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

Slide based on slides by Saul Greenberg
MODERN TRACTORS

Roll cage

Low centre of gravity

Wider wheel bases

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

Slide based on slides by Saul Greenberg
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*
THE “GRANDMA” REMOTE

Image from College Humor
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

“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

HAWAII FALSE ALARM

MY STRUGGLES AS AN 8 YEAR OLD

Error Deleting File or Folder

Cannot delete Samples: There is not enough free disk space.
Delete one or more files to free disk space, and then try again.

OK
MY STRUGGLES TODAY

Park Plus App, Feb 24, 2018
THE DESIGN OF EVERYDAY THINGS
Don Norman
AFFORDANCES

SIGNIFIERS

MAPPINGS

CONCEPTUAL MODELS
AFFORDANCES

SIGNIFIERS

MAPPINGS

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

Principles of Gestalt Psychology (Koffka, 1935)
not hungry

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

use me as paper weight
Characteristics of the object might affect that attraction/repulsion

Principles of Gestalt Psychology (Koffka, 1935)
hungry

 Principles of Gestalt Psychology (Koffka, 1935)
hungry

Principles of Gestalt Psychology (Koffka, 1935)
Relationship with object is tied to the current condition
Principles of Gestalt Psychology (Koffka, 1935)
Principles of Gestalt Psychology (Koffka, 1935)
Principles of Gestalt Psychology (Koffka, 1935)
... days later
Stimulus might “stick around” after

Principles of Gestalt Psychology (Koffka, 1935)
Relationships are learned or chosen (when an object demands attention, e.g. phone ringing)

Principles of Gestalt Psychology (Koffka, 1935)
GIBSON AND AFFORDANCE
1954
AFFORDANCE

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

The Theory of Affordances (Gibson, 1954)
“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.

The Theory of Affordances (Gibson, 1954)
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

The Theory of Affordances (Gibson, 1954)
AFFORDANCE

What does this chair afford?

The Theory of Affordances (Gibson, 1954)
AFFORDANCE

It affords...

Sitting
Standing on it
Throwing (if it’s light)
Self-defense

The Theory of Affordances (Gibson, 1954)
AFFORDANCE

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

The Theory of Affordances (Gibson, 1954)
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

Design of Everyday Things (1964)
PERCEIVED AFFORDANCE

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

Design of Everyday Things (1988)
PERCEIVED AFFORDANCE

Switch suggests toggling

knob suggests turning

button suggests pressing

slot suggests inserting, handle suggests turning
SKEUOMORPHISM

Making virtual items resemble physical counterparts

Slide credits: Lora Oehlberg
SKEUOMORPHISM

Image credit: Steven Houben
SKEUOMORPHISM

IBM Real Objects (1998)

Slide credit: Saul Greenberg
SKEUOMORPHISM
VISIBLE CONSTRAINTS

Limiting possible actions through appearance

Design of Everyday Things (1988)
VISIBLE CONSTRAINTS

PUSH OR PULL?

WHICH SIDE?

CAN ONLY PUSH, SIDE TO PUSH CLEARLY VISIBLE

Design of Everyday Things (1988), Slide credits: Lora Oehlberg
VISIBLE CONSTRAINTS

Controls disabled when an image is selected
MAPPINGS
“What does this button do?”
MAPPING

The set of possible relations between objects

Design of Everyday Things (1988)
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

Design of Everyday Things (1988)
CONTROL-DISPLAY COMPATIBILITY

How controls relate to displays

**ARBITRARY**
- front right
- front left
- front right
- back right

**PAIRED**
- back
- front
- front
- back

**FULL MAPPING**

24 Possibilities (requires labels + memory)

2 Possibilities per side = 4 total

Design of Everyday Things (1988)
The thing that happens right after an action is assumed by people to be caused by that action.

Essentially: *Feedback*

*Design of Everyday Things* (1988)
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

Design of Everyday Things (1988)
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

*Design of Everyday Things (1988)*
PROBLEMATIC MAPPINGS

Revolv Home Control (2014)
SORRY DUDE
BUT THE LIGHT BULB IS IN ANOTHER HOUSE
PROBLEMATIC MAPPINGS
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 = ???*
<table>
<thead>
<tr>
<th>AFFORDANCES</th>
<th>MAPPINGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIGNIFIERS</td>
<td>CONCEPTUAL MODELS</td>
</tr>
</tbody>
</table>
SIGNIFIER

Any mark or sound, any perceivable indicator that communicates appropriate behavior to a person.
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?
Here it is hard to tell what is interactive (i.e. what can be clicked).
DISCOVERABILITY

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

Proxemic–Aware Controls (Ledo, Greenberg, Marquardt, Boring, 2015)
DISCOVERABILITY

How do we know when auto-flash will trigger?

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

(Vermeulen, Luyten, van den Hoven, Coninx, 2013)
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

(Bau, MacKay, 2008)
FEEDFORWARD

DISCOVERABILITY

Cursor icons provide information about:

- Effect of action (feedforward)
- Current state (feedback)
part of the ‘viewport’ we are at instances of the search within the document
“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."[2][xxi] 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][xviii] 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][xxvii]

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/
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
Conceived 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
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
"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?
“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

CONCEPTUAL MODEL

Backwards Bicycle, Smarter Every Day

The Backwards Brain Bicycle - Smarter Every Day 133, https://www.youtube.com/watch?v=MFzDaBzBILO
CONCEPTUAL MODEL

How do people hold mobile phones?

CONCEPTUAL MODEL

Corners are hard to reach

Fat Thumb (Boring, Ledo, Chen, Marquardt, Tang, Greenberg, 2012)
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

SIGNIFIERS
Properties of Action

MAPPINGS
Effects 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