

## Design Psychology

### The Psychology of Everyday Things

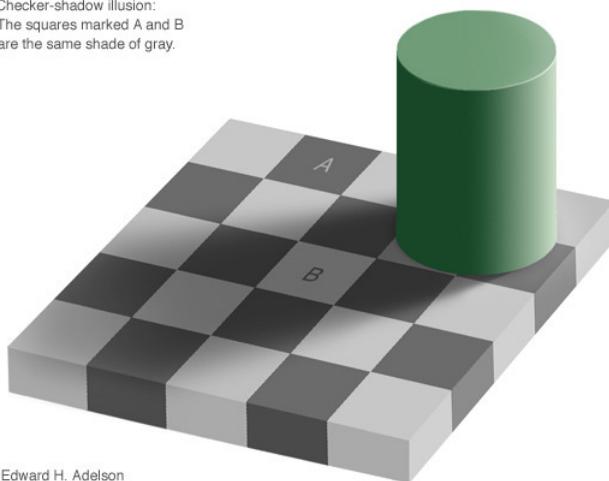
Don Norman - POET

**There are several basic cognitive principles to be aware of while designing interfaces:**

- **Affordances (Visibility helps this)**
- **Constraints**
- **Mappings**
- **Causality (providing quick Feedback helps this)**
- **Transfer effects**
- **Consistency / Cultural standards**
- **Mental Models / Conceptual Models**
- **Comfort (allowing for Undo helps this)**

## Understand How the Brain Works (I)

Checker-shadow illusion:  
The squares marked A and B  
are the same shade of gray.



Edward H. Adelson

Go ahead – print it out – cut out the “B” box and move it over the “A” box!

[http://web.mit.edu/persci/people/adelson/checkershadow\\_illusion.html](http://web.mit.edu/persci/people/adelson/checkershadow_illusion.html)

## Understand How the Brain Works (II)

*post hoc ergo propter hoc*

after this therefore because of this

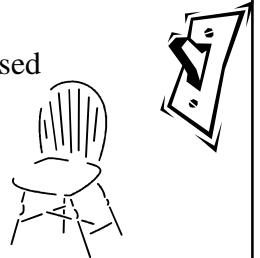
Logical Fallacy known as “Coincidental Correlation”

## Making things work: Visual Structure (I)

### Visual Affordances

- the perceived and actual fundamental properties of the object that determine how it could possibly be used

- appearance indicates how the object should be used
  - chair for sitting
  - table for placing things on
  - knobs for turning
  - slots for inserting things into
  - buttons for pushing
  - computers for ???



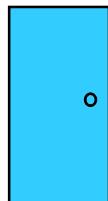
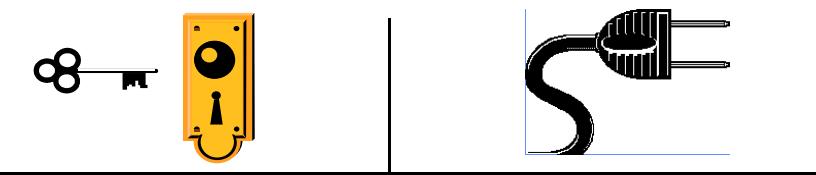
- complex things may need explaining, but simple things really should not...
  - when simple things need pictures, labels, instructions, then design has likely failed



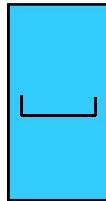
## Making things work: Visual Structure (II)

### Visible Constraints

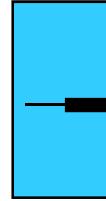
- limitations of the actions possible, perceived from object's appearance
- provides people with a range of usage possibilities



Push or pull?



Which side?

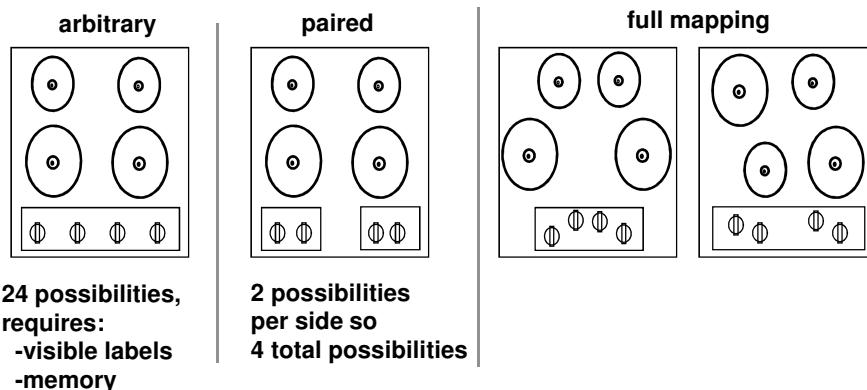


Can only push, side to push clearly visible

## Making things work: Visual Structure (III)

### Mappings

- the set of possible relations between objects
- the natural relationship between two things
  - eg control-display compatibility
    - visible mapping and mimic diagrams: stove and controls
    - cause and effect: steering wheel-turn right, car turns right



## Making things work in context

These SEEM to have a very nice mapping?  
Why did I not like the design of this stove top?



HINT: It was an electric stove.

Evan Golub / Ben Bederson / Saul Greenberg

## Making things work: Understandable action (I)

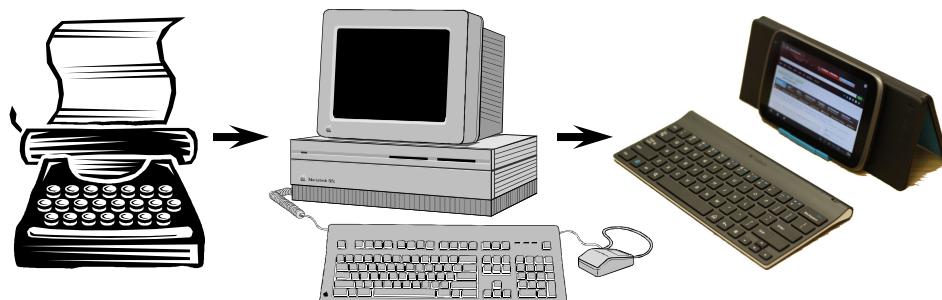
### Causality

- the thing that happens right after an action is assumed by people to be caused by that action
- interpretation of “feedback”
- false causality
  - incorrect effect
    - starting up an unfamiliar application just as computer crashes
    - causes “superstitious” behaviors
  - invisible effect
    - command with no apparent result often re-entered repeatedly
    - e.g., mouse click to raise menu on unresponsive system

## Making things work: Understandable action (II)

### 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





## Cultural Standards (I)

### **Populations learn idioms that work in a certain way**

- red means danger
- green means safe

### **But idioms vary in different cultures!**

- Light switches  
America: down is off    BUT    Britain: down is on
- Faucets  
America: anti-clockwise on    BUT    Britain: anti-clockwise off

### **Ignoring standards or ‘standards’ that change?**

- home handyman: light switches installed upside down
- calculators vs. phone number pads: which should computer keypads follow?

### **Difficulty of changing standards even if desired?**

- Qwerty keyboard: designed to prevent jamming of keyboard
- Dvorak keyboard ('30s): provably faster to use

## Cultural Standards (II)

Because a trashcan in Thailand may look like this:



might a Thai user be confused by the “trash can” in some operating systems?

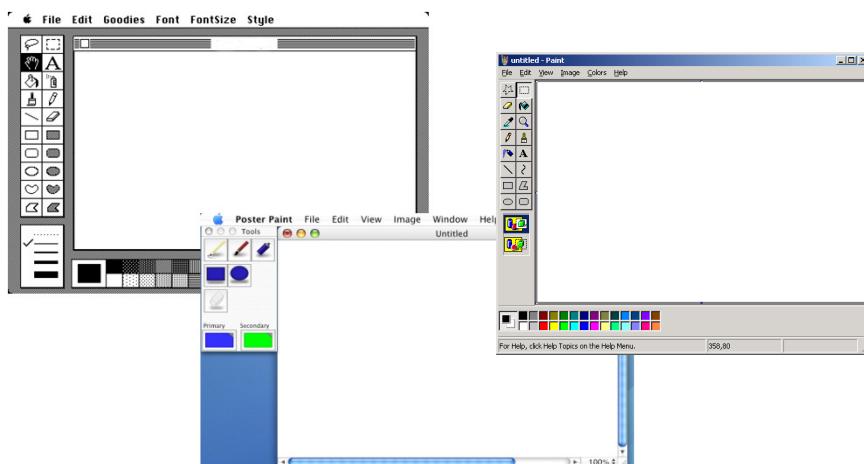


Years ago, Sun found their email icon problematic for some American urban dwellers who are unfamiliar with rural mail boxes.



## Cultural Standards (III)

A Mac user might find a Windows system only somewhat familiar. A pre-OS X Mac user might find an OS X Mac system only somewhat familiar. Similar things might work in different ways...



## Conceptual model

People have “mental models” of how things work

**conceptual models built from:**

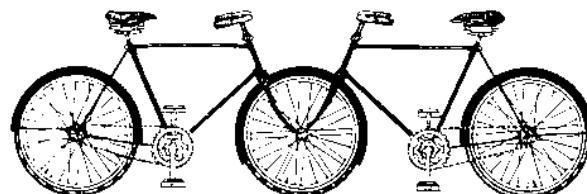
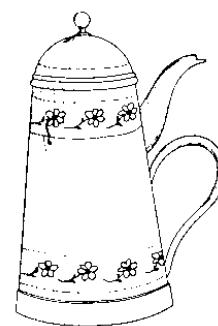
- affordances
- causality
- constraints
- mapping
- positive transfer
- population stereotypes/cultural standards
- instructions
- interactions
- familiarity with similar devices (positive transfer)

**models may be wrong, particularly if above attributes are misleading**

**models allows people to mentally simulate operation of device**

From *The Design of Everyday Things*

What are your initial impressions of these items?



## Comfort / Learning the Technology

**People are often intimidated by technology**

**Users are often afraid of breaking the system or losing data**

**Given these two issues, how do people learn the technology?**

Examples:

- Support rapid, incremental, reversible actions
- Don't use dialogs to report normacy
- If it's worth asking the user, it's worth the program remembering

**Implemented through “Direct Manipulation”, or at least  
“Undo”**

**Encourages experimentation, increases comfort**

## Example (I)

**Good: Scissors**

affordances:

holes for something to be inserted

constraints:

big hole for several fingers, small hole for thumb

mapping:

between holes and fingers suggested and constrained by appearance

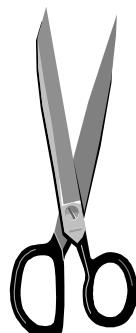
positive transfer and cultural idioms

learnt when young

constant mechanism

conceptual model:

implications clear of how the operating parts work

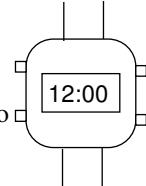


## Example (II)

### **Bad: “Classic” digital watch**

affordances:

several push buttons to push, but not clear what they will do



constraints and mapping unknown

no visible relation between buttons, possible actions and end result

transfer of training

little relation to analog watches

cultural idiom

somewhat standardized core controls and functions

but still highly variable

conceptual model:

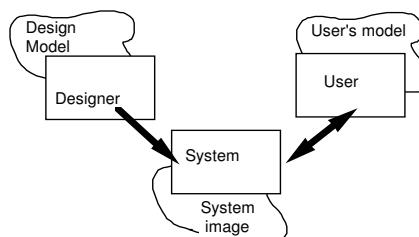
must be taught

**Will the current wave of “smart watches” that is sure to come make this better or worse?**

## Two guidelines for design

### **1. Provide a good conceptual model**

- allows user to predict the effects of our actions
- potential problem:
  - designer’s conceptual model communicated to user through system image:  
appearance, written instructions, system behavior through interaction, transfer, idioms and stereotypes
  - if system image does not make model clear and consistent, user will develop wrong conceptual model



## Two guidelines for design (continued)

### 2. Make things visible

Relations between user's intentions, required actions, and results are

- sensible
- non arbitrary
- meaningful

Visible affordances, mappings, and constraints

Use visible cultural idioms

Reminds person of what can be done and how to do it

## Who do you design for?



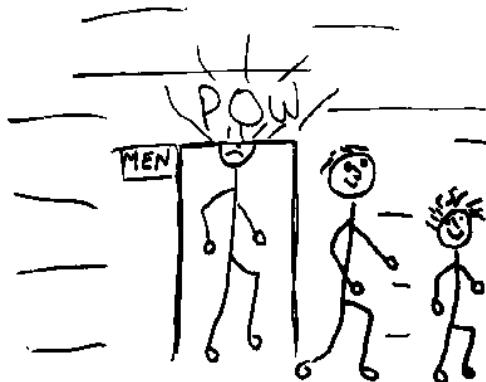
The person of medium height is able to see the mirror.

The taller person must slouch.

The shorter person is out of luck.

**WHAT WOULD YOU DO????**

## Who do you design for?



The person of medium height is easily able to walk through.

The taller person better slouch.

The shorter person is easily able to walk through.

**WHAT WOULD YOU DO????**

## Who do you design for?

**People are different – give options to customize if possible.**

**It is rarely possible to accommodate all people perfectly...**

Design often a compromise

– Maybe your ceiling height is 8' but the tallest human is 8' 11"!

### **Rule of thumb:**

Design should cater for at least 95% of audience (ie for 5th or 95th percentile)

– but means 5% of population may be (seriously!) compromised

Designing specifically for the average is generally a mistake

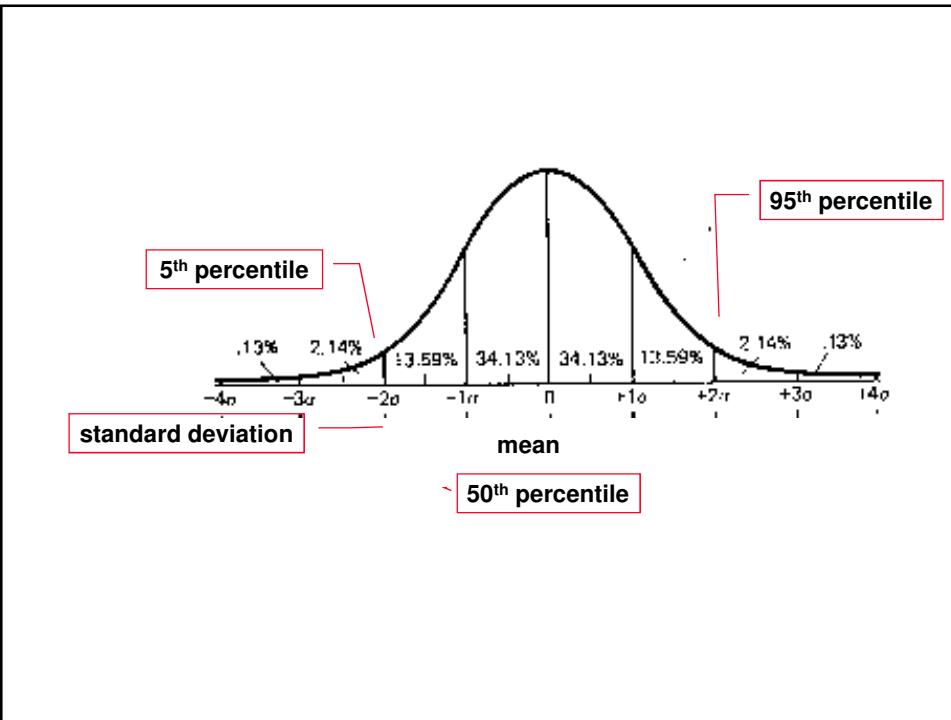
– may exclude half the audience

### **Examples:**

Cars and human height: headroom, seat size, safety

Computers and visibility:

– font size, line thickness, color for color blind people?



### Why design is hard (I)

Over the last century the number of things to control on a single device has increased dramatically

- car “radio” could have AM, FM, pre-sets, station selection, CD, MP3 player, balance, fader, bass, treble, fast forward and reverse, etc. all while potentially driving at night or being a part of the same control panel as AC/fuel efficiency...

Displays are increasingly artificial

- various lights on a car dashboard to indicate problems don't look like the thing they represent and/or are very vague

Feedback is more complex, subtle, and less natural

- is your alarm on and set correctly?

Errors increasing serious and/or costly

- airplane crashes, car crashes, losing days of work...
- eg: <http://hcil.cs.umd.edu/trs/2004-12/2004-12.pdf>

## Why design is hard (II)

### Marketplace pressures

Adding functionality (complexity) now seen as easy and cheap

- computers, cell phones, cameras, tablets, etc.

Samsung's MM-A800



Adding physical controls/feedback expensive

- physical buttons, LEDs, display resolution
- menus, descriptions, feedback consume screen real estate

Design often requires several iterations before success

- product might be pulled if not immediately successful (see HP)

People often consider cost and/or appearance and/or feature list over human factors design.

- user demands and expectations keep changing too

Design is an art - usability testing does not replace design!

## Real or Fake? iPhone adapter for SLR lenses



Evan Golub / Ben Bederson / Saul Greenberg