

Design of  
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# Design of Everyday Things

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# Overview

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## 1 Design of Everyday Things

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# Reminders

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- **HW1** is due this Friday
- **Team forming** as well (group of 4-5 people) due this Friday
- **Project** - starts reading CHI/UIST 2018-2019 papers!  
Submit your paper reading summary on Feb 6 and first proposal on Feb 21
- **Class on Friday** - move to 10:30-12:00

# Doors

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- Good design is not vague. It has only one clear meaning.
- Simple things *should* be simple.  
**Instructions/explanations for simple things are a sign of failure**
- Any better door?

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# Elevators

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How many times - instead of opening, they close the elevator door?



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In a popular flanker test, the mean accuracy range from 0.76 for incongruent trials to 0.98 for congruent trials

Compatible	Incompatible
Congruent	Congruent
>>>>>	>>>>>
Response Right	Response Left
Compatible	Incompatible
Incongruent	Incongruent
>><>>	>><>>
Response Left	Response Right

# Projector

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Zeiss Slide Projector

- Only one button to control the slide advance
- During lectures, sometimes the slides go forwards, sometimes they go backwards
- If you can find an instruction manual; Short press = forward, long press = backward.
- What an elegant design! two functions with one button (an engineer shouts!)
- But how should first time users know what to do?

# Toilet sign

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- Took this picture at IconSiam
- Which one is man and woman?
- Minimalism or aesthetically pleasing are not design either!

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- Here, the desk is dominantly right-handed!

# Mcdonald

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- I have my lunch at a McDonald at TheNine
- I put the tray and it falls down
- So how to design better?

# Remote control

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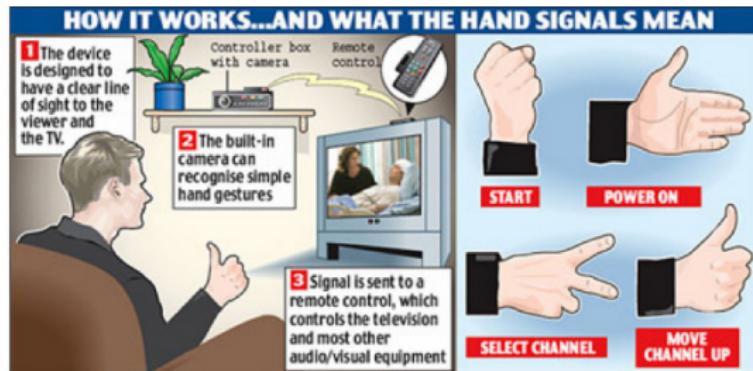
- Some of the buttons on a VCR remote control are easy to understand, but others are unfathomable without the instruction manual
- Remove buttons are not the solution either! (this is in fact 90% of what people will suggest which is wrong! Why?)
- Better question is to ask how we can better support novice and expert users at the same time.

# TV gestures

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Never a commercial success.....why?



# List goes on....

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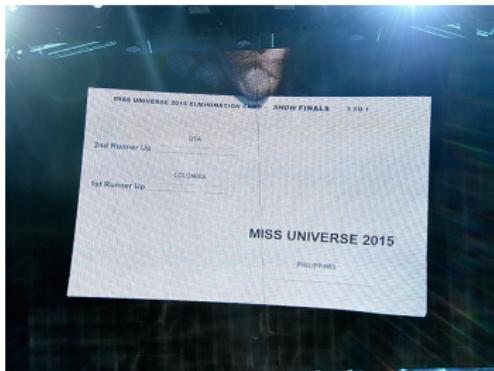
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- Do you remember **Miss Universe 2015** incident?
- How many times you or your acquaintances forgot to **withdraw your card from ATM**?
- How many times we forgot to **turn off the front lights of the car**?
- Have your mom/grandma go to a hotel and wonder **how to use the hot/cold water**?  
Have they ever got **water splashed right** on their body?

# Stupid design is easy to avoid though

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- Of course, this class won't discuss those silly mistakes because they are just for the sake of joke. Very few people really do that. But this class gonna focus on "non-obvious" stuff that so many people designs wrong....

# Hmm...so what happen?

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- Most engineers will often make the excuse of “if the user read the instructions or manual”, or “if the user click this before this”. But anyhow, when users cannot perform the tasks, it is **NEVER the fault of users, but of designers**
- Most of the design problems stem from a **complete lack of understandings of the design principles**
- Engineering people usually **lack understanding of people**. The problem of engineers are that they are **too logical**, yet normal humans (even engineers themselves!) are quite diverse and usually less logical
- We are people ourselves, so we think we understand people, but in fact, we **humans are amazingly complex.**

# Why design is hard?

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- Design is hard because of **tradeoffs**
  - Designers know what makes design good, but the problem is that you cannot always take all the good things
  - Common **tradeoffs** - e.g., security vs convenience? familiarity vs. cool new experience? speed vs accuracy? customizability vs. learnability?
- Design is hard because of **context**
  - Context of use - which tasks the tools/systems are being used
  - Expertise - novice vs. experts
  - Cultural differences
  - User groups (e.g., old vs. young, blind, female)
  - Personal preferences!
  - Difficult to have **one-fits-all** solution

# Why design is hard?

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- Design is hard because of **human nature**
  - Human **perception** is flawed
  - Human **attention span** is limited
  - Users does not like to **memorize**, nor **read**, nor **think**
  - Users are **hot-headed** and impatient
  - Humans seems rational but actually not
- Design is hard because of **engineer nature**
  - Engineer usually assumes users are same as him/her
  - Engineer usually interested in solving technical challenge
  - Engineers make stuff that only make sense to technical people
  - Engineers make stuffs that usually are very logical and rational, which most users (could be engineers) are not

# Human Centered Design

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- **Human-centered design** is a philosophy that concerns the process that ensures that the designs match the needs and capabilities of users
- HCD starts with **understanding people**
- HCD believes that is is **impossible to get the design right at the first time**, even we are grounded upon principles. Thus **rapid prototyping** and **rapid implementation** are preferred
- HCD is **NOT about interviewing users and following what your users tell you to do.**
- HCI is **NOT simplicity** (simplest but not simpler), is **NOT minimalism**, is **NOT feels/looks good**
- Let's visit some design principles that *may* help us in our design journey - affordance, constraints, consistency, mapping, feedback

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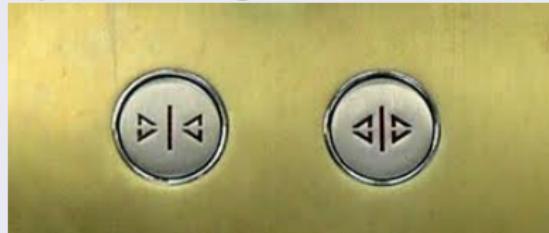
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## Classwork

Attempt to redesign the elevator buttons



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- **HW1 and team forming** are due today
- **HW2-4** due next Friday
- **Project** - first submission on Feb 6
- **Seminar** on security today at 13:30

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- We live in a world filled with objects, but yet we manage to know to interact them naturally. When we see a glass, we know we need to hold it. When we see a knob, we know we need to turn it. The key principle here is **affordances**
- Affordance refers to the **relationship** between a physical object and a person. A chair affords support and, therefore, affords sitting.
- The notion of affordance comes with J. J. Gibson, an eminent psychologist who studied human perception. He argued that the world contained **clues** what to do, and he called them **direct perception**. In addition, he claimed that physical objects conveyed what actions are possible, which he named “affordance”

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Many affordances here. What is good for controlling fan speed? Which is good for turning on/off lights? Which is good for adjusting stove heat?



# Lack of affordance

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Figure: Not sure how to open?

# Lack of affordance

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## Keyboards

Bluetooth or Wireless Keyboards   Corded Keyboards   TV Keyboards   Tablet Keyboards   Gaming Keyboards   Numberpads   Keyboard and Mice Combos



**K580 Slim Multi-Device  
Wireless Keyboard**  
Ultra-slim, compact, and  
quiet keyboard for  
computers, phones or  
tablets



**K580 Slim Multi-Device  
Wireless Keyboard Chrome  
OS Edition**  
Ultra-slim, compact, and  
quiet keyboard for  
computers, phones or  
tablets with a special



**MX Keys Wireless  
Illuminated Keyboard**  
*M/N: Y-R0073*



**Wireless All-in-One  
Keyboard TK820**  
*M/N: Y-R0039*

Figure: Clickable?

# Bad affordance

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Bad affordance also exists! How many times did your family members put something on top of this similar machine?



# Affordance but lack of signifiers

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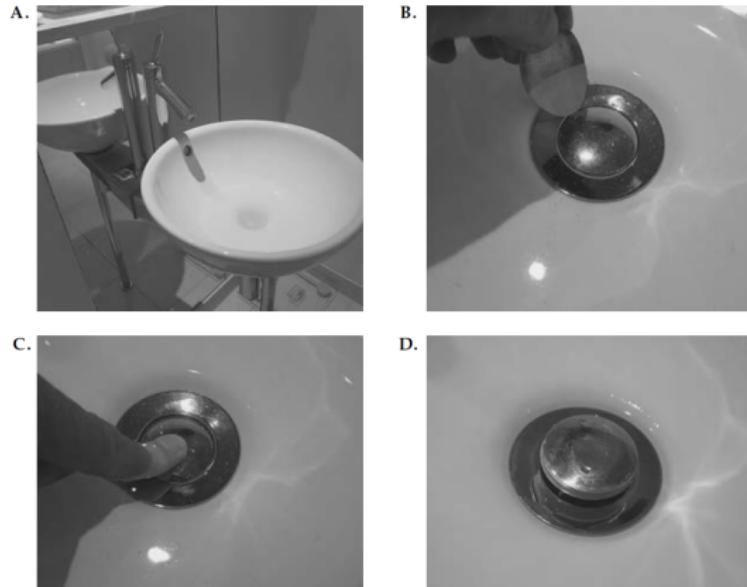


Figure: Source: Fg 1.4 (Norman) - Not sure how to take out!

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- Constraints is about **limiting what user can do**. It sounds uncomfortable but why it is good?
- By **limiting users' options**, user has a better idea what to do
- **Lower** the chance for errors
- Humans also feel good when they see **limited** choices

# Physical, Cultural, Semantic, and Logical

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- **Physical:** constrain possible operations. A large thing cannot fit in small things. **Cylindrical battery has bad physical constraints** because it can fit both orientations! Why no one changes?
- **Cultural:** set of **acceptable actions** in society. Red light is danger is US, death in Egypt, life in India, and happiness in China. Down is off for US, but opposite for Britain. Anti-clockwise is water on for US, but opposite for Britain
- **Semantic:** constraints by **meaning**. Rider sits only facing front, for example
- **Logical:** constraints by logical or spatial relationships - similar to natural mappings

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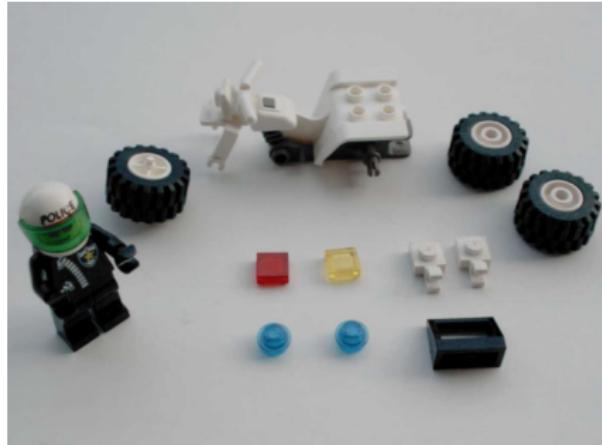
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- Motorbike toy with 12 parts. Constraints make its construction simple, even for adults!
  - *Physical*: Front wheel only fits in one place
  - *Semantic*: The rider sits on the seat facing forward
  - *Cultural*: Red is a rear light, yellow a front light
  - *Logical*: Two blue lights, two white pieces, go together

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The assembled lego motorbike



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**FIGURE 4.7. A Lockout Forcing Function for Fire Exit.**  
The gate, placed at the ground floor of stairways, prevents people who might be rushing down the stairs to escape a fire from continuing into the basement areas, where they might get trapped.

Figure: Source: Fg 4.7 (Norman)

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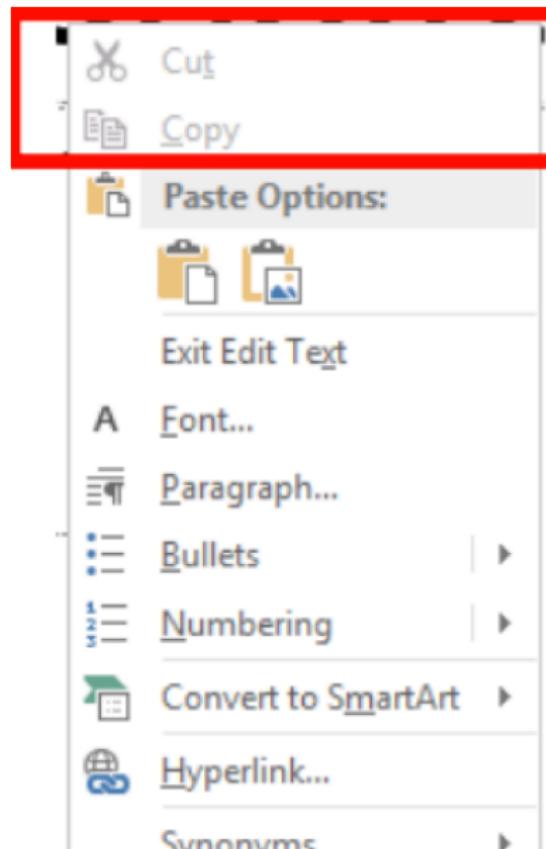
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Amazon.com: Huawei Nexus 6P - Graphite smartphone - 32 GB (U.S. Version: Nin-A1) - Unlocked 5.7-inch Android 6.0 smartphone w/ 4G LTE (U.S. Warranty)

by **Huawei**

★ ★ ★ ★ ★ (749 customer reviews)  
| 159 answered questions

List Price: \$499.00  
Price: \$419.00 **Prime**  
You Save: \$80.00 (16%)

In Stock.  
Want it Friday, June 17? Order within 6 hrs 21 mins and choose Two-Day Shipping at checkout. Details  
Ships from and sold by Amazon.com.

Color: Graphite

Size: 32GB

32GB 64 GB 128GB

Add a SIM card

Activation:  
AT&T Micro SIM Adapter  
TracFone SIM Card  
SIM Card  
H2O SIM Card  
T-Mobile SIM Card  
\$9.00

Turn on 1-Click ordering  
Ship to: Loren Veen  
Add to List

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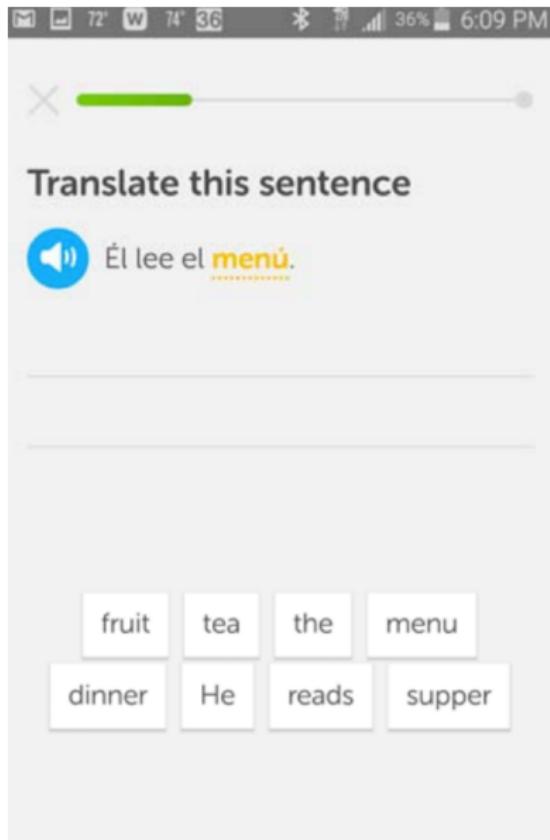
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Undo	Ctrl+Z
Cut	Ctrl+X
Copy	Ctrl+C
Paste	Ctrl+V
Delete	Del
Find...	Ctrl+F
Find Next	F3
Replace...	Ctrl+H
Go To...	Ctrl+G
Select All	Ctrl+A
Time/Date	F5



Undo	Ctrl+Z
Cut	Ctrl+X
Copy	Ctrl+C
Paste	Ctrl+V
Delete	Del
Find...	Ctrl+F
Find Next	F3
Replace...	Ctrl+H
Go To...	Ctrl+G
Select All	Ctrl+A
Time/Date	F5

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- How to better design this McDonald tray using the constraint concept?

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Isn't it familiar where people forgets to take their card after using the ATM? Attempt to redesign ATM to address this problem.

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- **HW2-4** due this Friday
- **HW5-7** due next Friday
- **Zero-plagiarism tolerance** - accepts only **original** work - no paraphrasing, no quotations, no copy/paste, no fancy front page, formal writing is **NOT** required (aside from paper writing) - only **key points** and **substance**. Any non-original work will be mark zero.
- **Project** - first submission on Feb 6
- **No class** on this coming Friday Jan 24 at 13:30

# Conventions

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Conventions are cultural constraints. They are initially arbitrary, but evolve and become accepted over time. They can vary enormously between cultures.

- Light switches:

America	down is off
Britain	down is on
- Water taps:

America	anti-clockwise is on
Britain	anti-clockwise is off

- The colour red:

America	danger
Egypt	death
India	life
China	happiness

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- It is important to leverage these conventions, rather than trying to break these conventions as it will add **confusion**
- For **website**, there are many conventions - where do you usually place logos in website? Usually what is color of a link in website? Where is the contact menu? Where is the search bar? Where are the social media icons? When you choose a range of price, what is the usual input style - a slider or a textbox?
- Violate conventions and people will complain. Imagine US, they still yet to switch to metric system even though metric system is more precise! You can always introduce **new** convention but do it only if they introduce **value** to customers.
- Never introduce your own psychology!

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- Exploiting convention is about consistency
- **Consistency** in design is virtuous. It means the lessons learned with one system transfer readily to others. It makes **learning effortless**
- is about making things consistent across interfaces or systems.
- When things are consistent, it becomes easy for users to catch the pattern, and thus learn. Vice versa, it can become very confusing to users.
- Example: Ctrl-S, Cltr-C, Cltr-V (This function is same across all applications)

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(a) phones, remote controls

1	2	3
4	5	6
7	8	9
0		

(b) calculators, computer keypads

7	8	9
4	5	6
1	2	3
0		

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Drag a file icon to:

Result:

Folder on same  
physical disk



File is moved

Folder on another  
physical disk



File is copied

Trash can



File is discarded

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Important to allow users to observe any permanent states

# External consistency

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External consistency concerns the consistency with other elements in the same environment (e.g., Mac OS)

**Chrome** File Edit View History Bookmarks People Window Help

**PowerPoint** File Edit View Insert Format Arrange Tools Slide Show Window Help

**Mail** File Edit View Mailbox Message Format Window Help

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- **Mapping** is the relationship between the elements of two sets of things
- For example, the mapping of switches to **lights** specifies which switch controls which light (light switches perhaps have the biggest mapping problems, especially in auditorium)
- When the mapping uses **spatial correspondence** between the layout of the controls and the devices being controlled, it is easy to determine how to use them.
- Mappings vary with **culture** - Arabic (right to left), Chinese (top to bottom), Roman (left to right). So how to design an elevator buttons layout depends on culture
- If you create an **universal** design, it is possible to break cultural convention, but expect a period of confusion before people adapt to them. Also make sure people can **learn your system**

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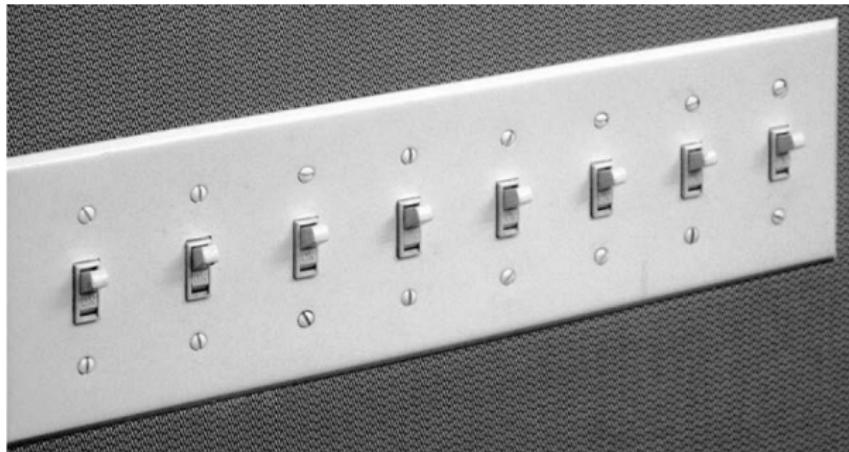


Figure: Source: Fg 4.4 (Norman) - Incomprehensible Light Switches

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**FIGURE 4.5. A Natural Mapping of Light Switches to Lights.** This is how I mapped five switches to the lights in my living room. I placed small toggle switches that fit onto a plan of the home's living room, balcony, and hall, with each switch placed where the light was located. The X by the center switch indicates where this panel was located. The surface was tilted to make it easier to relate it to the horizontal arrangement of the lights, and the slope provided a natural anti-affordance, preventing people from putting coffee cups and drink containers on the controls.

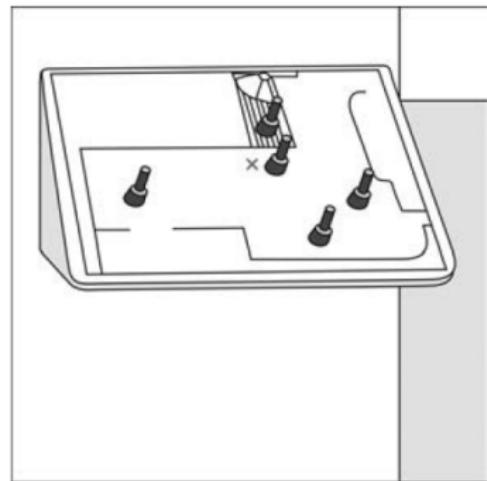


Figure: Source: Fg 4.5 (Norman)

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Figure: Source: Fg 1.7 (Norman)

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- Oh my....there is a fire on my furnace....I got to turn it off...
- ....Oh no! which one is off?

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- Ever drive at the road and wonder how long you need to wait for a traffic light? Ever smile to a person and he/she doesn't smile back?
- When there is **no feedback**, we do not know whether the system is working on your request
- Feedback must be **immediate**: even a delay of a tenth of a second can be devastating. If the delay is too long, people often give up, and do other things.
- Feedback must be **informative** - one flash and two flashes error message isn't very helpful
- **Too much feedback** can be annoying. Too much cause people to ignore them, turn them off, which sometimes critical ones are apt to be missed.

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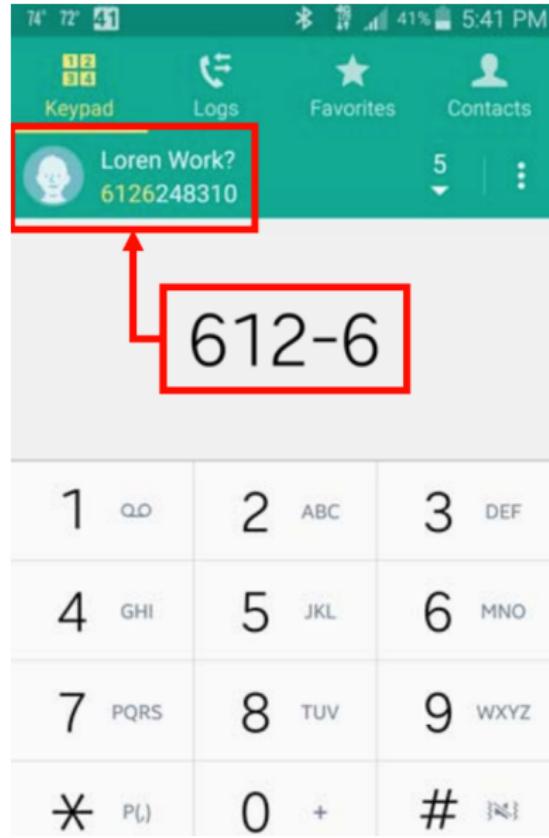
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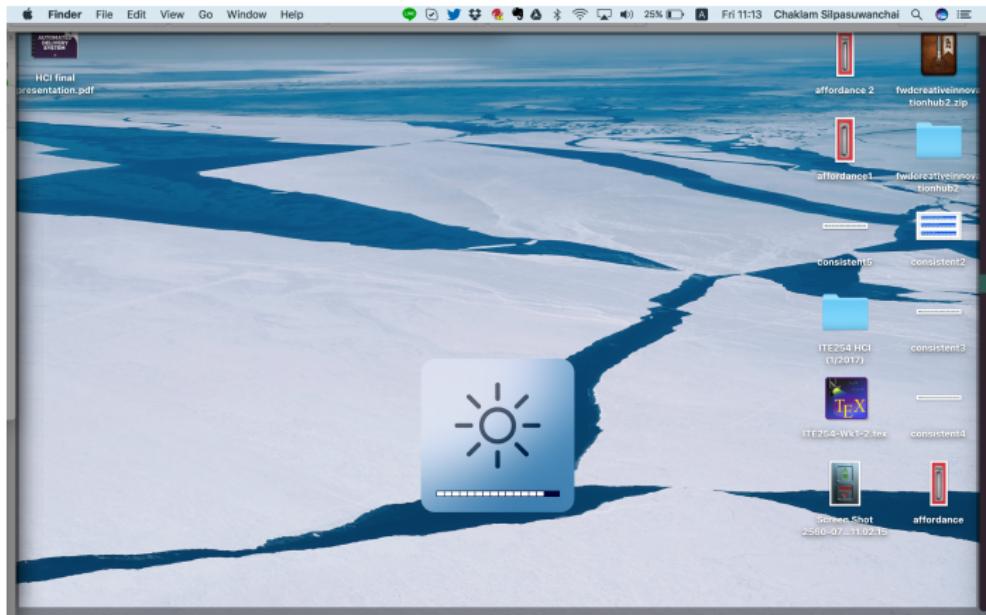
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Every week you will need to complete readings, watch videos, complete projects, or do other things that will take about the same time as a class meeting. Make sure that everything is completed before the next class so you are ready to learn.

- Take a look at the [Week 1-1- Introduction.pdf](#) to be prepared for the next class :)
- Check out the [Course Wiki](#) for resources; if you post a comment adding some useful resources for HCI, you will get one bonus point for each resource! (maximum 3pts). These points can be used to add up if you get a poor score on your homework or quizzes.



## LOOKING AHEAD

This is where everything you need to know before the next face to face class will be posted.

Reminders:

### 1. Complete P0 (0pts) - Due Apr 10

- Blackboard -> Homework -> P0 -> Create Blog Entry (each group posts one)

Path: p » img

Words:305

## ATTACHMENTS

You can drag files from your computer to the Attach Files area or use the browse functions. Files are saved in the top-level folder in your course's file repository. If you select a file you do not want, click **Do Not Attach** to remove the attachment from the content item. The file itself is not deleted.

Attach Files

Browse My Computer      Browse Content Collection

Attached files

File Name	Link Title	File Action
-----------	------------	-------------

Click **Submit** to proceed. Click **Cancel** to go back.

Cancel

Submit

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- A clever trick Instagram uses to upload photo quick
- Whenever you upload a photo, Instagram will quickly finish uploading
- Trick users to think it finishes already
- However, in fact, it is uploading in the background
- Smart design that makes users feel "good"

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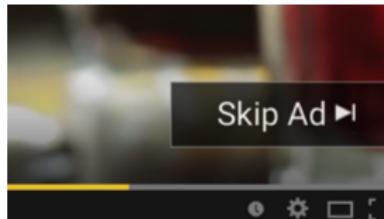
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- Human attention span is 8 secs (goldfish has a 12 secs!)
- 0.1 sec - is the limit that humans can wait while manipulating
  - Important for direct manipulation, virtual world navigation
- 1 sec - the limit that user's flow of thoughts go uninterrupted
  - Display a busy cursor if things take longer than 1 sec
- 10 sec - the limit that user can wait
  - Display a progress bar if things take longer than 10 sec

# Activities

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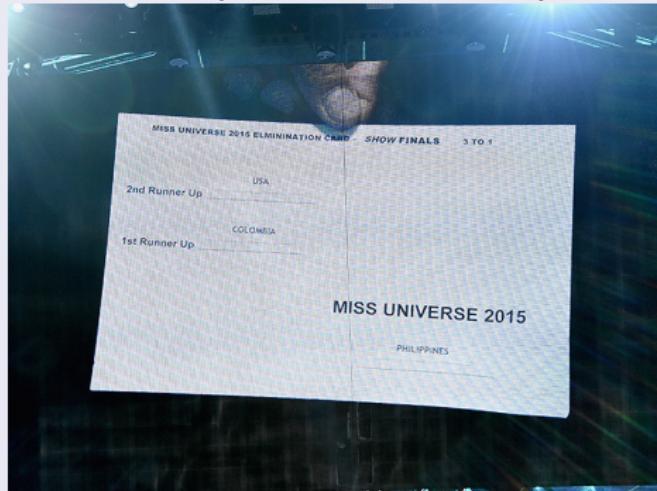
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## Classwork

Miss Universe 2015 was an embarrassing moment where winners were announced wrong. First, discuss why such errors happen in the first place. Then attempt to redesign.



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- **HW5-7** due this Friday
- **HW8-10** due next Friday
- **Homework recap** - green/red elevator buttons, light/sound feedback, mindset (there is no best), resubmit unlimitedly but first think slowly and deeply
- **Project leaders** - first submission on **Feb 7** - paper readings and **Feb 21** - writing the first proposal
- **Project programmers** - you should start exploring the tools and gauge the difficulty - do not overpromise, but also do not propose "non-technically" challenging work. For EEG, you have to start exploring **OpenVibe** (check out Apiporn Simapornchai Medium blog) or **python** - namely MNE-python, psychopy, and pyOpenBCI-LSL (check out my blog on BCI + Python)
- **Project team size** - increases to six

# So...what's a successful design? - Mental Models

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- Matches of mental models is a characteristics of a successful design
- **Mental model** is an explanation, usually highly simplified, of how something works
- The files, folders, and icons help create the mental model of documents and folders inside the computer - in fact, there are no folders in the computer! only binary bits
- There are often **multiple mental model** of a product. Novice and experts, for example, have completely different models. Designers and users also have often very different models
- Mental models comes from **device itself**, comes from **reading**, but usually from **experience**.

# Mental Models

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- When users have correct mental models, your design can be said to be successful. Correct mental model is usually an **embodiment** of design principles.
- Scissors:** The holes are both **affordances**; they allow the fingers to be inserted and **signifiers**; they indicate where the fingers are to go. The sizes of the holes provide **constraints** to limit the possible fingers: a big hole suggests several fingers; a small hole, only one. The **mapping** between holes and fingers—the set of possible operations—is signified and constrained by the holes. Moreover, the operation is not sensitive to finger placement

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FIGURE 1.8. Junghans Mega 1000 Digital Radio Controlled Watch. There is no good conceptual model for understanding the operation of my watch. It has five buttons with no hints as to what each one does. And yes, the buttons do different things in their different modes. But it is a very nice-looking watch, and always has the exact time because it checks official radio time stations. (The top row of the display is the date: Wednesday, February 20, the eighth week of the year.) (Photograph by the author.)

Figure: Source: Fg 1.8 (Norman)

- On the other hand, when users have incorrect mental models, your design fails
- Watch:** There are five buttons. There are **affordances** of buttons but it does not **signifies** what to do. There are also no clear **mappings** between functions and buttons. **Constraints** are also not applied properly - each button can be pressed or hold or press twice, none of which are explained clearly. Only way to use this watch is to read the manual....too bad

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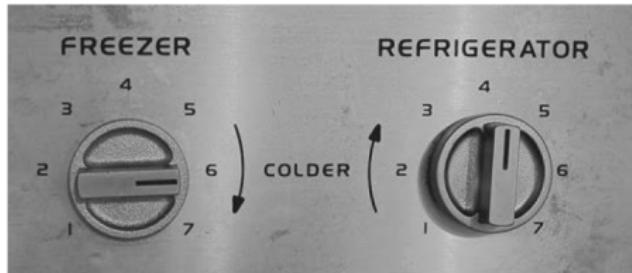
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**FIGURE 1.9. Refrigerator Controls.** Two compartments—fresh food and freezer—and two controls (in the fresh food unit). Your task: Suppose the freezer is too cold, the fresh food section just right. How would you adjust the controls so as to make the freezer warmer and keep the fresh food the same? (Photograph by the author.)

Figure: Source: Fg 1.9 (Norman)

- **Refrigerator:** If the freezer is too cold, what you will do?
- It happens that this refrigerator's two controls are not independent. In fact, there is only one thermostat

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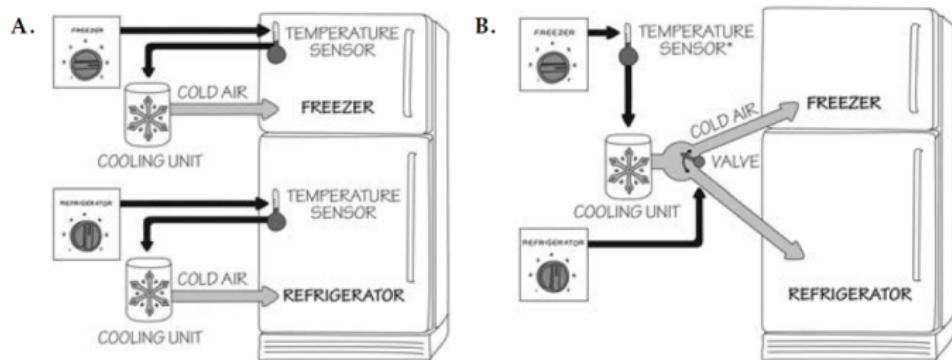
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**FIGURE 1.10. Two Conceptual Models for a Refrigerator.** The conceptual model A is provided by the system image of the refrigerator as gleaned from the controls. Each control determines the temperature of the named part of the refrigerator. This means that each compartment has its own temperature sensor and cooling unit. This is wrong. The correct conceptual model is shown in B. There is no way of knowing where the temperature sensor is located so it is shown outside the refrigerator. The freezer control determines the freezer temperature (so is this where the sensor is located?). The refrigerator control determines how much of the cold air goes to the freezer and how much to the refrigerator.

Figure: Source: Fg 1.10 (Norman)

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**FIGURE 1.11. The Designer's Model, the User's Model, and the System Image.** The designer's conceptual model is the designer's conception of the look, feel, and operation of a product. The system image is what can be derived from the physical structure that has been built (including documentation). The user's mental model is developed through interaction with the product and the system image. Designers expect the user's model to be identical to their own, but because they cannot communicate directly with the user, the burden of communication is with the system image.



Figure: Source: Fig 1.11 (Norman)

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- This section describes some key concepts derived from the famous book of Steve Krug's *Don't Make Me Think*
- The book focuses on one key concept: design should be **self-explanatory, obvious.**
- The book provides examples from web but very applicable to other domains
- **Not thinking** means that users should be able to quickly reach their goal without unnecessary cognitive effort
- The point is, when we're using the Web every question mark adds to our **cognitive workload, distracting our attention** from the task at hand. The distractions may be slight but they add up

# Don't Make Me Think

# Design of Everyday Things

## Don't Make Me Think

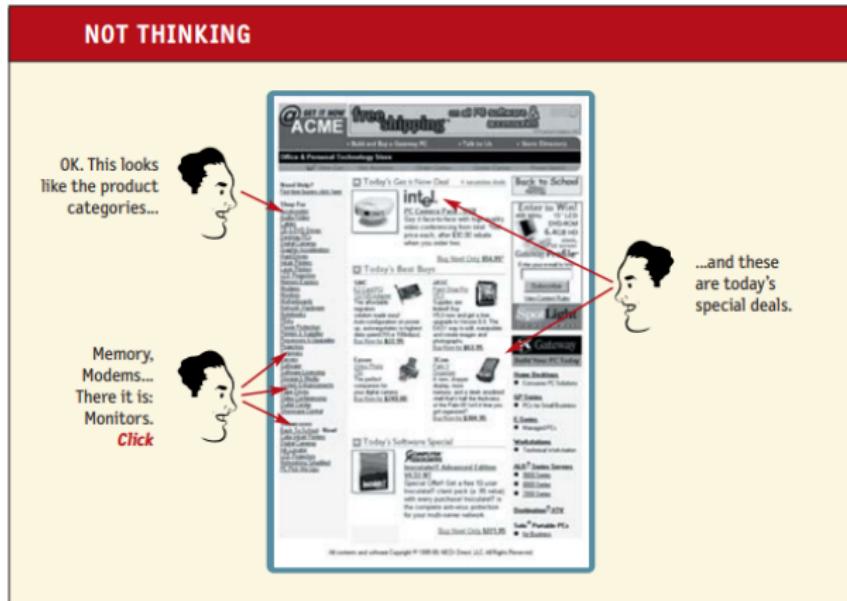


Figure: Source: Pg. 12 (Steve)

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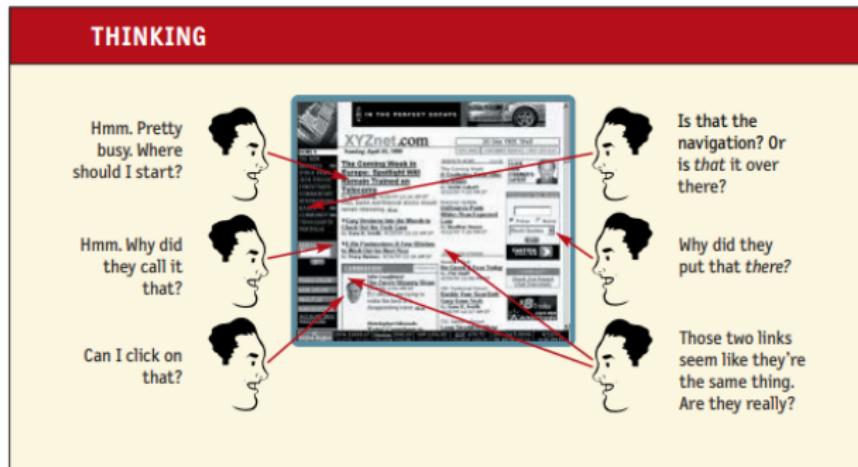


Figure: Source: Pg. 13 (Steve)

# Things that Make Us Think - Names

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- Typical culprits include cute or clever **names**, marketing-induced names, company-specific names, and unfamiliar names



Figure: Source: Pg. 14 (Steve)

# Things that Make Us Think - Links and Buttons

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- Needless source of question marks over people's heads is **links and buttons that aren't obviously clickable**. The point is simple things like links should not cause any such headache

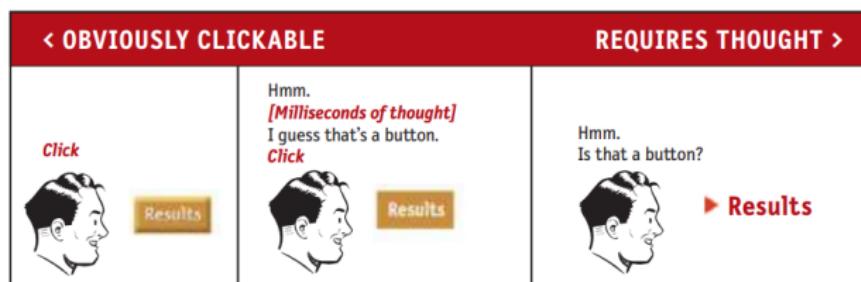


Figure: Source: Pg. 15 (Steve)

# Things that Make Us Think - Search

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- Many bookstore sites require us to **think how we want to search** which adds up the cognitive effort



Do I have to click on that drop-down menu thing?

All I know about the book is that it's by Tom Clancy. Is Clancy a keyword?

(What is a keyword, anyway?)



I guess I have to use the menu.

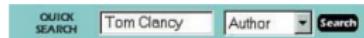
**Clicks on the arrow**



"Title. Author. Keyword."

OK. I want "Author."

**Clicks "Author"**



Types "Tom Clancy"

**Clicks "Search"**

Figure: Source: Pg. 16 (Steve)

# How We Really Use the Web

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- A gap often between how we think people use Websites and how they actually use them
- In fact, people mostly is **impatient** and usually in hurry, only care about their **goal**, **does not like to think**
- Thus, most people will just **scan** and **click**, within tenth of a second...

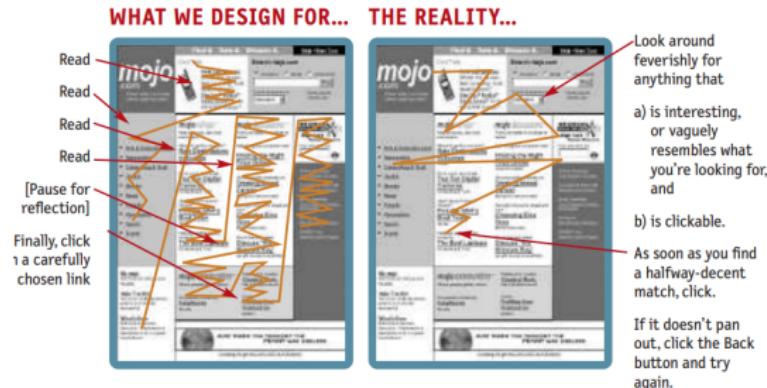


Figure: Source: Pg. 21 (Steve)

# Fact of Life I - We scan

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- We don't read. We scan. We are smart to know we do not need to read everything



Figure: Source: Pg. 23 (Steve)

# Fact of Life II - local optima

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- We don't choose the **best** option. We choose the **first reasonable** option because
  - We are usually in a **hurry**
  - The **penalty** for guessing wrong is low with the Back button always available
  - Not to mention guessing is **fun**

# Fact of Life III - We don't like to learn/think

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- We usually don't figure out how things work by reading instructions or by thinking, we usually just **muddle through**
- Why is that? Because it's not important to us whether we understand everything.
- Almost all (if not all) users (including smart people) don't like to learn or think.
- If we find something that works, we stick to it, we **hardly change our way** even the way is better
- Designers are usually surprised of user behaviors, because they **thought everyone are just like them** who are interested in how things work

# Self-Evident Design

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- Because most people are in such a hurry, design all be self-evident and obvious. Not to mention that winners between two designs are due to only very minor details.

**Self-Evident Design** may be achieved with:

- Clear **visual hierarchy** - know the rank of importance (like mappings)
- Take advantage of **conventions** - transfer what they know to the task, allows faster scan (similar to constraints)
  - Designers have temptation to **reinvent** the wheel, because they **feel** they are hired to do something **new** and **different**
  - Links and buttons in unconventional colors causing confusion
  - User becomes lost when navigation does not have breadcrumbs, have no search bar or way to go back HOME
  - If you really want to break convention, you have to make sure there is **zero learning curve**

# Self-Evident Design

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- Omit **needless words** - less is more; providing only important words make useful content more prominent.  
Avoid happy talks, e.g., self-congratulatory promotional writing - “*Welcome....; We hope you enjoy them*” - convey no information
- Don't argue but **test** - it is always difficult to judge how well a design can work, thus regular testing should be done

# Activities

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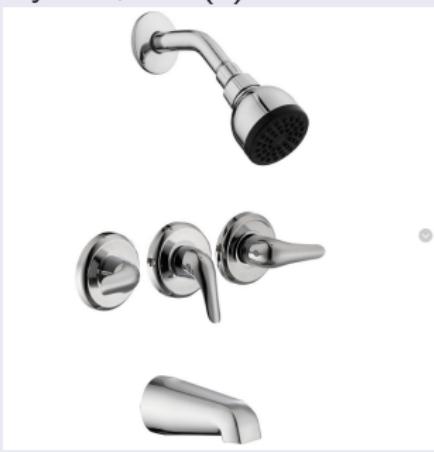
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## Classwork

Shower at hotel is something simple that is often designed wrong. Have you ever encountered relatives where they have difficulty understanding how the shower works? Have you ever turn on the shower with water splash right on your face when it's not intended? Attempt to redesign (1) the hot and cold water system, and (2) faucet vs. rain shower.



# How we do things?

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- Recall that HCD is about understanding humans, particularly on how people **do things**, what happens when things **go wrong**, how do we **detect** that something isn't working, and then how do we **know what to do?**
- Key important thing is most of human behavior is **subconscious** and have many erroneous beliefs. We are **unaware** of them. As a result, we usually do not understand humans. Thus, we need to use multiple disciplines to understand humans
- In this section, first, let's discuss the notion of **Gulf of Execution and Evaluation** and **Three Levels of Processings**

# Gulf of Execution and Evaluation

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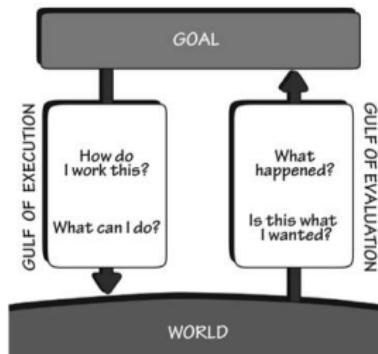


Figure: Source: Figure 2.1 (Norman)

- When people use something, we face two gulfs: the **Gulf of Execution** - when they try to figure out how it operates, and **Gulf of Evaluation**, where they try to figure out what happens. Designers job is to **bridge** the two gulfs
- So how can designers bridge the Gulf of Execution? through **affordances**, **constraints**, **mappings**, and **matches of mental model**
- How about Gulf of Evaluation? - through use of **feedback** and **matches of mental model**

# Seven Stages of Action

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Figure: Source: Figure  
2.2 (Norman)

- ① **Goal** (form the goal)
- ② **Plan** (the action)
- ③ **Specify** (an action sequence)
- ④ **Perform** (the action sequence)
- ⑤ **Perceive** (the state of the world)
- ⑥ **Interpret** (the perception)
- ⑦ **Compare** (the outcome with the goal)

# Seven Stages of Action

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- ① **Goal** - Low-level (click) - Middle-level (purchase iPhone) - high-level (calling) - Very high-level (self-image). Humans are usually subconscious about low-level goals. **Good designers understand all levels**, i.e., *root-cause analysis*
- ② **Action** - Most actions are opportunistic, meaning they are performed based on circumstances. Also, users tend to repeat erroneous action immediately if without sufficient feedback **Good designers make sure possible actions are unambiguous through affordance, signifiers, constraints, and mappings**
- ③ **Evaluation** - **Feedback** and having a correct **model** are crucial for humans to make the right interpretation, as well as knowing what to do next. It is also important to take care of **loose-ends** because users usually forget after achieving their goal (e.g., taking ATM card, forget to press buttons on elevators)

# Three Levels of Processing

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One can also look at emotional-cognitive processing to understand how people do things. Three levels of processing can be considered:

- ① **Visceral** - the quick, automatic, and subconscious judgments; the first impression; the immediate perception; minimal learning involved. Linked with motor systems (fight or flee). Design aesthetics drive these responses.
- ② **Behavioral** - relates to experience when performing actions and every action is associated with an expectation. A state **flow** happens when challenge of activity just slightly exceeds our skill. Most action in this level is subconscious
- ③ **Reflective** - relates to home of conscious cognition. This is your experience after conscious reasoning. Highest levels of emotions come from this level. Emotion and cognition are tightly intertwined

# Three Levels of Processing

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- Good design satisfy all levels
- But for designer, **reflection** is perhaps the most important because it is conscious, emotions are highest, it is reflection that drive us to recommend a product
- **Reflection as the decider** - if you have strong positive visceral experience but some usability problems at the behavioral level, your reflections may overlook these usability problems.. On the other hand, if you have too many usability problems, your reflections may overlook the strong positive visceral experience
- At the end, the **philosophy** or what **high-level value** you provide to your customer is most important. Company that **understand their why** is most successful

# Three Levels of Processing

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- In psychology, long debate whether emotion or cognition happens first
- Both because **they affect/trigger one another.** You feel hungry, thus you find food. You are thinking about food, thus you feel hungry.
- Thus, all three levels of processing determine a person's cognitive and emotional state.

# Seven Stages + Three Levels of Processing

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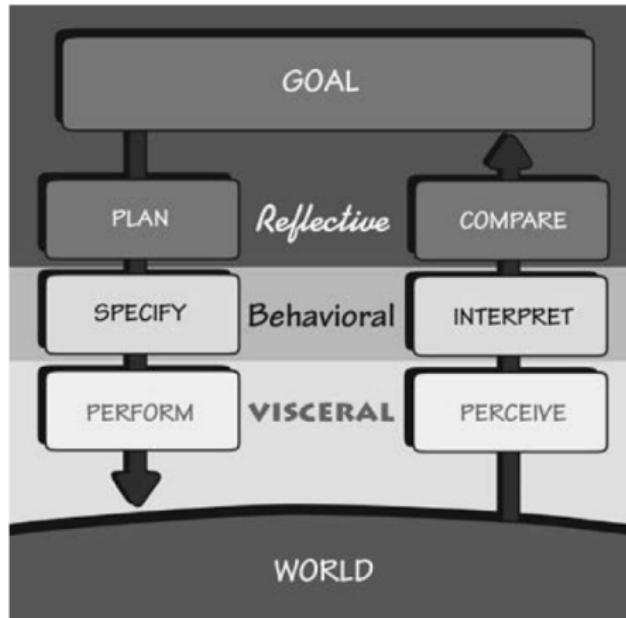


Figure: Source: Figure 2.4 (Norman)

# Design Thinking

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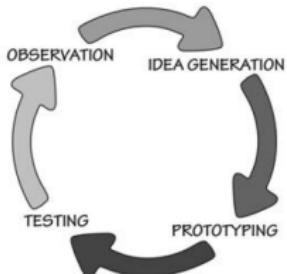


FIGURE 6.2. The Iterative Cycle of Human-Centered Design. Make observations on the intended target population, generate ideas, produce prototypes and test them. Repeat until satisfied. This is often called the *spiral method* (rather than the circle depicted here), to emphasize that each iteration through the stages makes progress.

Figure: Source: Figure 6.2 (Norman)

- Design thinking is the process for **solving design problems**
- Pre step is to make sure you solve the correct problem using **root cause analysis, i.e., keeping whys**. Many people goes to the problem right away before questioning
- HCD Process is a common process for solving design problems focusing on iterative and empathy approach

# Observation

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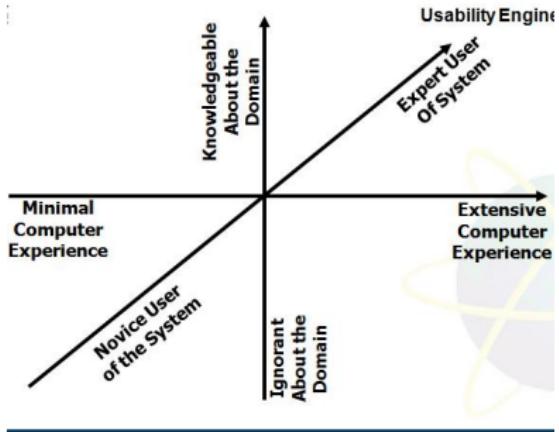
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- The first step towards understanding the problem is to first **understand your users**. Classifications often help.
- Users can be classified according to their:
  - Educational level, Age, Gender, Assumptions
  - **Expertise**: experience of computers in general, understanding of the task domain, and expertise in using the specific system.
  - **Goals**: Low-level and High-level

# Design for Novice and Expert Users

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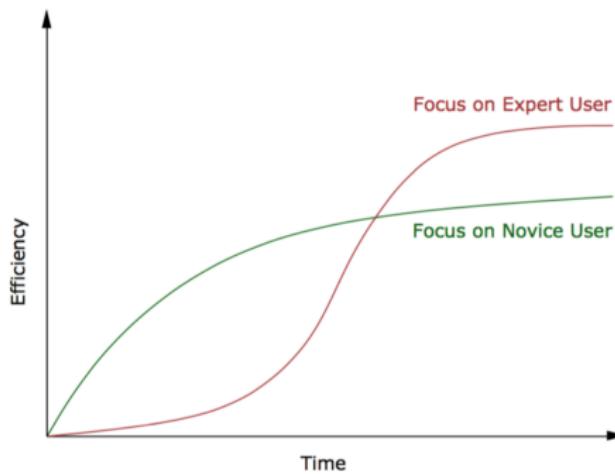
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- **Learning curves** for hypothetical systems focusing on the novice user (easy to learn, but less efficient to use) and the expert user (harder to learn, but then highly efficient).
- A system should aim to support both **novices** and **experts**



# Design for Boundary Users, Not Average

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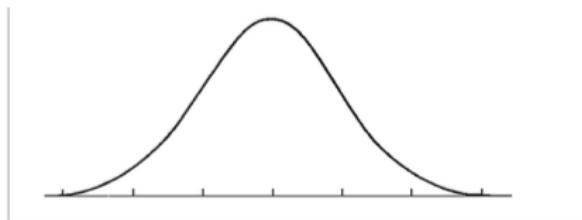
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- The experience level of people using computer software tends, like most population distributions, to follow the classical statistical **bell curve** (normal distribution).
- Beginners do not remain beginners for long
- The difficulty of maintaining a high level of expertise means that experts fade over time
- **Most users gravitate over time towards intermediacy**
- **Do not design for the average user;** it produces a design to please no-one



# Design for Boundary Users, Not Average

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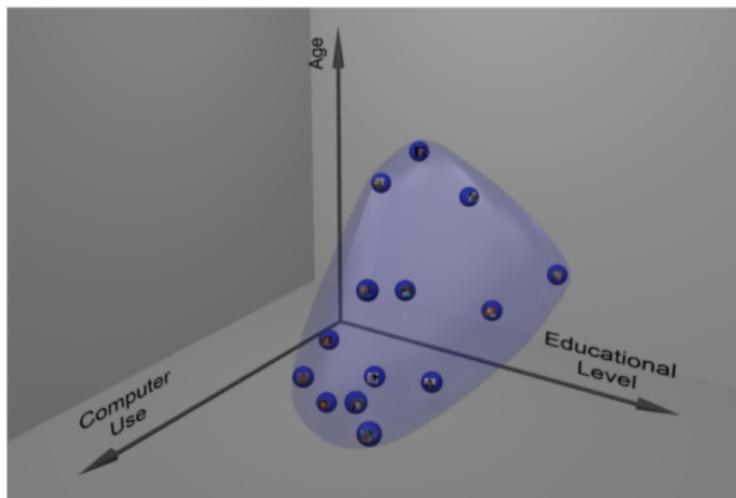
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- Users form a point cloud



# Design for Boundary Users, Not Average

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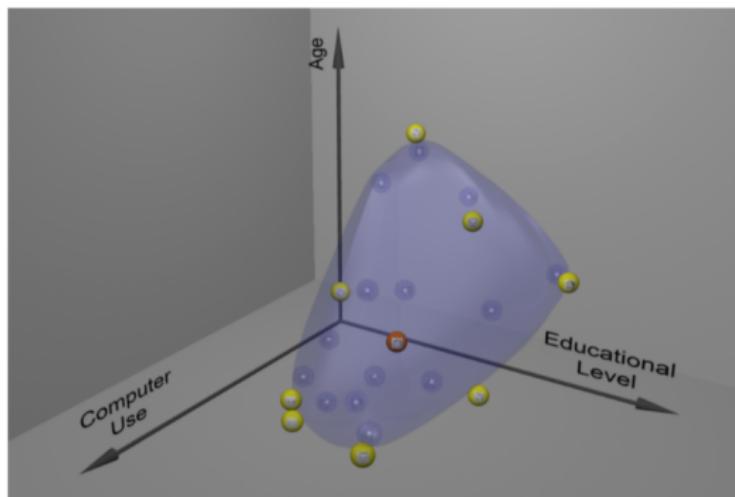
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## • Average users



# Design for Boundary Users, Not Average

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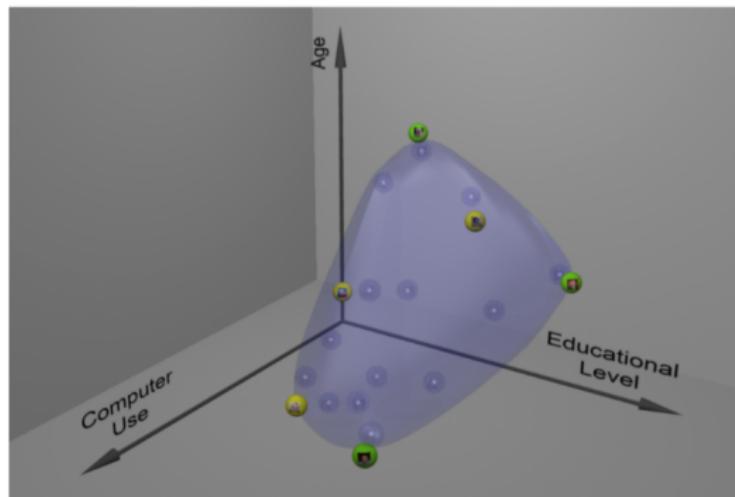
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- If our design **satisfies the hard cases around the edges**, the ones in the middle should be able to use the interface as well.



# Interview users; be goal-oriented

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- **One-on-one interviews** are often more effective to discover hidden problems
- Make sure you interview with **target population**
- Designers need to be aware of:
  - Most people does not understand their own behavior
  - Rather than ask, sometimes it is better to **observe** how user use the tools
  - Do not always follow your user, understand why and what they really need
  - Clarifying questions in the context of use
- Interview should be goal-oriented - Key things to ask include: (1) **current way of doing things**, (2) **current problems**, and (3) **what they truly want to achieve (goal)**
- You may ask users for solutions but be cautious. What we want is to understand the problem, not solution. You may also be mislead by users

# Etiquette of Interview

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- Avoid **biases**, focus on listening, don't talk too much...
- *Are you happy in the products [encourage bias]?*
- *But I think you may not be thinking right [providing unnecessary opinions]?*
- *Hmm....[Showing unnecessary approval]...*
- Ask open-ended questions
- Use closed-questions to clarify your answer
- Keep on asking **why why why** to understand their goals and how they reach their goals
- **Summarize** your points to interviewers

# Tasks are not Goals

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- Goal: Get something to eat.
- Task: Go to the restaurant around the corner
- Task: Call the pizza delivery service, Or
- Task: Go to the supermarket, buy ingredients, and cook for myself

Too often, designers focus on simplifying a task, rather than accomplishing a goal. Tasks are a means to an end, not an end in themselves.

# Ideation

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- Rules for brainstorming

- ① No one is allowed to criticize another's ideas.
- ② Programmers must not say it cannot be implemented.
- ③ Graphic designers must not laugh at programmers' drawings.
- ④ Propose **multiple alternatives**
- ⑤ Be as crazy and foolish as possible (but serious)
- ⑥ Respect

- Only *after*, organize ideas and rank them according to:

- **Novelty** - what is new here? Did you carefully check that no one has done this before?
- **Feasibility** - given time, skill, resource constraints, can you really achieve the work?
- **Effective** - does your system truly solve the existing root-cause problem of your users?

# Ideation

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- **Getting ideas from others** are helpful such as reading papers or talking with other designers
- Some designers are afraid to be influenced by others' ideas. What's wrong with this thought?
- Two top-tier conferences in HCI includes **CHI** and **UIST**
- May be daunting task to find 1000+ papers related to your topic. The trick is to start with only 1 key paper you really like, then perform snowballing (the paper references) and backtracking (who cites the paper) to understand the web of related works. Also this methods provides a holistic understanding of the domain

# Prototyping

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"There's a mantra at IDEO: "**Never go to a meeting without a prototype.**" At whatever stage of development, one week, one month, or 6 months."

- Tim Brown, President, IDEO, CHI 2004

# Prototypes

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- Prototyping serves two main purpose
  - ① For gathering **requirements**
  - ② For **communication**
  - ③ For initial **evaluation**
- Types of prototypes in order of complexity
  - ① **Verbal** - simple textual description of choices and results (useful for beginnings but often adds confusion because of its ambiguity)
  - ② **Paper** - has two types - low fidelity and high fidelity
  - ③ **Interactive** - adds interaction to high fidelity prototypes
  - ④ **Working** - actual codebase; easy to transition to final product

# Low-Fidelity Paper Prototypes

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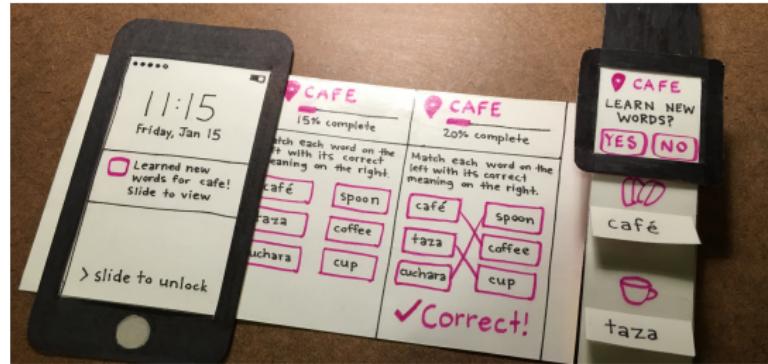
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- Simulate screen and dialogue elements
- Hand-drawn, postits, cardboard etc.
- Mantra: "Maximum Feedback for Minimum Effort" or "Fail Early!"
- **Example Software:** Balsamiq Mockups
- Commonly used in requirements gathering in the **general concept**

# High-Fidelity Paper Prototypes

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- Elaborate screen designs
- **Software:** Photoshop; Illustrator; Corel Draw; GIMP
- Commonly used in requirements gathering regarding **aesthetical and layout elements**
- **Drawbacks:** more time-consuming than low-fidelity; misleading colors and fonts; cannot depict the interactivity

# Interactive Sketches

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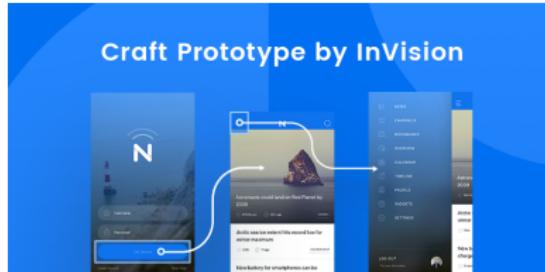
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- Add interactive components to high-fi paper prototypes
- **Software:** Invision, FluidUI, etc.
- Some software such as Framer, Origami Studio or Wave Form allows programmable prototypes.
- Agoda, Google, Facebook, and Uber are using Framer (last interviewed: 2017)
- Commonly used in requirements gathering regarding **interaction elements**
- **Drawbacks:** Although interactivity is promised, they can throw off clients when clients truly believe it is working.

# Working Prototypes

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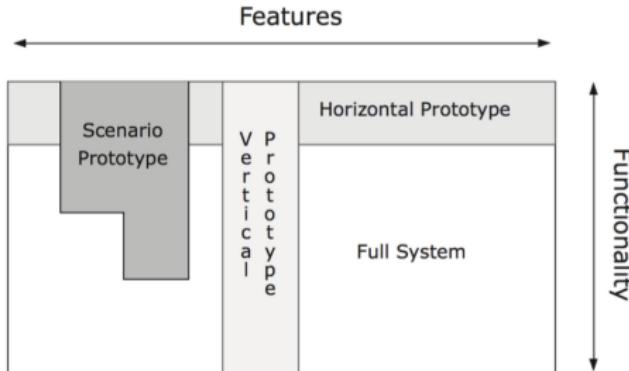
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- Basic logic: ignore special cases
- Actual codebase and hardware
- Fake data: some mockup csv file
- Vertical vs. Horizontal vs. Scenario
- Commonly used during iterations to test **particular component** of the design
- **Drawbacks:** Risky, time-consuming but easy transition to final product

# Activities

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## Classwork

Have you wonder why some people simply miss their seats at airplane? One possible reason is the confusion between gates and seat which has the same format. Attempt to redesign. (Note that you are not allowed to change how the format of the ticket or the process of how airport works)



# Readings For Next Week

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- Jeff, **Designing with the Mind in Mind: Simple Guide to Understanding User Interface Design Guidelines**, 2nd ed. (2014).
- Mackenzie, Chapter 2, **Human Factors**, Human Computer Interaction: An Empirical Research Perspective, 1st ed. (2013)

# Appendix: Shneiderman's Eight Golden Rules of Interface Design

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- ① Strives for **consistency**: consistent aesthetics, terminologies, layout ease learning process
- ② Seek **universal usability**: Recognize the needs for diverse users - novice vs. experts, age ranges, disabilities, culture, expertise. For example, add explanations for novices, but also add shortcuts for experts. Allowing multiple ways of doing same thing.
- ③ Offer **informative feedback**: For frequent actions, response can be modest. For infrequent and major actions, response should be substantial. Avoid non-informative feedback.
- ④ Design **dialogs** to yield closure: Sequence of actions organizes into groups with a beginning, middle, and end, e.g., checkout process. By leading users, it avoids confusion and errors.

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- ① Prevent **errors**: design so that users cannot make **serious** errors by graying out items, form validations, provide informative feedback
- ② Permit easy **reversal of actions**: actions should be reversible to relieve anxiety and encourages exploration
- ③ Keep users in **control**: Experienced users want to be in control, get annoyed by tedious data-entry, get annoyed by new convention. Enable control through customization and shortcuts
- ④ Reduce **short-term memory** load: Human have limited short-term memory (rule of thumb is that people can remember seven plus or minus two chunks; for Steve Job, people can best remember three points); lengthy forms, action recall, for example, should be avoided

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# Questions