Introduction to HCI
Fall 2021

Design Concepts

Mahmood Jasim

UMass Amherst

mjasim@umass.edu
https://people.cs.umass.edu/~mjasim/

Learning goals

▸ After this lecture, you should be able to:
▸ Explain the relationship between the myth of human error and the goals of human computer interaction
▸ List concepts/heuristics/principles for good/bad interface design
▸ Be able to identify and critique interface strengths and weaknesses in terms of this language

How interfaces fail: Myth of human error

▸ Most failures of human-machine system are:
  ▸ Due to poor designs that don't recognize peoples' capabilities and fallibilities
  ▸ This leads to apparent machine misuse and "human error"

  ▸ Good design accounts for human limitations

Early tractors

Original design:

high center
of gravity

narrow
wheel base

Photo credit: John Schanlaub, 2009

Typical terrain:
un-surfaced, rough, hilly

Frequent CRASHES → used to be called "Driver's Error"

Modern tractors

But accidents became infrequent when designs changed to low center of gravity & wider wheelbases

The myth of human error

▸ Humans are imperfect and unpredictable
  ▸ We have lousy memories
  ▸ We don't see what's really there
  ▸ We don't say what we really mean
  ▸ We get confused when too much is going on
  ▸ We are easily distracted and don't pay attention
  ▸ We get tired or bored
▸ Need to design for human errors:
  ▸ Many so-called human errors and "machine misuses" are actually errors in design

A few way interfaces can fail:

- Functionality problem
  - What are the functions this object can perform? will it do what I want?

- Visibility problem
  - System status: what mode is this object in?
  - Control visibility: which control, or sequence of controls do I use to get what I want?

- Feedback problem
  - How do I know if I got what I wanted?
  - What's wrong?

  - And so on…

Human-centered design (HCD)

▶ Is a design framework that develops solutions to problems by involving the human perspective in all steps of the problem-solving process. (Wikipedia)

▶ Is the process of ensuring that people's needs are met, that the resulting product is understandable and usable, that it accomplishes the desired tasks, and that the experience of user is positive and enjoyable. (Norman, The design of everyday things)

Principles of human-centered design

https://www.nngroup.com/videos/principles-human-centered-design-don-norman/

What is a "design concept" ?

- Design concept:
  - High level, abstract, descriptive
  - How we talk about "properties" of an interface
    - e.g., "signifier", "visibility"
      - (or relationship with a user in case of "affordance")
- Design principle/heuristic/guideline:
  - Help you implement the concept
  - Typically prescriptive: "do it this way"
    - Can conflict – don't follow slavishly
    - e.g., "provide a signifier that can clearly communicate proper affordances"
  - Neither are completely clear cut—can overlap

Design concepts

- Affordance
- Signifier
- Constraints
- Mapping
- Visibility
- Feedback
- Consistency
- Transfer effect

Affordance

- Normanian definition:
  "A relationship between the properties of an object and the capabilities of the agent that determine how the object could possibly be used"

  - Small, cylindrical, light > I can grab this.

  - Flat, sturdy, not too high > I can sit on this.

  - Chairs afford sitting… but so do tables, boxes, floor
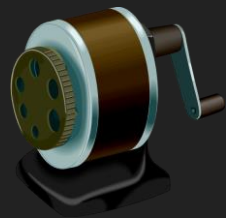
Affordance
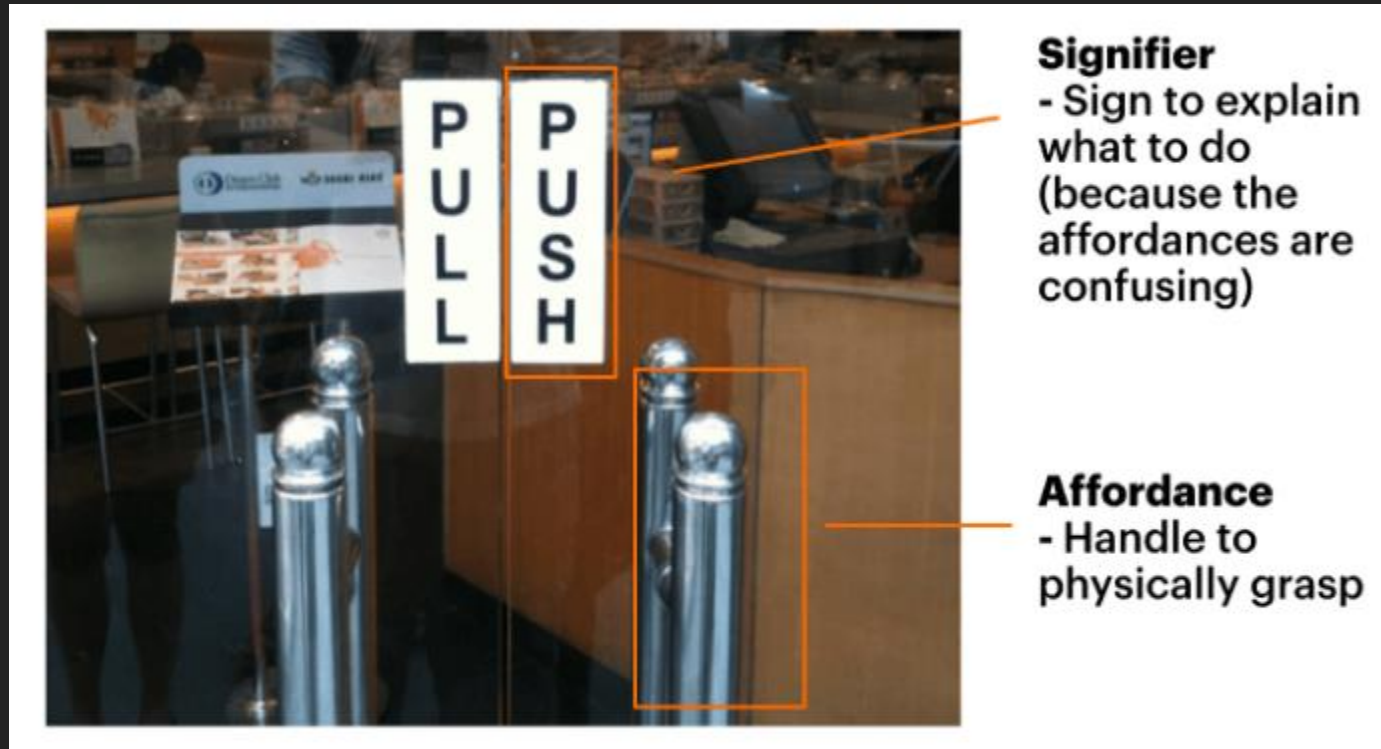

Photo credit: willow tyrer, 2010

Norman: "Affordances exist even if they are not visible (DOET, 2013)"

Gibsonian definition: "the perceived and actual fundamental properties of the object that determine how it could possibly be used (Gibson 1977)"

Signifier

- Normanian definition of 'proper signifier':
"A perceivable indicator that communicates appropriate behavior to a person (DOET, Norman, 2013)"
  - Definition from Semiotics: the material form of a sign.
- You manipulate signifiers to communicate an affordance.
  - i.e. you change the properties of an object to tell people what they can do with it.

Signifier

Signifier
- Sign to explain what to do (because the affordances are confusing)

Affordance
- Handle to physically grasp

PULL PUSH

https://uxdesign.cc/what-is-an-affordance-6b60f2de79f2

Affordance(s), Perceived affordance(s), Signifier(s)

Photo credit: Ade Oshineye, 2012

Constraint

A limit on what we can do with a system.

Plug shapes, Directions, …

Photo credit: Jamie McCall, 2008

Mapping

A relationship between signifiers and functions/states of an interface.

Things I can perceive

Actions/states

buttons → functions

knob twist
(up/down) → volume
(up/down)

turn wheel
(left/right) → Steer
(left/right)
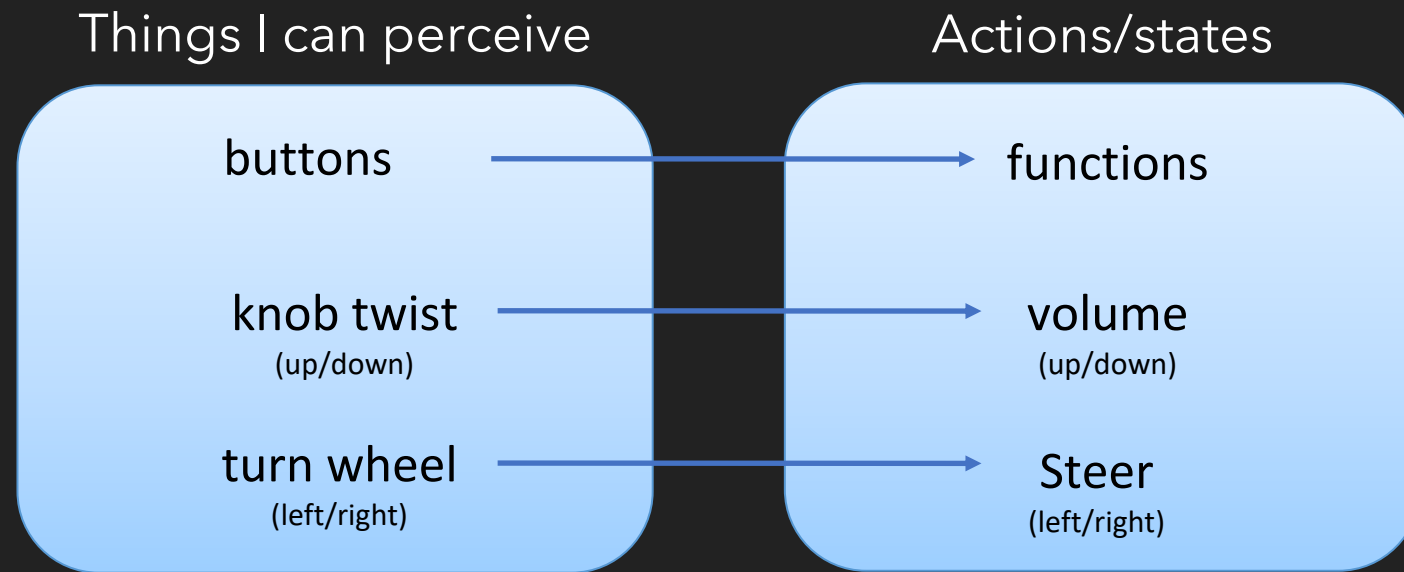
Can be natural or arbitrary

Mapping

Visibility

▸ How perceptible a system status or a function is.

▸ More than just visual…

▸ (Out of sight -> hard to find and hard to know how to use)

▸ Good to think about in relation to additional concepts:
  ▸ Discoverability
    Can the user easily perceive (encounter) the actions that they were not aware of?
  ▸ Findability
    Can the user easily find the actions that they assume is present?
 ▸ Learnability
    "How quick and easy a system is to learn to use (RSP)"

Feedback

▸ A signal from the system after an action is performed

▸ Can the user correctly interpret the relationship between their actions and the system's actions?

▸ E.g. Good feedback: when I type on my iPhone keyboard, a 'click' sound plays

▸ E.g. No feedback: when press a button, and nothing happens…what's wrong?

▸ E.g. Bad feedback: when my computer is frozen, I bang on it, then it magically starts working again…

Feedback

ICICS, X-Wing Elevator
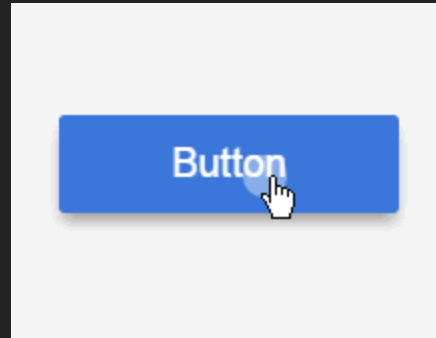
Material Design from Google

Consistency

▸ Refers to designing interfaces to have similar operations and use similar elements for achieving similar tasks.

  ▸ A consistent interface is one that follows rules, such as using the same operation to select all objects.

  ▸ For example, a consistent operation is using the same input action to highlight any graphical object at the interface, such as always clicking the left mouse button.

  ▸ Inconsistent interfaces, on the other hand, allow exceptions to a rule.

Transfer effect

- When knowledge acquired earlier affects one's ability to learn/perform in another context.

- Can be positive or negative.

- Positive transfer effect: I've driven a car before, so I can drive this car.

- Negative transfer effect: All the shortcuts I used to know don't work here!

In-class activities

- Gradescope consent on Piazza
  - https://piazza.com/class/kstpijqbjue3io?cid=7

- Team formation
  - Aptitude portfolio
  - Fill up your skillset, experience, and project you might be interested to do
  - https://tinyurl.com/znxn5kcv

Additional Information

Examples of good and bad design

- UX - https://uxdesign.cc/good-design-vs-bad-design-examples-from-everyday-experiences-18a7d1ba002c

Optional reading

▸ Chapter 1, Part 2 of The Design of Everyday Things: "The psychopathology of everyday things"

▸ https://drive.google.com/file/d/1eiUEhS8Jdj705oWXpLDOz2GeCmU4iSFO/view?usp=sharing