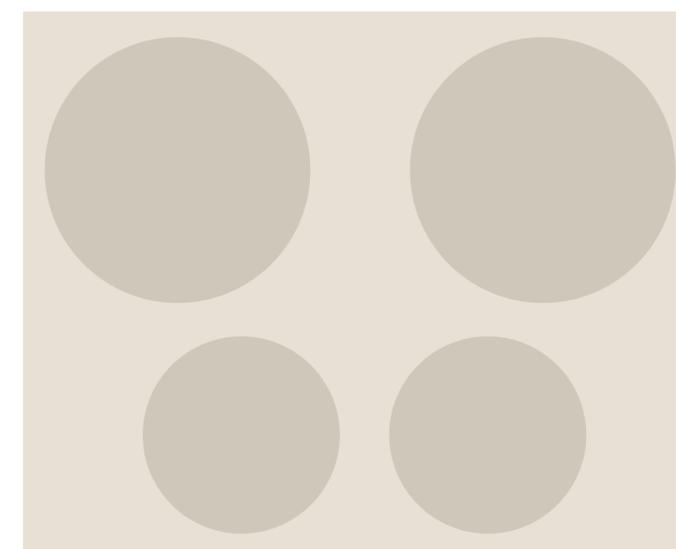
PAIRED

back front front back



2 Possibilities per side = 4 total

FULL MAPPING



CAUSE AND EFFECT



The thing that happens right after an action is assumed by people to be caused by that action.

Essentially: *Feedback*

FALSE CAUSALITY



incorrect effect

invoking unfamiliar function just as computer hangs

causes “superstitious” behaviors

invisible effect

command with no apparent result often re-entered repeatedly

e.g., mouse click to raise menu on unresponsive system

TRANSFER EFFECTS

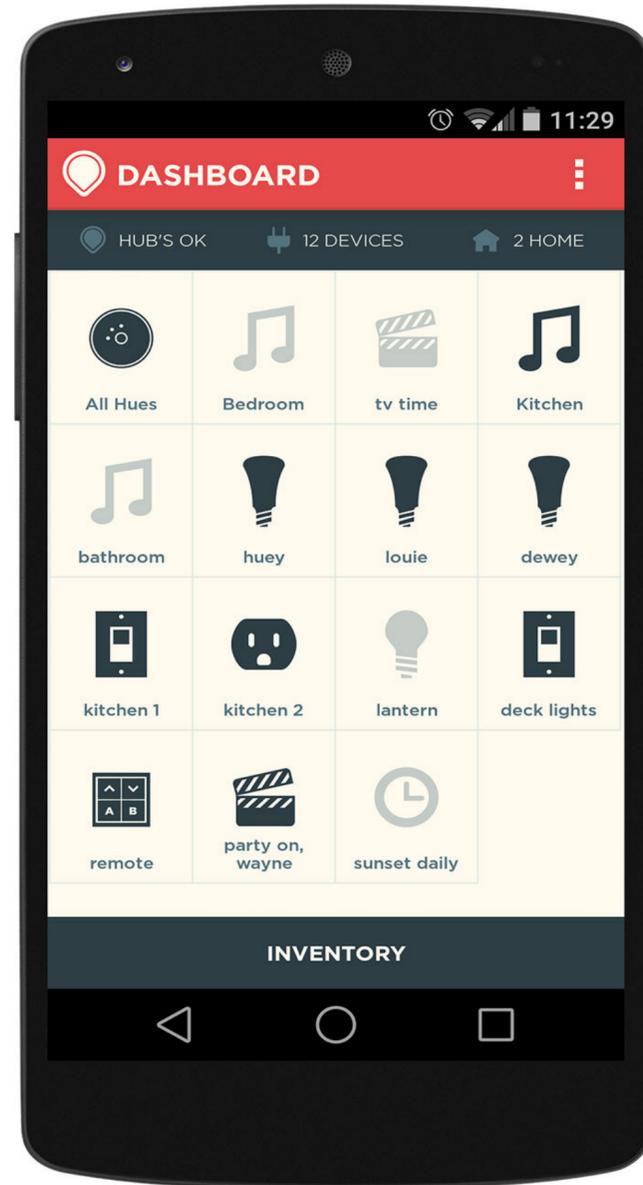
People transfer their learning/expectations of similar objects to the current objects

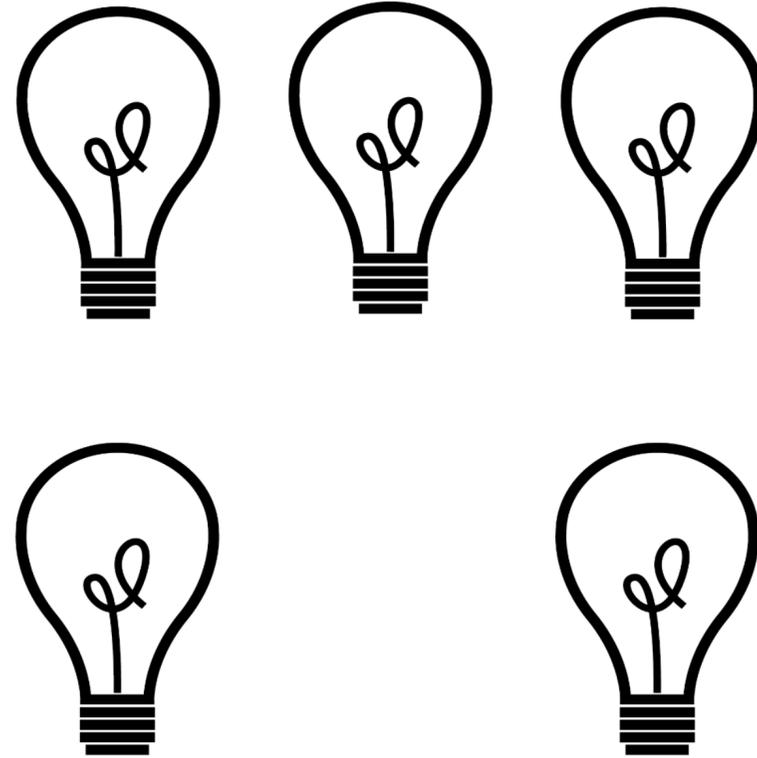
Positive transfer: previous learning's also apply to new situation

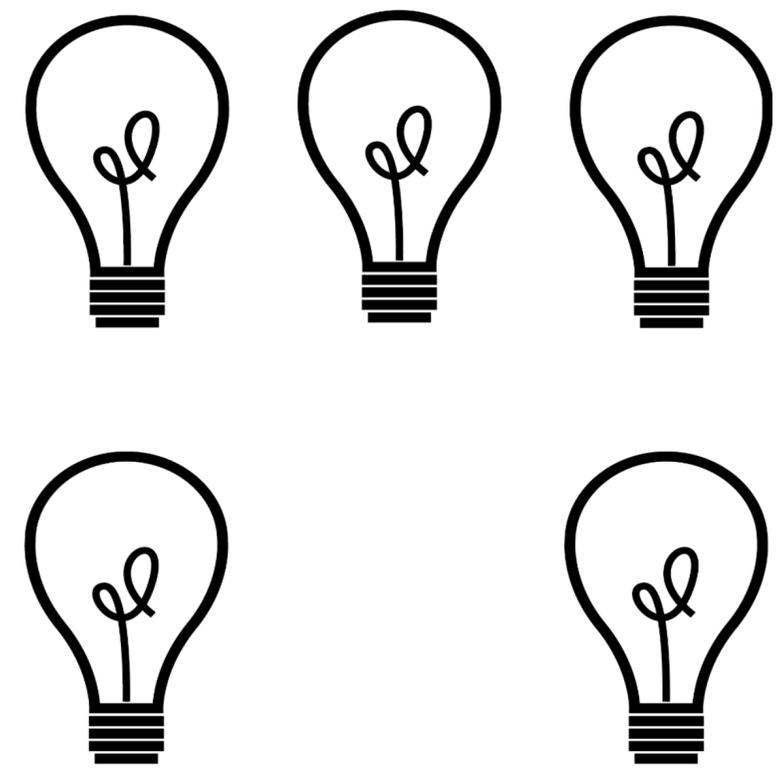
Negative transfer: previous learning's conflict with the new situation

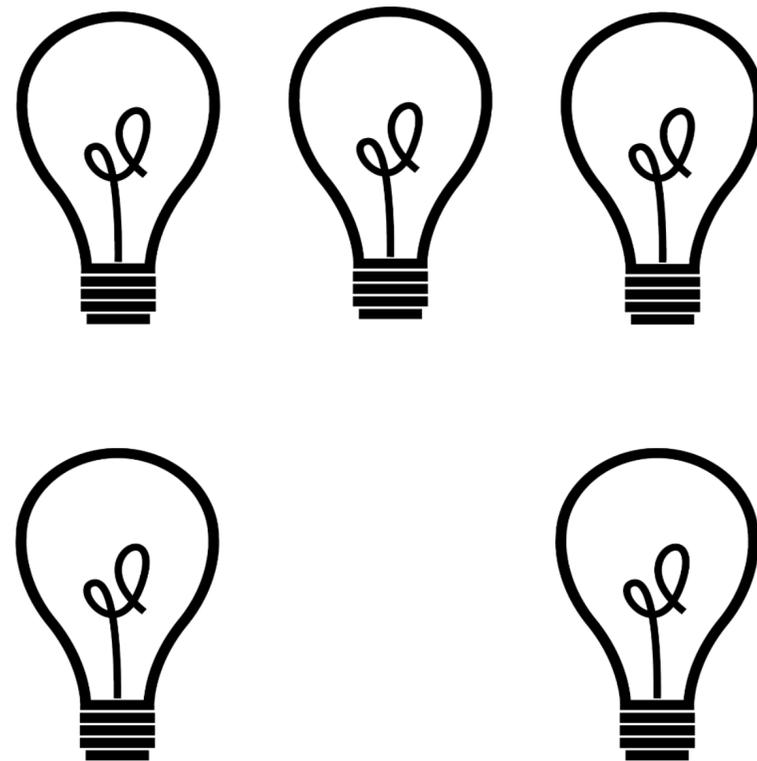


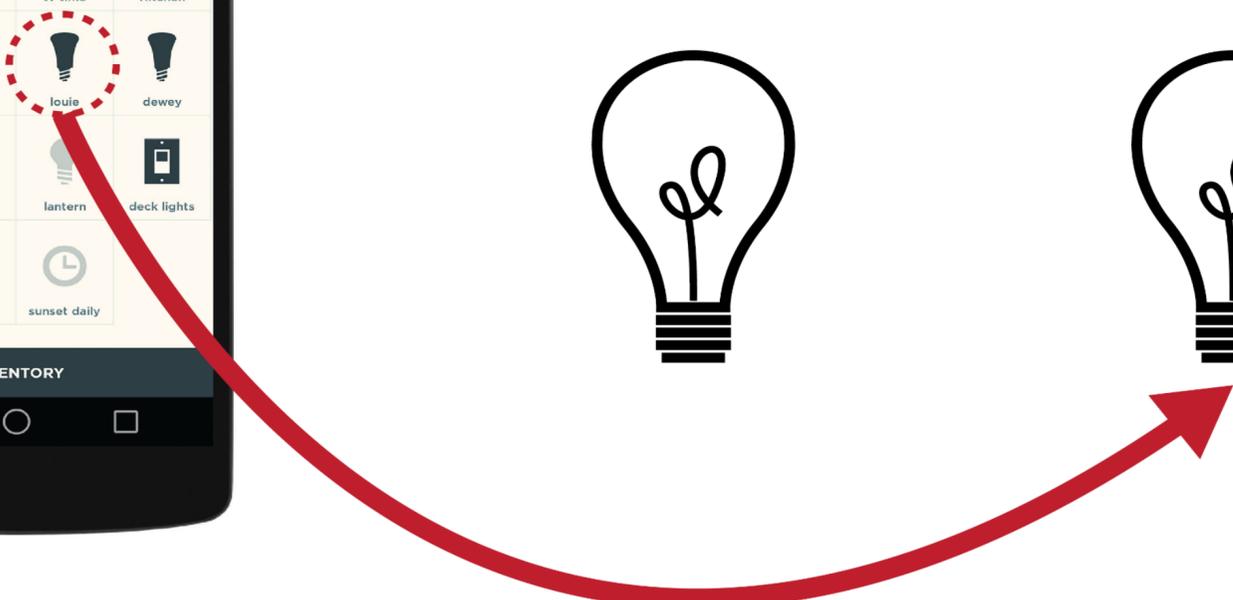
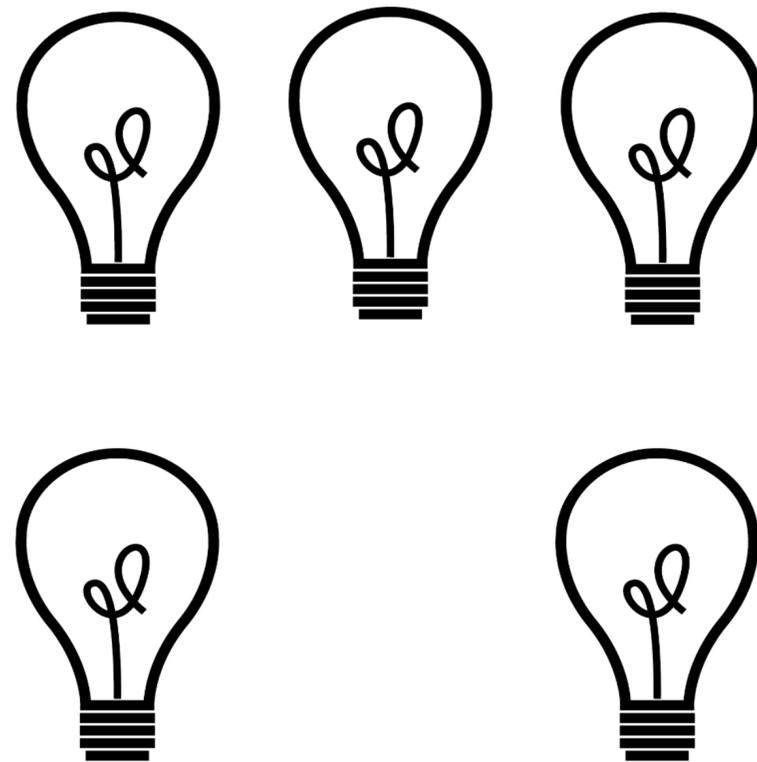
PROBLEMATIC MAPPINGS

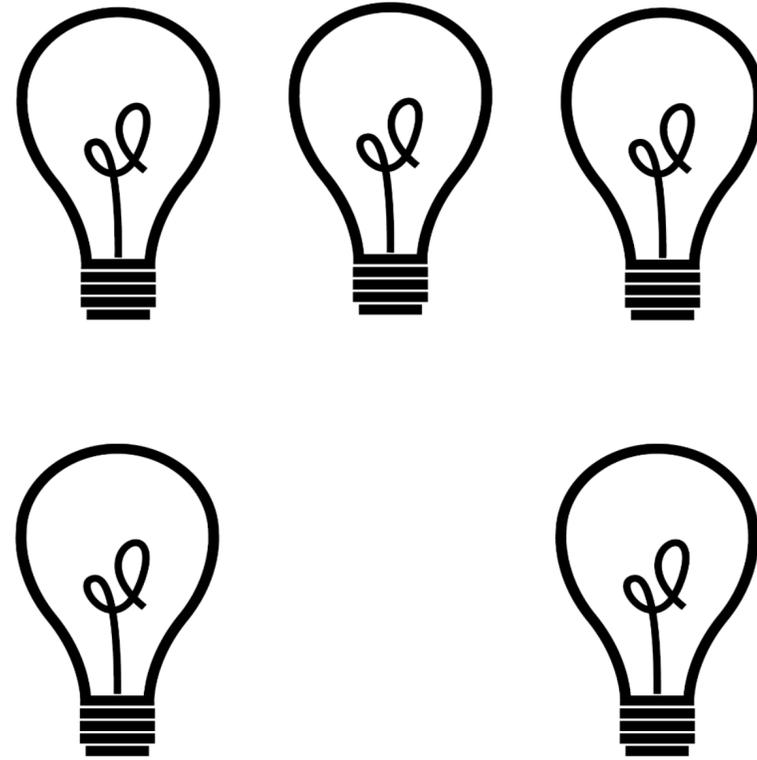


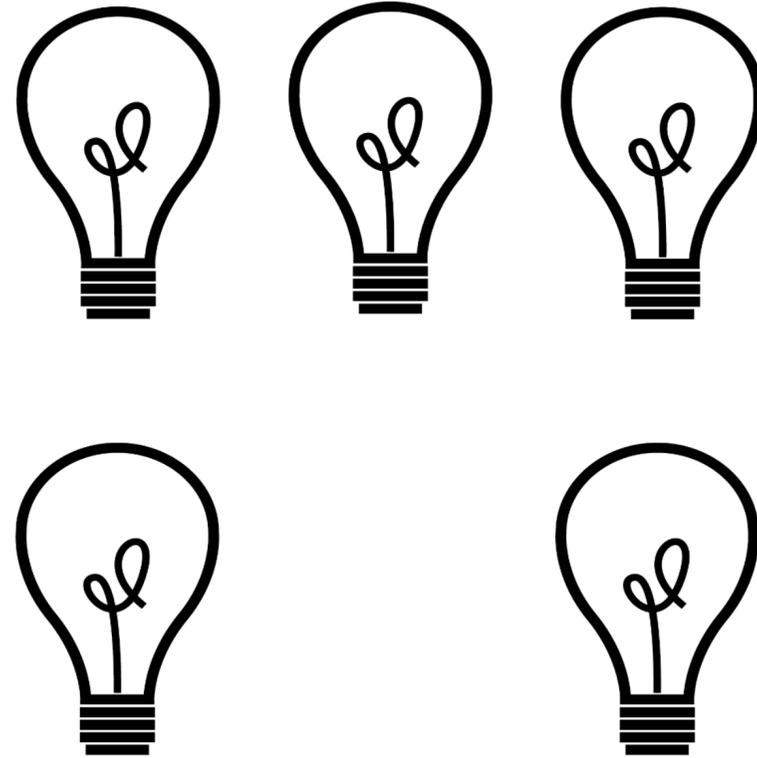


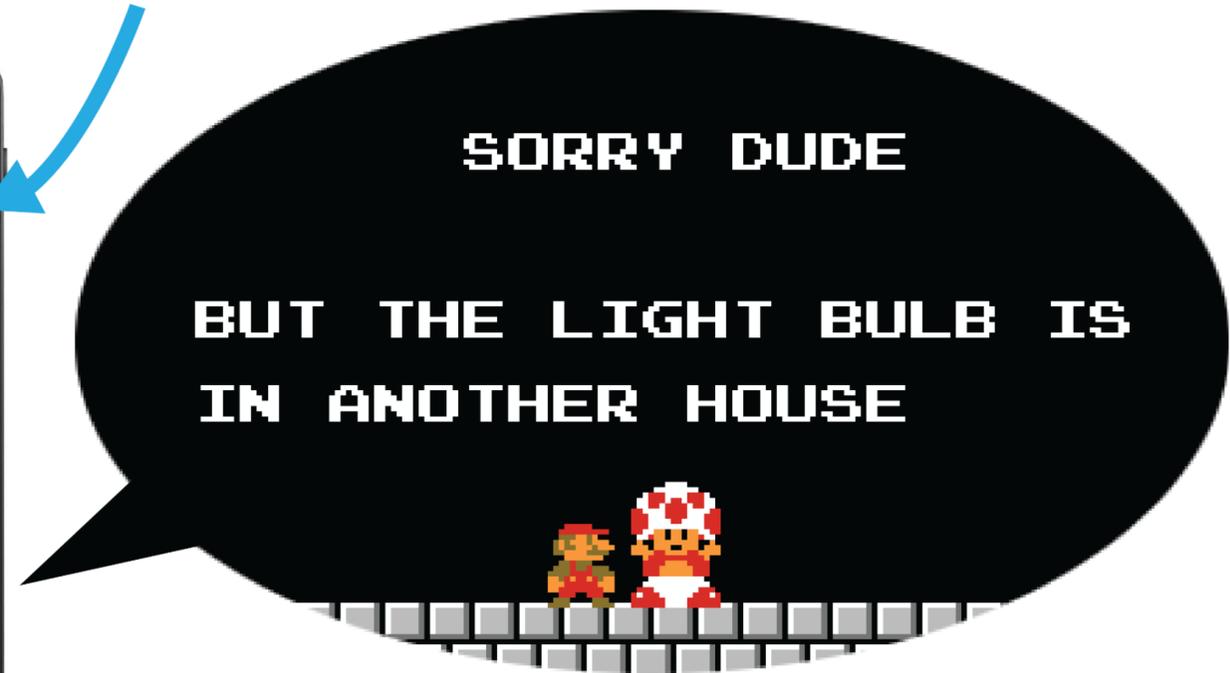
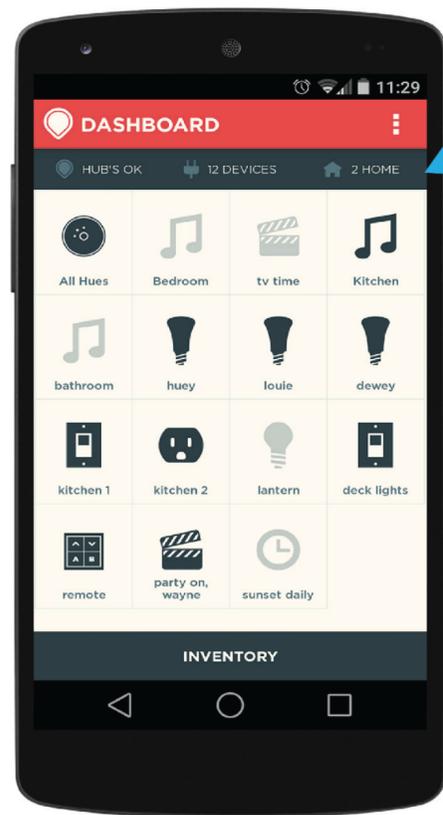












PROBLEMATIC MAPPINGS



Slide credits: Lora Oehlberg

PROBLEMATIC MAPPINGS



Earphone player controls -

Top and bottom: volume up and down

Middle button:

1 tap: pause

2 taps: next song

3 taps: previous song

problems in timing = ???

AFFORDANCES

MAPPINGS

SIGNIFIERS

**CONCEPTUAL
MODELS**

SIGNIFIER

Any mark or sound, any perceivable indicator that communicates appropriate behavior to a person.



SIGNIFIER

Signifiers are signals.

Some signifiers are signs, labels, and drawings placed in the world, such as the signs labeled “push,” “pull,” or “exit” on doors, or arrows and diagrams indicating what is to be acted upon or in which direction to gesture, or other instructions.

Some signifiers are simply the perceived affordances, such as the handle of a door or the physical structure of a switch.

DISCOVERABILITY

How do we know what is possible and the current state of a device?



DISCOVERABILITY



Here it is hard to tell what is interactive (i.e. what can be clicked).

Image credit: Steven Houben

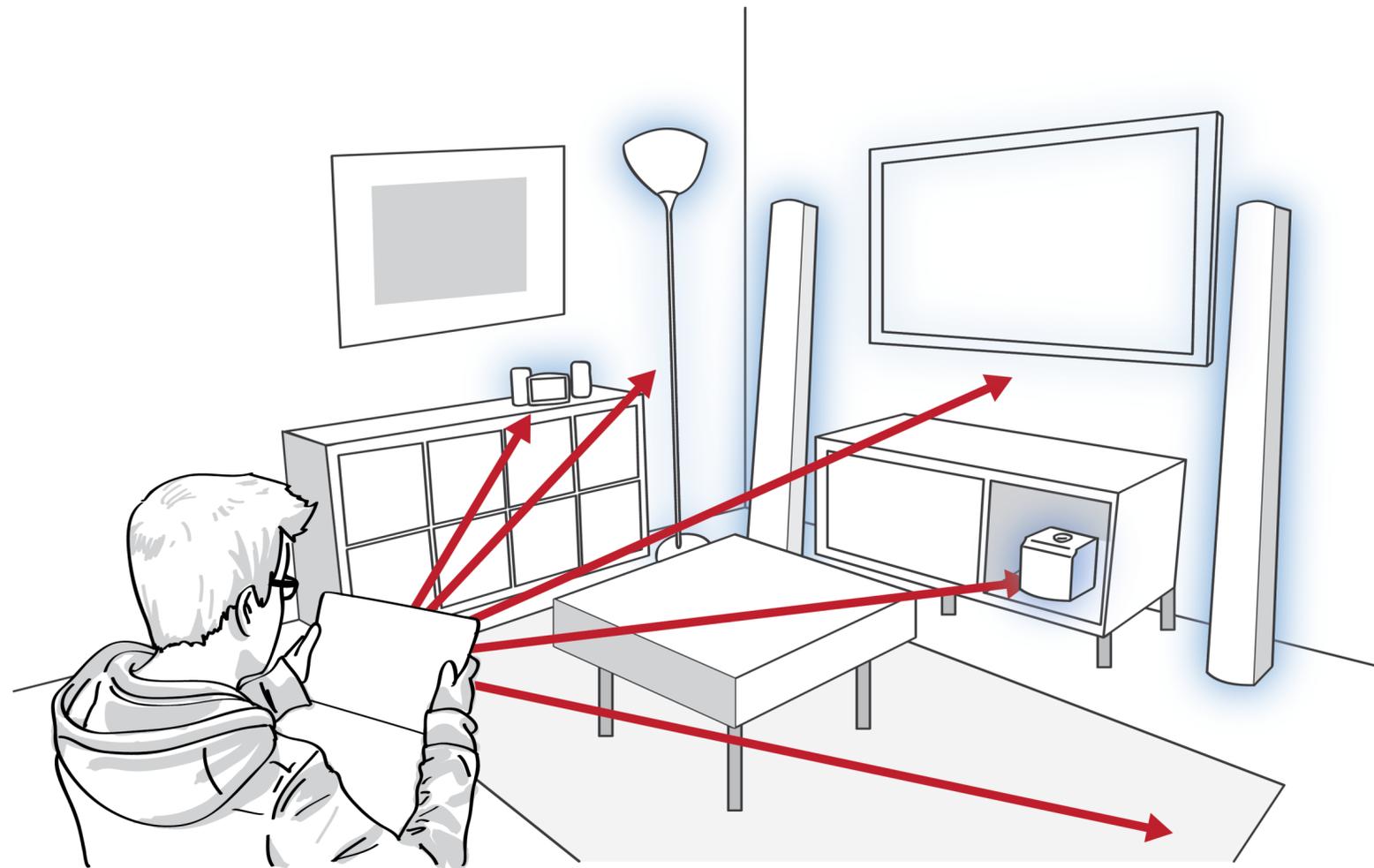
DISCOVERABILITY

How do we know what is possible and the current state of a device?



DISCOVERABILITY

How do we know what is possible and the current state of a device?



DISCOVERABILITY



How do we know when auto-flash will trigger?

Phone camera will show a yellow lightning icon at the bottom.

FEEDFORWARD



Informing users what the result of an action will be.

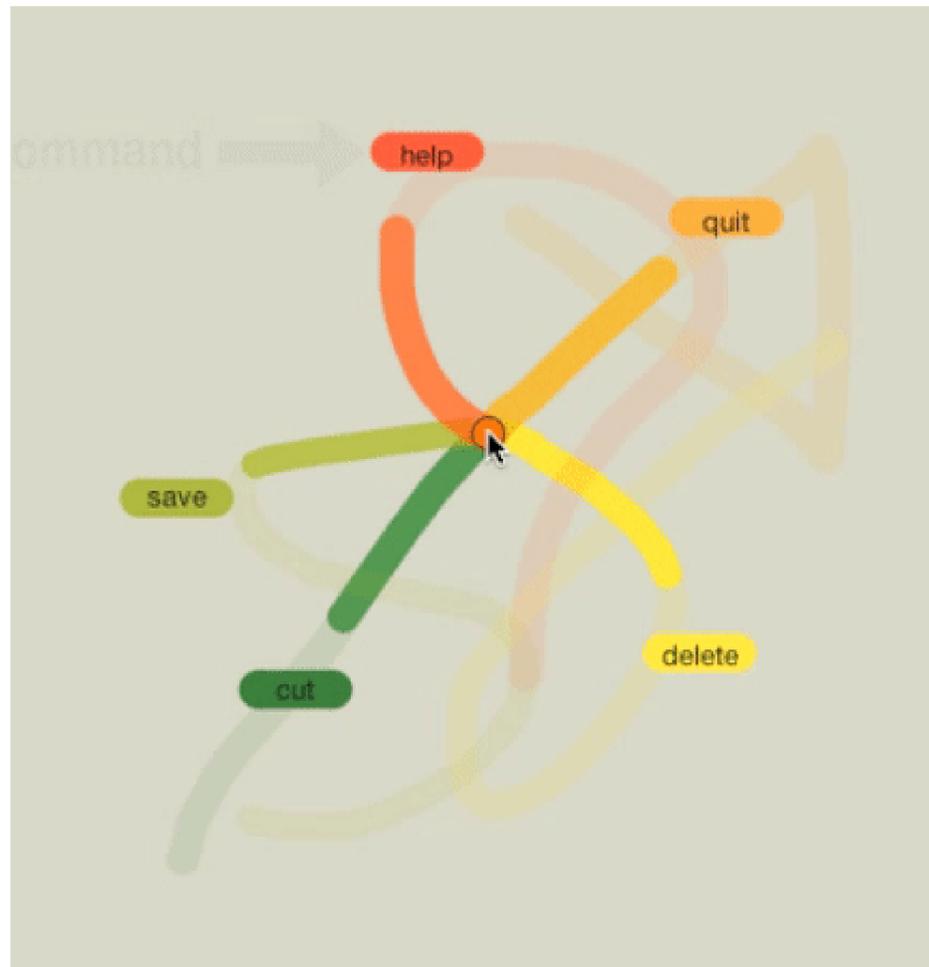
“Inviting the appropriate action is a prerequisite for feedforward but it is not sufficient. The product also needs to communicate what the user can expect. Feedback informs the user about the action that is carried out, shows that the product is responding, indicates progress, confirms navigation, etc.”

FEEDFORWARD



Hand icon in Crossy Road is animated to show that players should tap on the screen.

FEEDFORWARD



Gestures have low discoverability: how do we know what can be done?

OctoPocus – system revealing pathways for possible gestures

<http://www.olivierbau.com/octopocus.php>

FEEDFORWARD

Lorem ipsum dolor amet pabst bespoke locavore chia, heirloom wolf street art vice adaptogen raclette VHS. Knausgaard brunch skateboard, adaptogen occupy disrupt bushwick pok pok hell of organic readymade authentic scenester. Fixie thundercats health goth, aesthetic blue bottle actually coloring book tattooed polaroid cliché etsy forage adaptogen crucifix. Turmeric neutra austin, single-origin coffee hammock intelligentsia palo santo church-key direct trade beard af readymade ugh banh mi squid. Godard tilde post-ironic PBR&B everyday carry meggings art party mumblecore cardigan cornhole gochujang tumblr fashion axe ennui succulents. Wolf stumptown normcore franzen fixie coloring book. +1 tattooed asymmetrical brooklyn beard.

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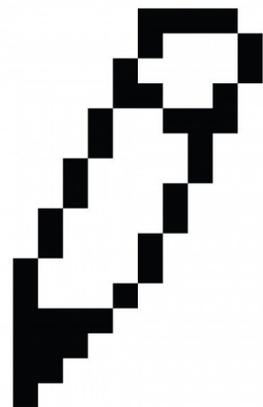
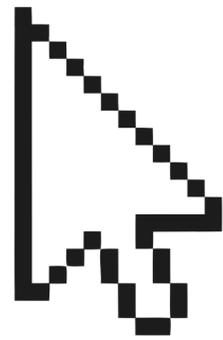
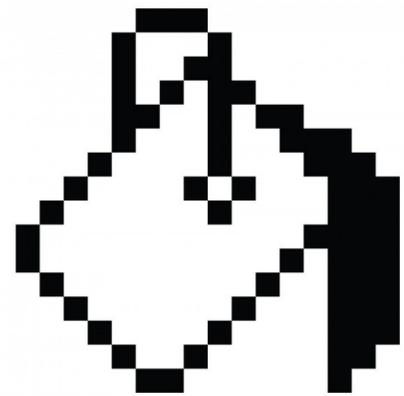
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DISCOVERABILITY



Cursor icons provide information about:

Effect of action (feedforward)

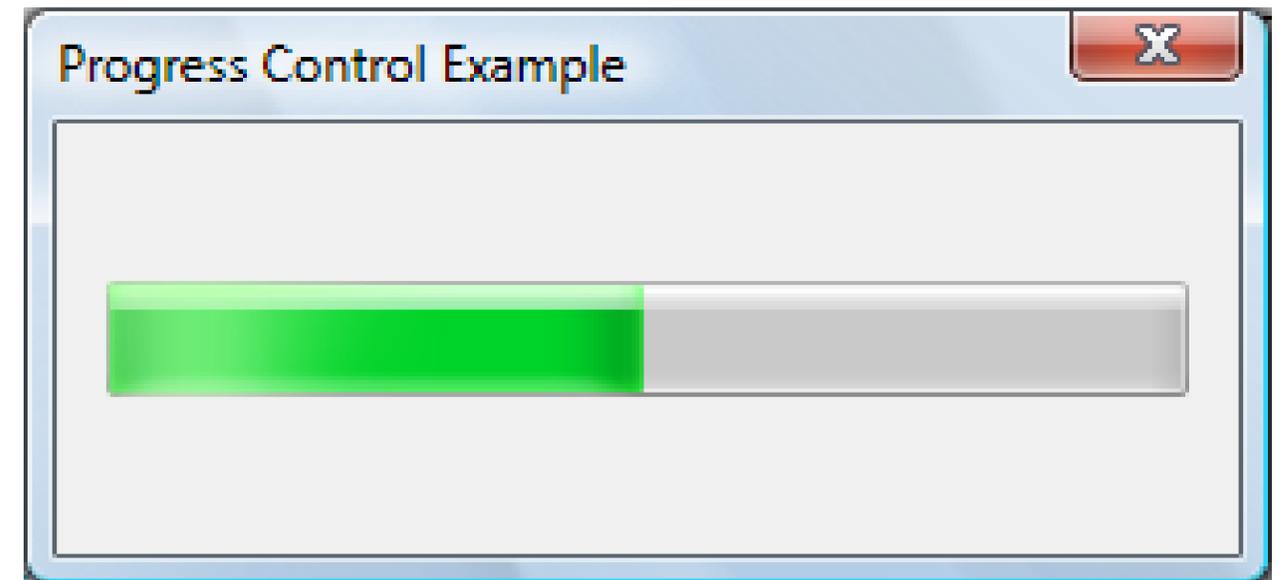
Current state (feedback)

DISCOVERABILITY

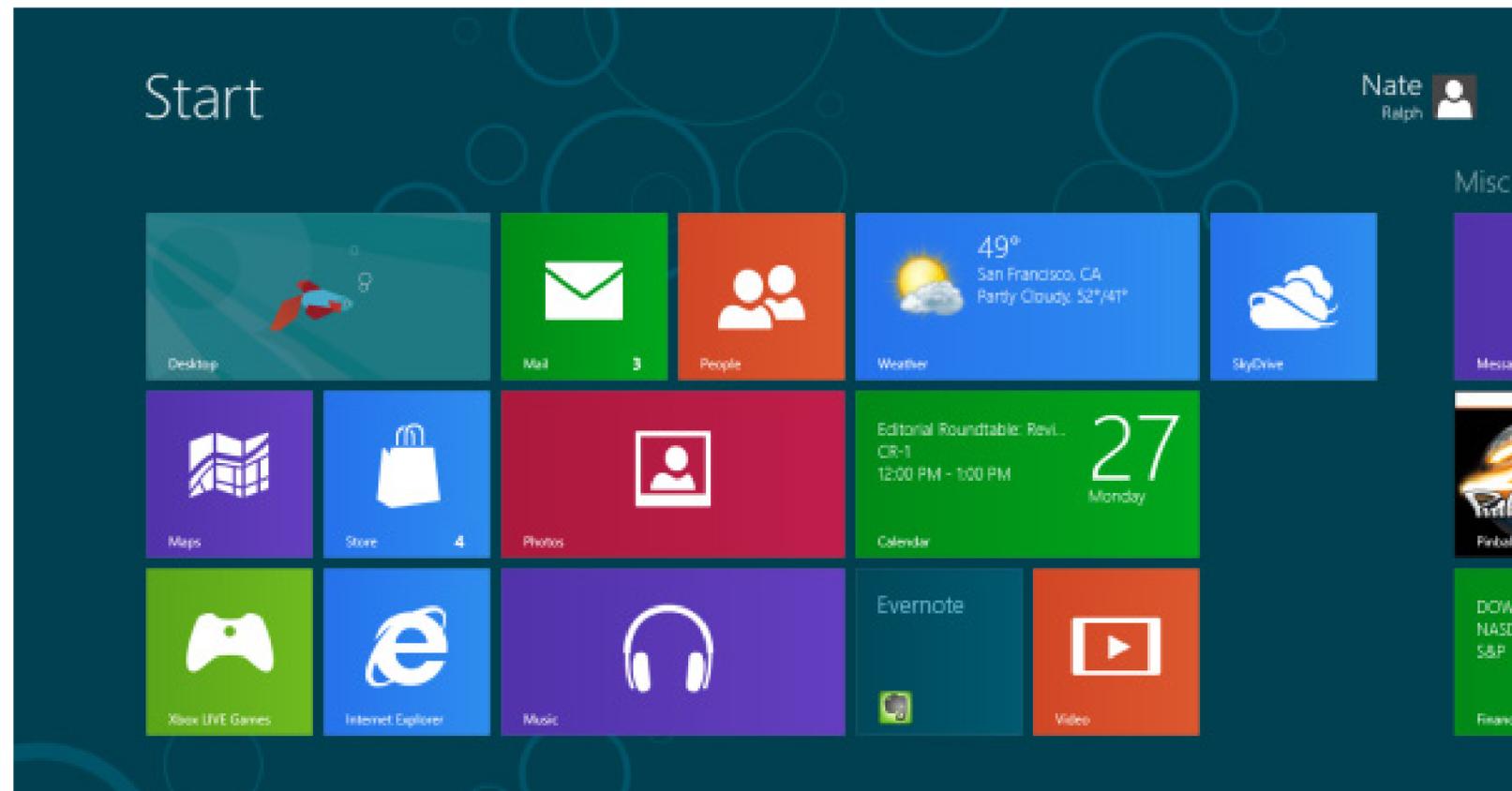
```
MainWindow.xaml.cs x MainWindow.xaml MainWindow.xaml.cs MainWindow.xaml MainWindow.xaml
CounterSample CounterSample.MainWindow timer
1 using System;
2 using System.Collections.Generic;
3 using System.Linq;
4 using System.Text;
5 using System.Threading.Tasks;
6 using System.Windows;
7 using System.Windows.Controls;
8 using System.Windows.Data;
9 using System.Windows.Documents;
10 using System.Windows.Input;
11 using System.Windows.Media;
12 using System.Windows.Media.Imaging;
13 using System.Windows.Navigation;
14 using System.Windows.Shapes;
15 using System.Windows.Threading;
16 using System.ComponentModel;
17
18 namespace CounterSample
19 {
20     /// <summary>
21     /// Interaction logic for MainWindow.xaml
22     /// </summary>
23     public partial class MainWindow : Window
24     {
25         #region Instance Variables
26
27         // Remember, to use DispatcherTimer, you have to import System.Windows.Threadi
28         public DispatcherTimer timer = new DispatcherTimer();
29         public Counter counter = new Counter();
30
31         #endregion
32
33         #region Constructor
34
35         public MainWindow()
36         {
37             InitializeComponent();
38
39             // Reminder on how to write things on the console - If you can't see your
40             // View > Output
41             Console.WriteLine("This is how you write to the console");
42
43
44             // Remember the hotkey to start an event, once you type "+=" hit <tab> twi
45             this.DecrementButton.Click += OnDecrementButtonClicked;
46             this.IncrementButton.Click += OnIncrementButtonClicked;
47             this.StartTimerButton.Click += OnStartTimerButtonClicked;
48             this.StopTimerButton.Click += OnStopTimerButtonClicked;
49
50             this.counter.PropertyChanged += OnCounterPropertyChanged;
51
52             // Initialization code for the timer
53             // 1. Setting the interval, we want the timer to trigger a function every
54             this.timer.Interval = TimeSpan.FromMilliseconds(300);
```

part of the 'viewport'
we are at

instances of the
search within the
document

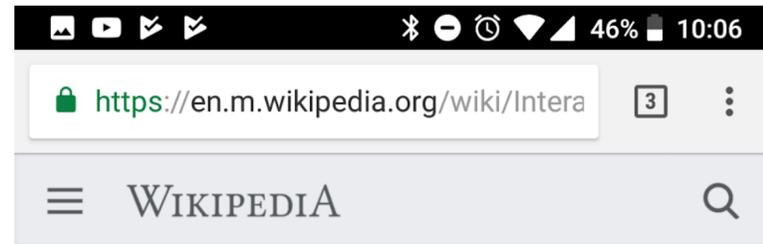


DISCOVERABILITY



“Windows Modern” (Windows 8+) people can tell that it is possible to scroll further, as hinted by widgets to the right

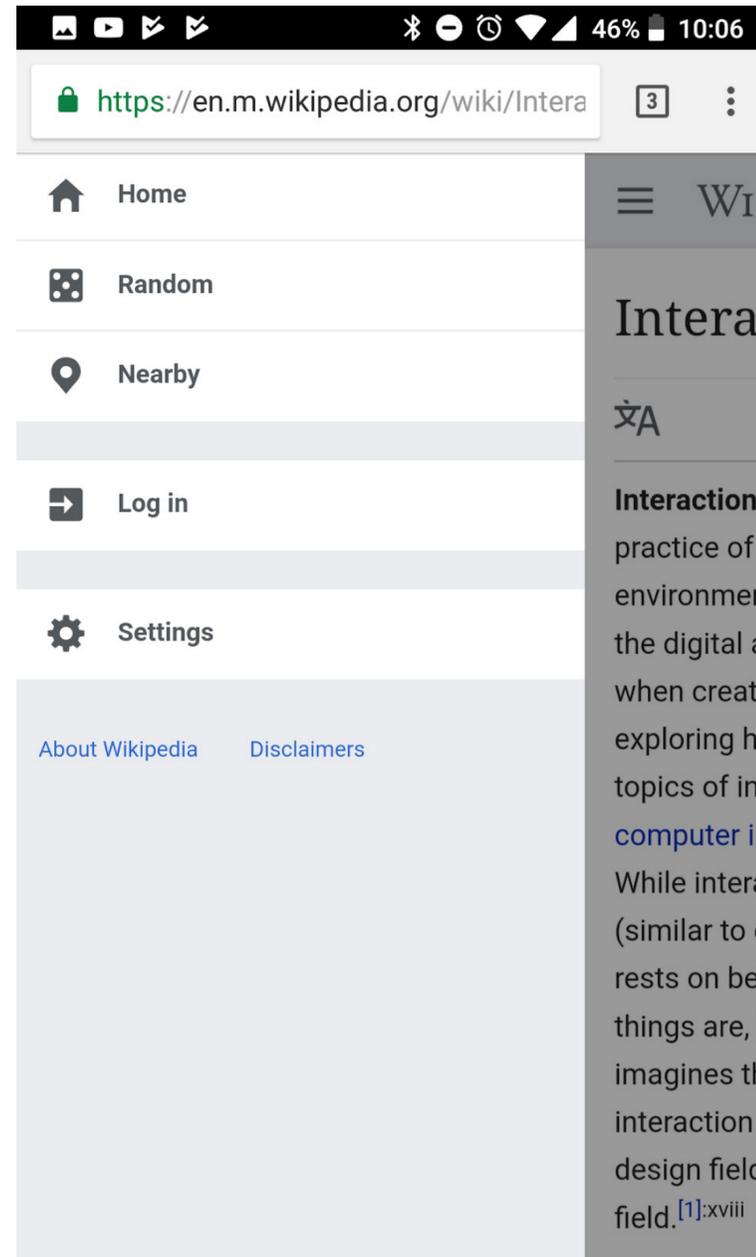
DISCOVERABILITY: HAMBURGER MENUS



Interaction design



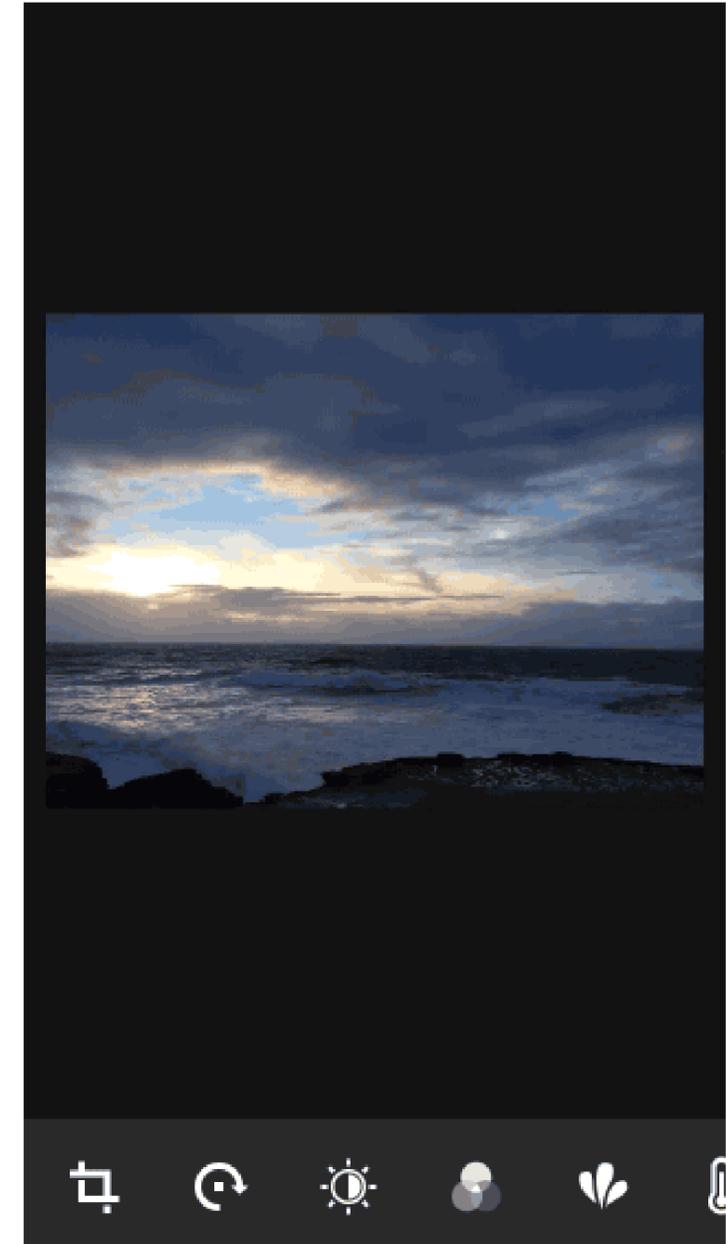
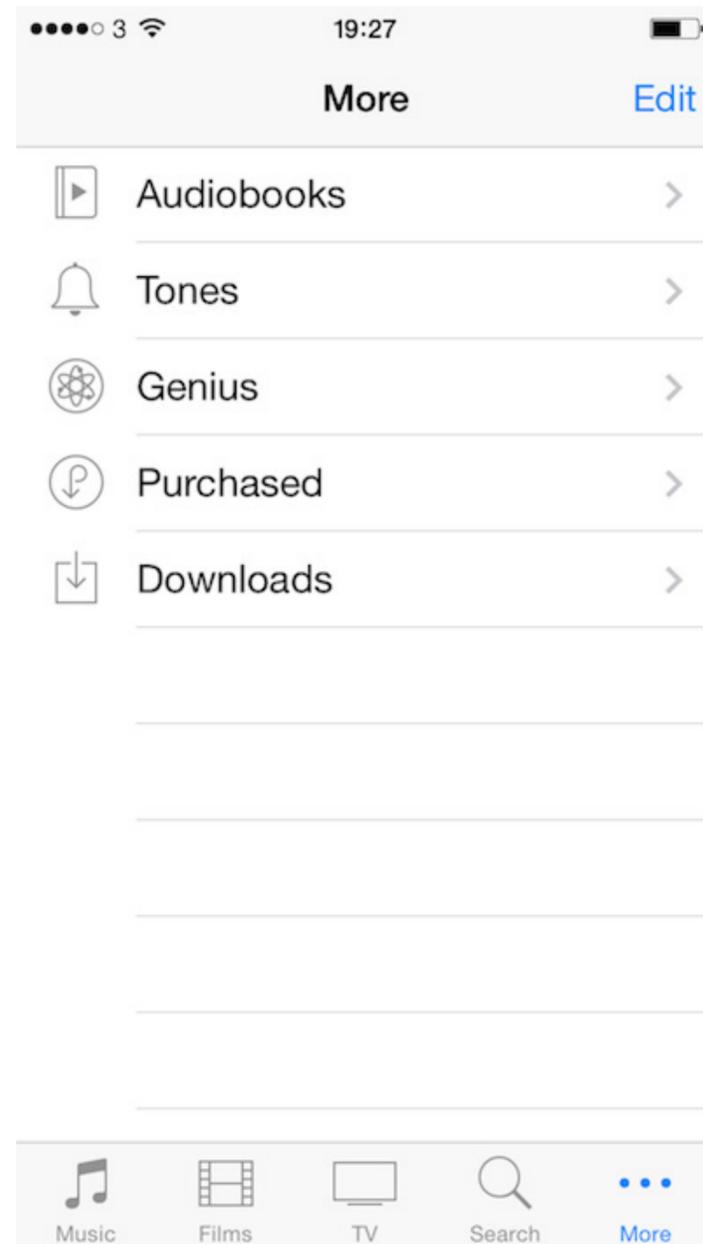
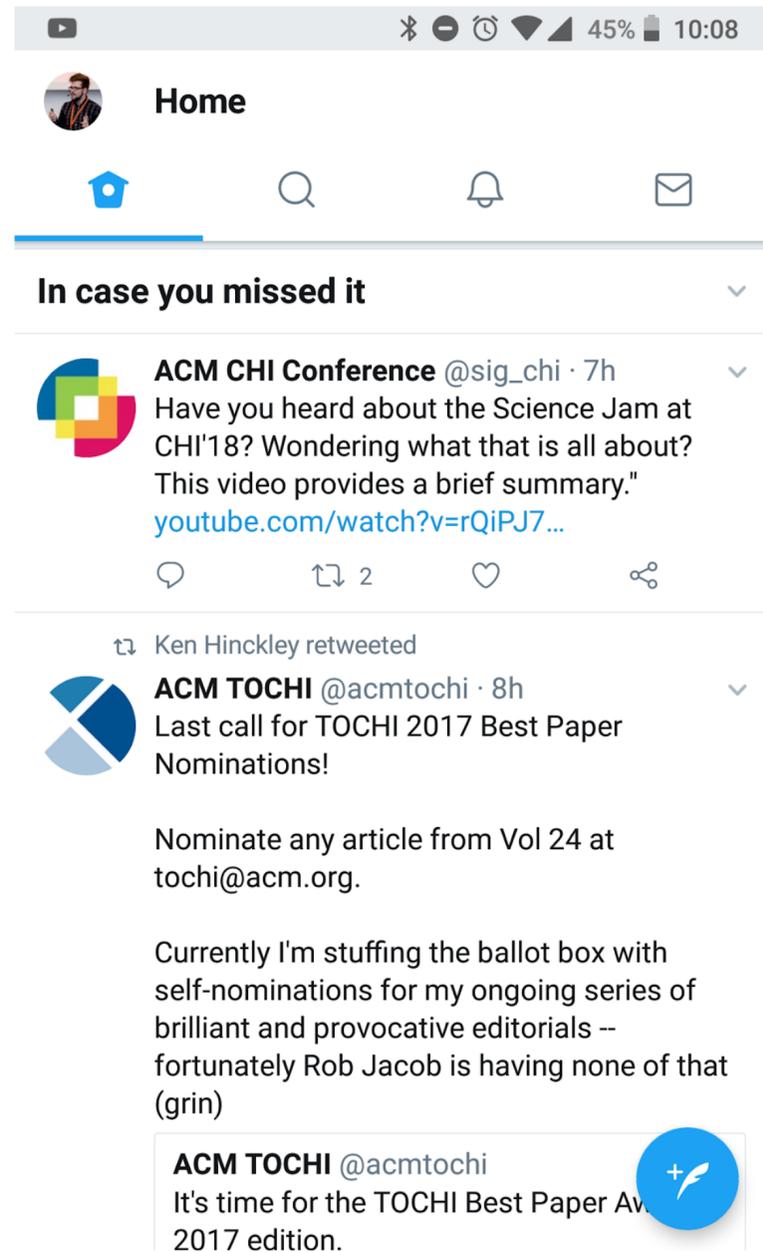
Interaction design, often abbreviated as **IxD**, is "the practice of designing interactive digital products, environments, systems, and services."^{[1]:xxx1,1} Beyond the digital aspect, interaction design is also useful when creating physical (non-digital) products, exploring how a user might interact with it. Common topics of interaction design include [design](#), [human-computer interaction](#), and [software development](#). While interaction design has an interest in form (similar to other design fields), its main area of focus rests on behavior.^{[1]:1} Rather than analyzing how things are, interaction design synthesizes and imagines things as they could be. This element of interaction design is what characterizes IxD as a design field as opposed to a science or engineering field.^{[1]:xviii}



<https://lmjabreu.com/post/why-and-how-to-avoid-hamburger-menus/>

<https://www.nngroup.com/articles/hamburger-menus/>

HAMBURGER MENUS WORKAROUNDS



<https://lmjabreu.com/post/why-and-how-to-avoid-hamburger-menus/>

<https://www.nngroup.com/articles/hamburger-menus/>

AFFORDANCES

MAPPINGS

SIGNIFIERS

**CONCEPTUAL
MODELS**

CONCEPTUAL MODEL

People have “*mental models*” of how things work, built from affordances, causality, constraints, mapping, positive transfer, cultural standards, instructions, interactions...

Models allow people to mentally simulate operation of device

Models may be wrong particularly if above attributes are misleading

CONCEPTUAL MODEL

perceived affordances: holes afford insertion
constraints: big hole for fingers, small for thumb



CONCEPTUAL MODEL



perceived affordances: holes afford insertion

constraints: big hole for fingers, small for thumb

mapping: between holes and fingers suggested and constrained by appearance

CONCEPTUAL MODEL



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positive transfer: learned when young, constant mechanism

CONCEPTUAL MODEL



perceived affordances: holes afford insertion
constraints: big hole for fingers, small for thumb

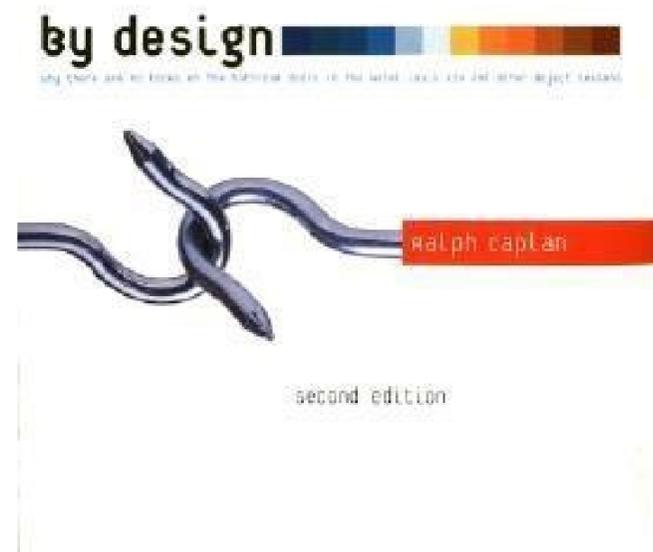
mapping: between holes and fingers suggested and constrained by appearance

positive transfer: learned when young, constant mechanism

conceptual model: implications clear of how the operating parts work

CONCEPTUAL MODEL

By Design: Why There Are No Locks on the Bathroom Doors in the Hotel Louis XIV and Other Object Lessons
Ralph Caplan



CONCEPTUAL MODEL



L'hôtel Louis XIV détruit

● QUEBEC — L'hôtel Louis XIV, un vieux immeuble de cinq étages, qui a subi des rénovations il y a quelques années, a été la proie des flammes, hier, dans l'un des plus vieux secteurs de la basse-ville de Québec. On ne rapporte aucune victime. Le propriétaire de l'établissement, M. Clément Leclerc, a déclaré que tous les occupants ont pu quitter les lieux sains et saufs. Les flammes, dont on ignore l'origine, auraient éclaté au troisième étage. Trois alertes ont fait accourir une centaine de pompiers sur les lieux. L'hôtel ravagé s'élève sur l'historique Place Royale, tout juste en face de l'église Notre-Dame-des-Victoires, construite en 1688. Le temple, qui renferme plusieurs reliques, n'a pas été menacé.

CONCEPTUAL MODEL



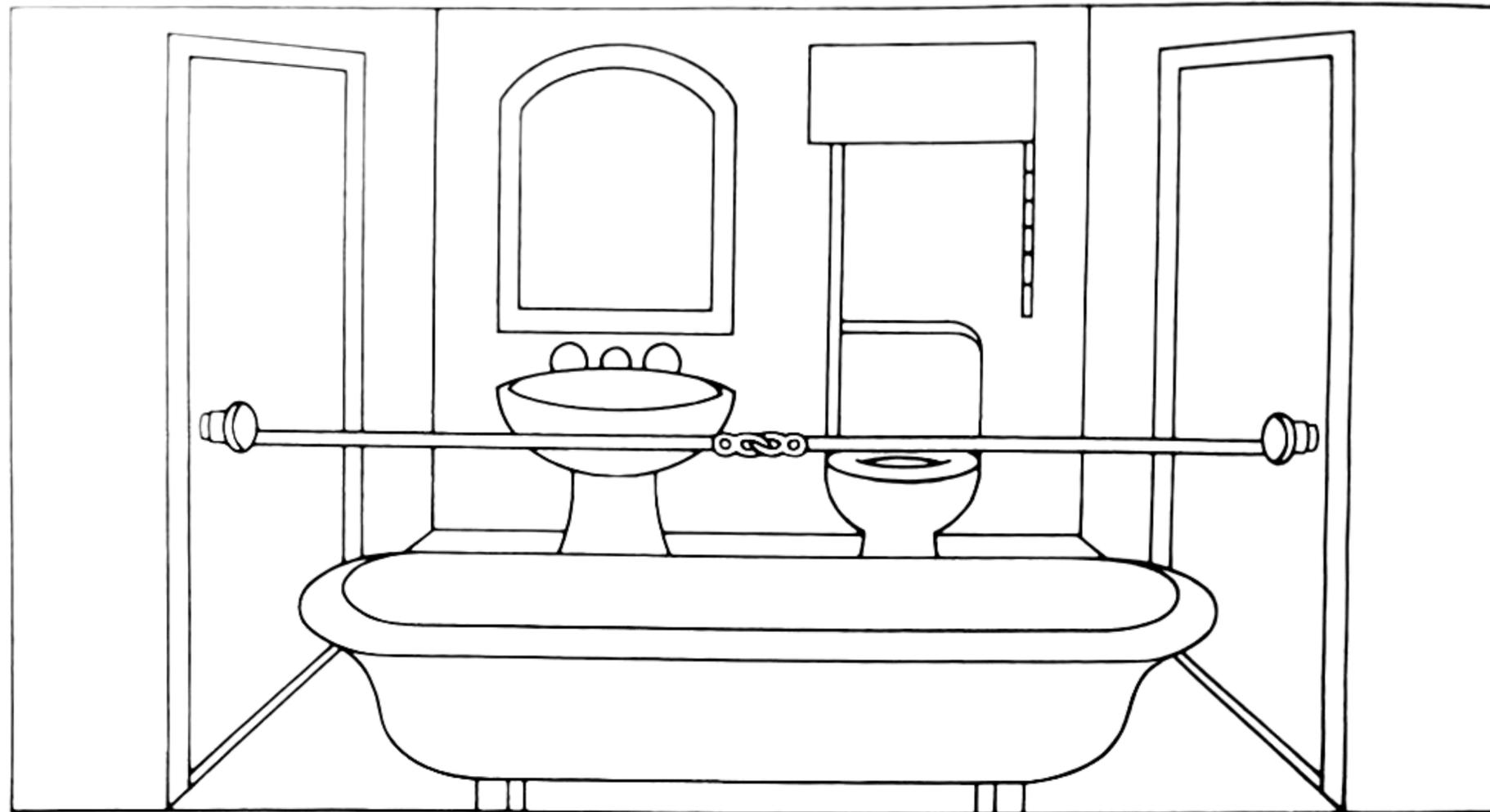
“Private bathroom” - individual use, but not personal.

Bathroom had two doors.

What happens if the bathroom doors have locks?

How would you solve this?

CONCEPTUAL MODEL



Third-floor bathroom in the Hotel Louis XIV drawn by Milton Glaser.

CONCEPTUAL MODEL

Which hand do you write with? Left or right?

CONCEPTUAL MODEL

“Let’s now step away from the computer for a moment and look at the example of handwriting with pencil and paper. These are “devices” that one interacts with in the real world, after all. Consider this simple question:

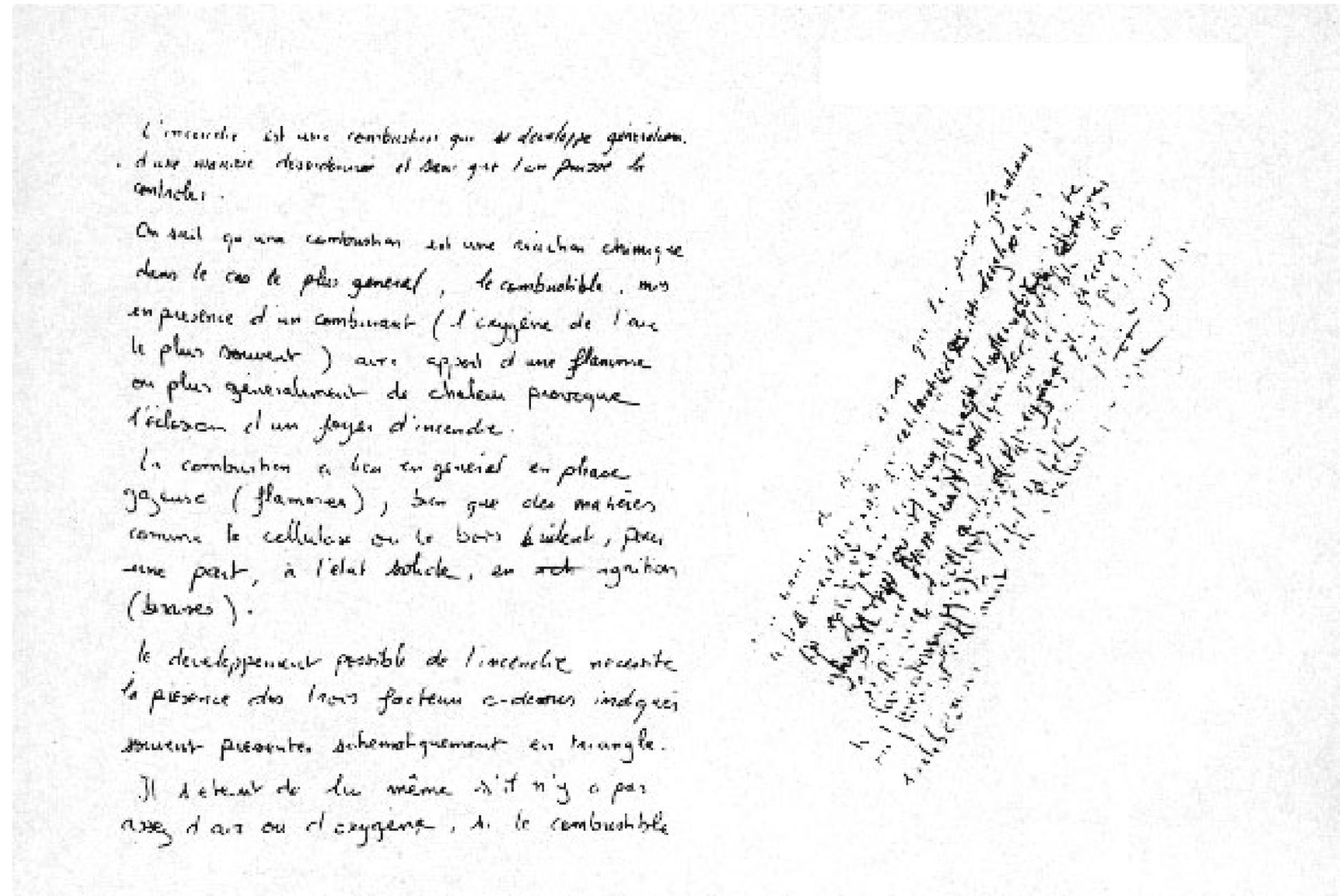
Which hand do you write with, right or left?

When we give talks on this subject, we have the audience raise their hands. Who uses their right hand? Do we have any left-handers in the audience? Which hand would you, the reader, raise? Now, of course, we have led you into a trap, because:

You are all wrong. No matter which hand you raised, you are wrong.

This is not a trick question. Rather the question is fundamentally ill-posed. People write with both hands, as demonstrated by Guiard (Guiard 1987)”

CONCEPTUAL MODEL



Yves Guiard's 1987 Paper Transfer Experiment (Asymmetric Division of Labor in Human Skilled Bimanual Action: The Kinematic Chain as a Model, *Journal of Motor Behavior*, 1987)

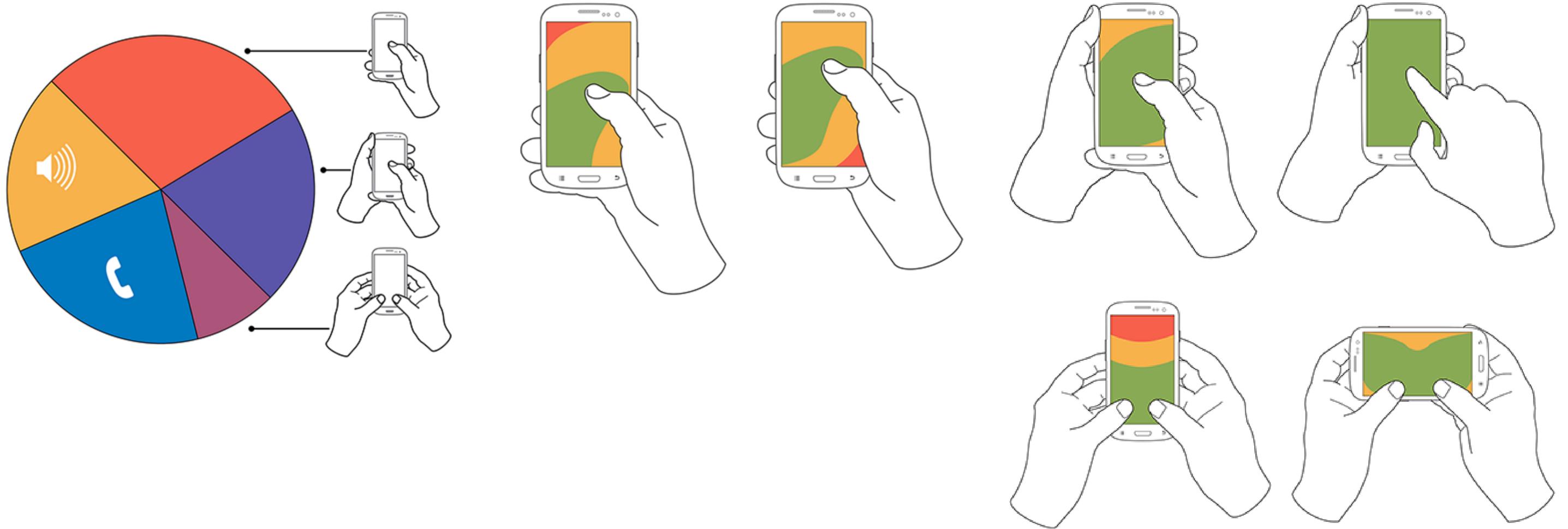
CONCEPTUAL MODEL

Backwards Bicycle, Smarter Every Day



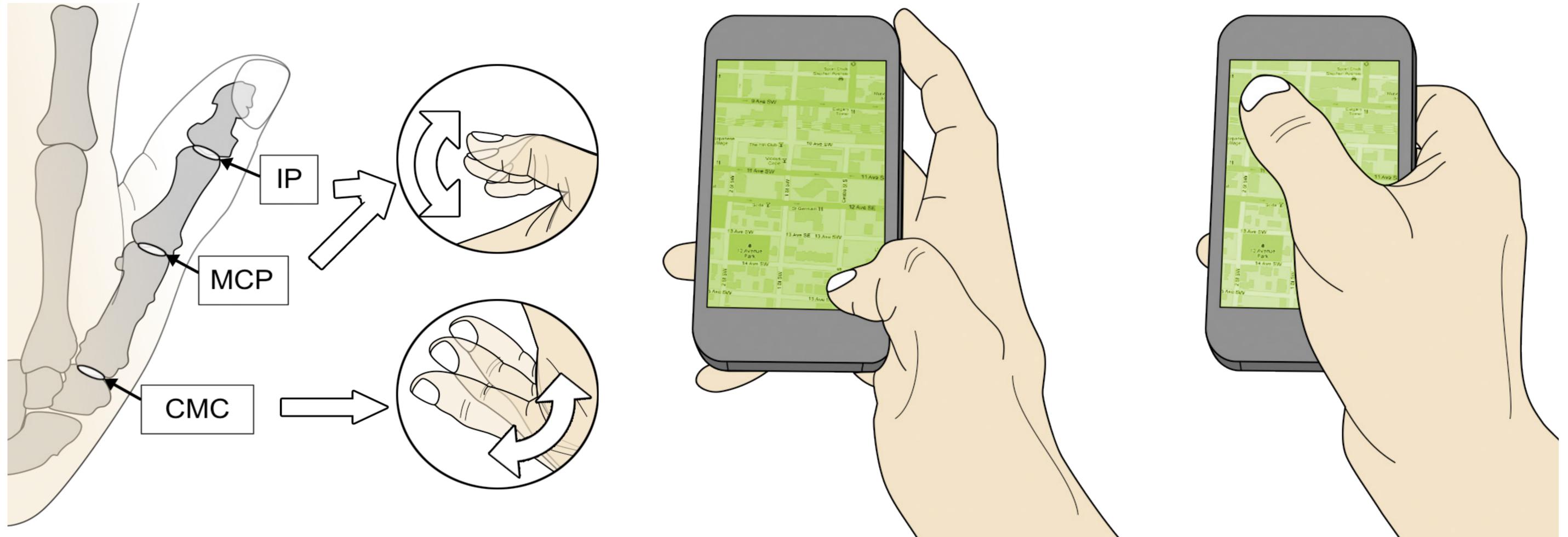
CONCEPTUAL MODEL

How do people hold mobile phones?



CONCEPTUAL MODEL

Corners are hard to reach



SKETCHING PROMPTS

- 1. Draw different affordances in objects that you can think of. Think of ways in which affordances can repurpose how you use an object*
- 2. Think of different mental models to print a file*

AFFORDANCES

Invitations to Action

MAPPINGS

Effects of Action

SIGNIFIERS

Properties of Action

CONCEPTUAL MODELS

Process behind Action

FOOD FOR THOUGHT

Look at the examples used to illustrate the different concepts

See how they might describe some of the other concepts