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❖ <https://www.youtube.com/watch?v=koOiHvn3UDc>

# Outline

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- ❖ A bunch of stuff



# Definition of Human Factors

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- ❖ The design of equipment that **people** use intentionally taking into account how **human** beings operate.
- ❖ The field of human factors engineering uses scientific knowledge about **human behavior** in specifying the design and use of a **human-machine system**.
- ❖ Human factors discovers and applies information **about human behaviors**, abilities, limitations, and other characteristics to design tools, machines, **systems**, tasks, and environments for productive, safe, comfortable, and effective human use.

# Usability

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Usability is defined as five aspects of a product or **system** that affect the performance, safety, and experience of users:

- ❖ Learnability - users can start to do tasks quickly
- ❖ Efficiency - high productivity once learned
- ❖ Memorability - easy to “come back to”
- ❖ Errors - low rate, easy recovery, none catastrophic
- ❖ Satisfaction - users “like it”

# Who cares?

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- ❖ Increased Productivity
- ❖ Reduced Reliance on Help Desks
- ❖ Reduced Costs on Formal Training
- ❖ Decreased Drop-off Rate
- ❖ Reduced Learning Curve
- ❖ Prevention of catastrophes, fatal accidents

# Lecture Based Mainly On



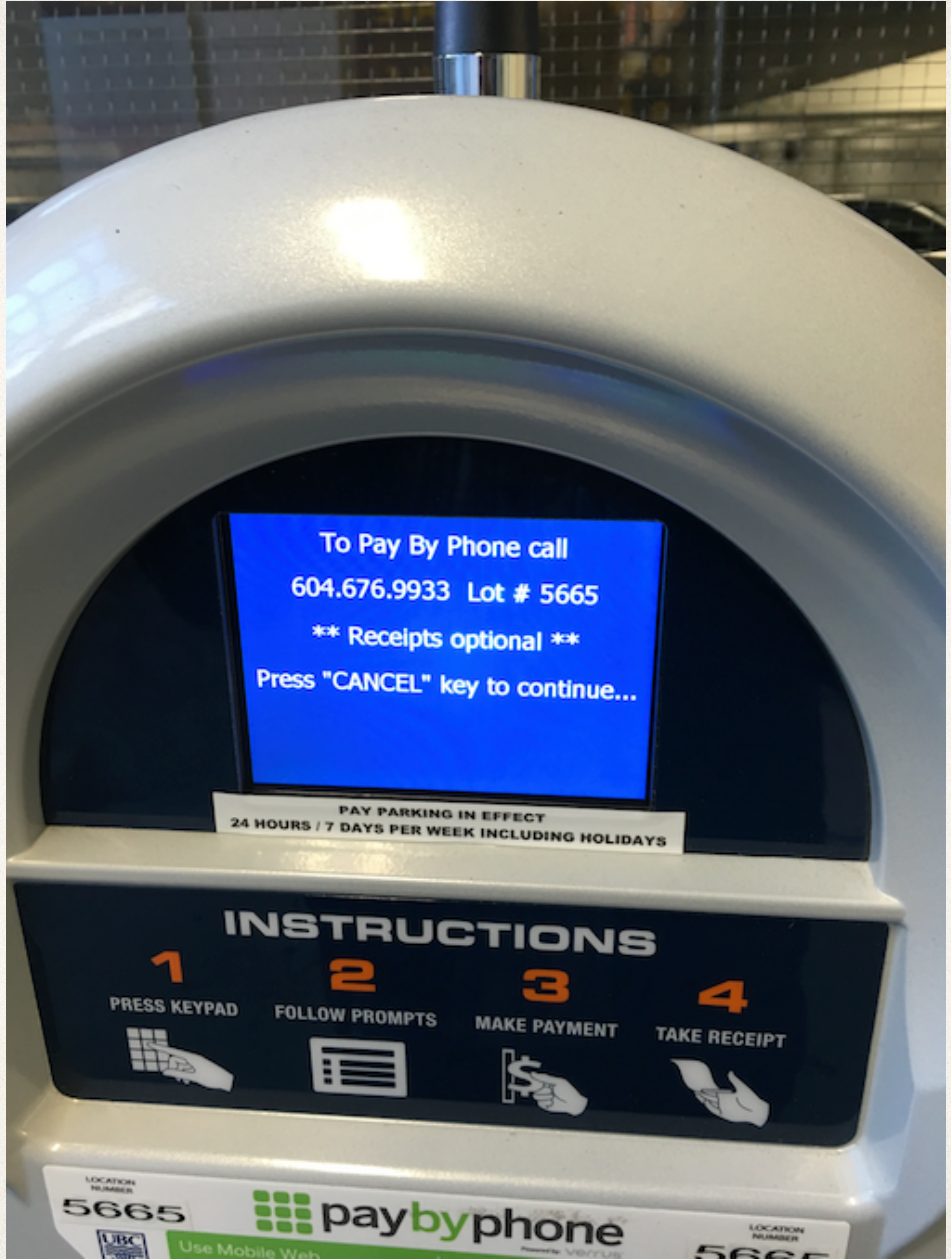
- \* Norman, D. A. (2013). The design of everyday things. New York: Perseus Books Group.
- \* *Note: This book is a revised and expanded edition. It is similar but not the same as the previous textbooks. It is available through SFU's library as an e-book.*  
<http://proquest.safaribooksonline.com.proxy.lib.sfu.ca/9780465072996>

# Group Exercise

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- ❖ 1) With your group, come up with several examples of bad design
- ❖ 2) Write each idea on its own sticky note
- ❖ 3) Place the sticky notes on the white board
- ❖ 4) Cluster into themes










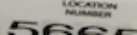
To Pay By Phone call  
604.676.9933 Lot # 5665  
\*\* Receipts optional \*\*  
Press "CANCEL" key to continue...

PAY PARKING IN EFFECT  
24 HOURS / 7 DAYS PER WEEK INCLUDING HOLIDAYS

### INSTRUCTIONS

- 1**  
PRESS KEYPAD  

- 2**  
FOLLOW PROMPTS  

- 3**  
MAKE PAYMENT  

- 4**  
TAKE RECEIPT  


LOCATION NUMBER 5665  paybyphone  Use Mobile Web 





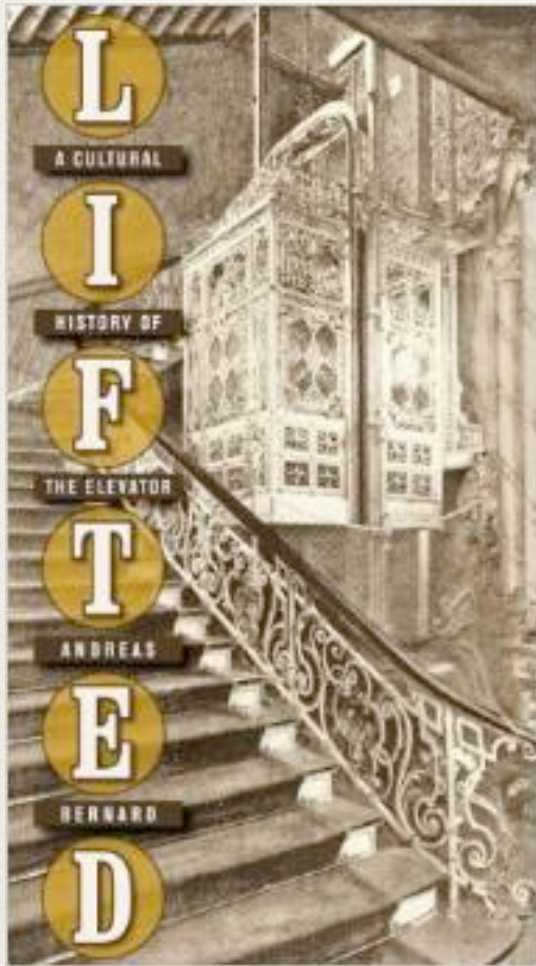
# Check out

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- ❖ <http://www.baddesigns.com/>
- ❖ <http://goodexperience.com/tib/>

# Lifted

Bernard, A. (2014). *Lifted: A cultural history of the elevator*. New York: New York University Press.



- ❖ “Thus the elevator created not only new visibilities but also new invisibilities.” p 57
- ❖ “The discontinuous points at which the elevator stops, the restriction of accessible space to the ‘first floor’, ‘second floor’, and so forth, transformed the tiers of the building into discrete units; whatever lies between those units in some sense no longer exists . In the vocabulary of signaling technology, the transition from stairwell to elevator could be described as a transition from the analog to the digital principle.” pp 57 - 58

Copyrighted Material

"BY TURNS ENCHANTING AND DISTURBING, VICENTE'S MARVELLOUS BOOK IS FULL OF ADVICE ON HOW TO MAKE THIS A MORE ELEGANT, AS WELL AS A SAFER, WORLD."

Maclean's

# KIM VICENTE THE HUMAN FACTOR

Revolutionizing the Way We Live with Technology

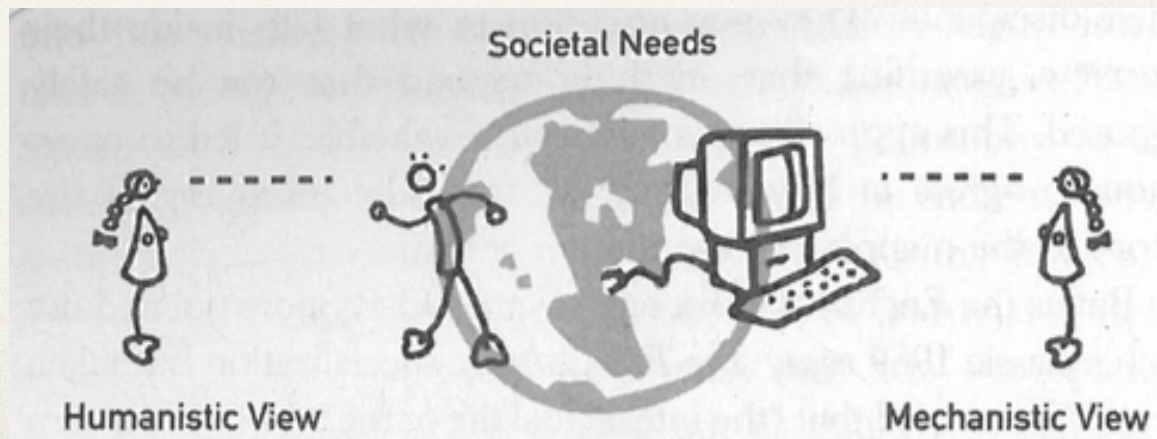
"We don't want to figure out what all those buttons do or why they are set up the way they are. We just want to get on with our lives and do our jobs well. When we make use of technology, we want to focus on achieving our goals, not on deciphering the technology. The design should be in the background of our attention."



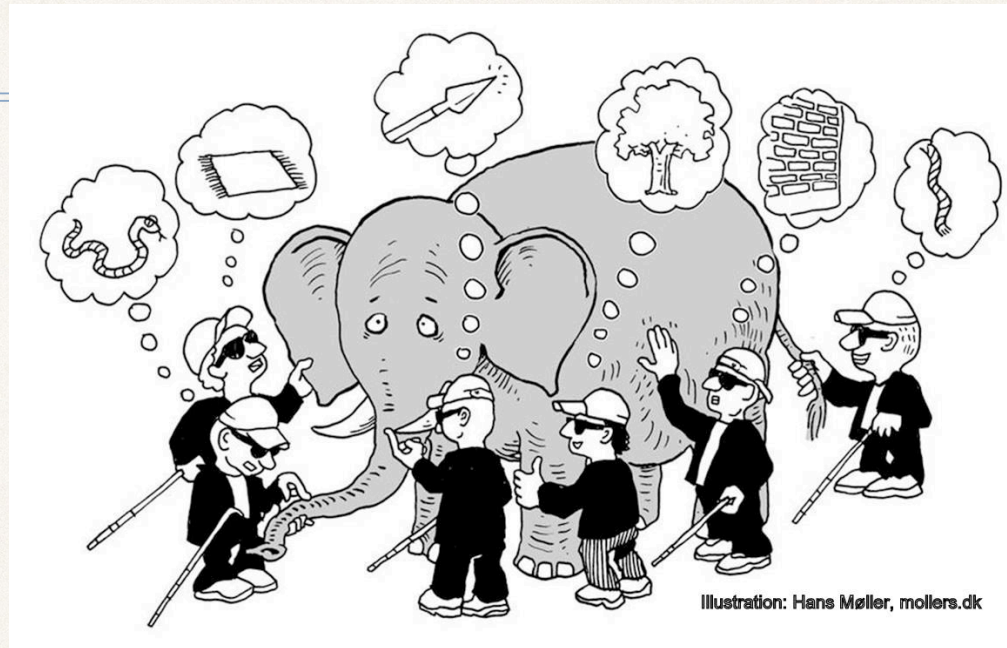
Image from: <http://floriswolswijk.com/personal-human-factor-book-review/>

Vincente, K. (2014). *The Human Factor*. Vintage Canada, Random House of Canada.

It bears emphasizing: *our traditional ways of thinking have ignored – and virtually made invisible – the relationship between people and technology*" p. 33



# Parable of Blind Men & Elephant



<http://scn.sap.com/community/business-trends/blog/2014/10/03/the-cloud-the-elephant-and-the-blind-men>

“What is interesting about the story is not so much the fate of the blind men but the magnificent role that the teller had given himself – namely, the ability to see the whole elephant and consequently observe the ridiculous behavior of the blind systems describer.” p. 28

Churchman, C. W. (1968). *The systems approach*. New York: Delacorte Press.

# Purposefulness of Systems

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System Type	Parts	Whole
Deterministic	Not Purposeful	Not Purposeful
Animated	Not Purposeful	Purposeful
Social	Purposeful	Purposeful

Ackoff, R. L., & Gharajedaghi, J. (1996). Reflections on systems and their models. *Systems Research*, 13(1), 13-23. doi:10.1002/(SICI)1099-1735(199603)13:1<13::AID-SRES66>3.0.CO;2-O

“The general idea is that an object behaves purposefully if it continues to pursue the same goal by changing its behavior as conditions change.” p. 14

Ackoff, R. L., & Emery, F. (1972). *On purposeful systems*. Chicago: Aldine-Atherton.



# Systems Thinking and Affordances

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- ❖ What does your product/ project let someone do?
- ❖ “The presence of an affordance is jointly determined by the qualities of the object and the abilities of the agent that is interacting...We are used to thinking that properties are associated with objects. But affordance is not a property. An affordance is a relationship. Whether an affordance exists depends upon the properties of both the object and the agent.” – p. 11 textbook

# Affordance and Signifiers



Norman Doors, from <https://avasqu20.files.wordpress.com/2014/05/pushpulldoors.jpg>





<https://www.niklsonecall.com/wp-content/cache/all/anti-skateboarding-guards//index.html>



<https://www.bcsiteservice.com/product/raised-diamondback-handrail-guards-kit/>



# People as Explanatory Creatures

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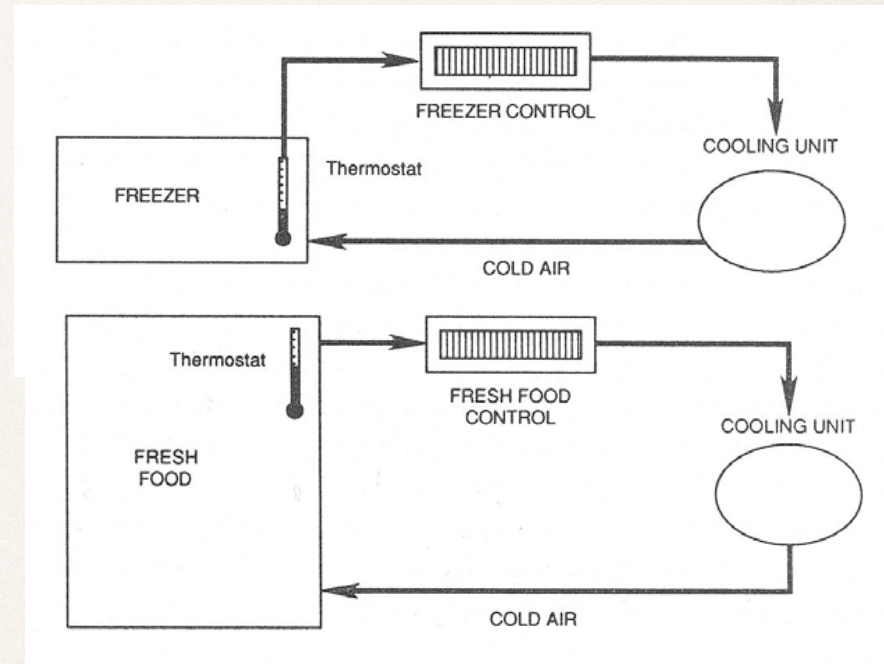
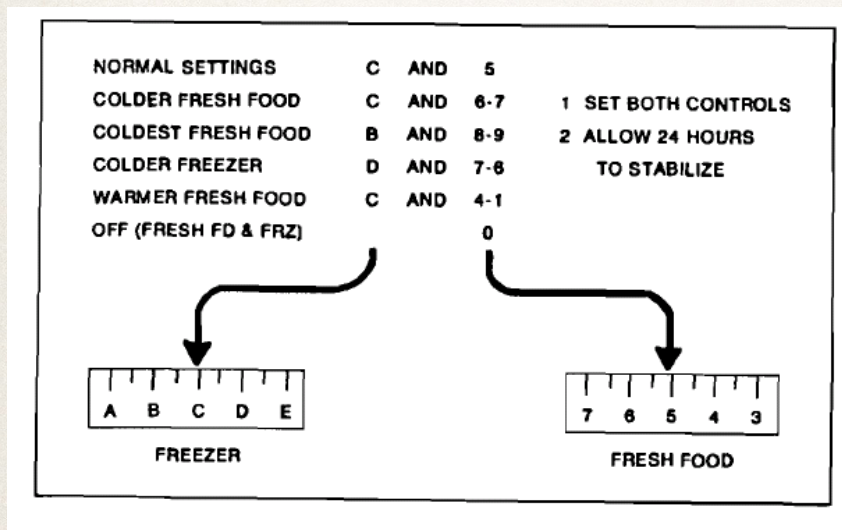
Our conceptual models are based on fragmentary/poor information that might be *accurate* or *inaccurate*.

Thus many of our conceptual models are, to a greater or lesser extent, flawed.

**In the absence of external information, people are free to let their imaginations run free as long as the mental models they develop account for the facts as they perceive them.**

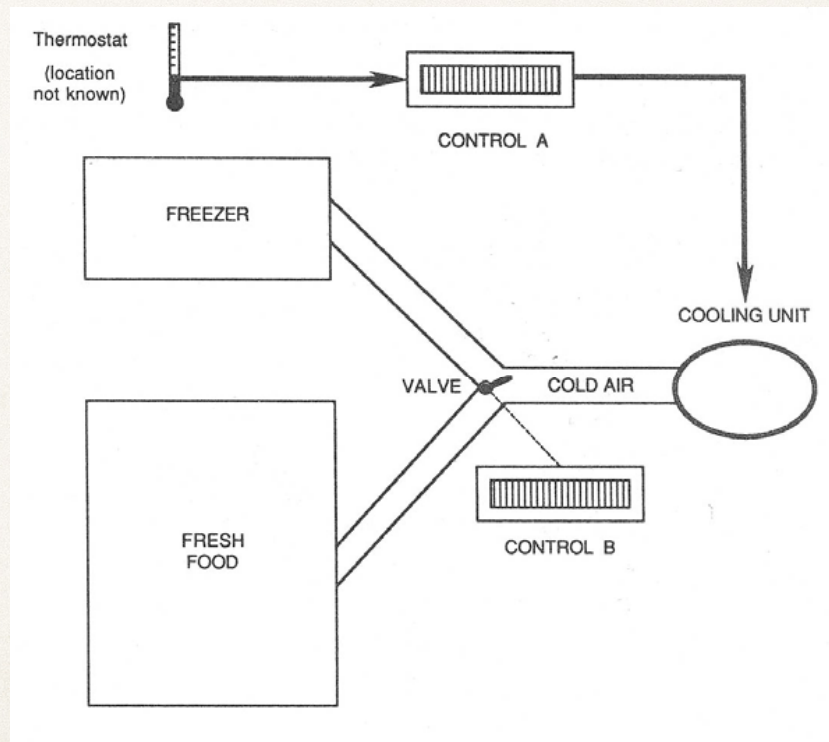


# Mental Models



# Mental Models

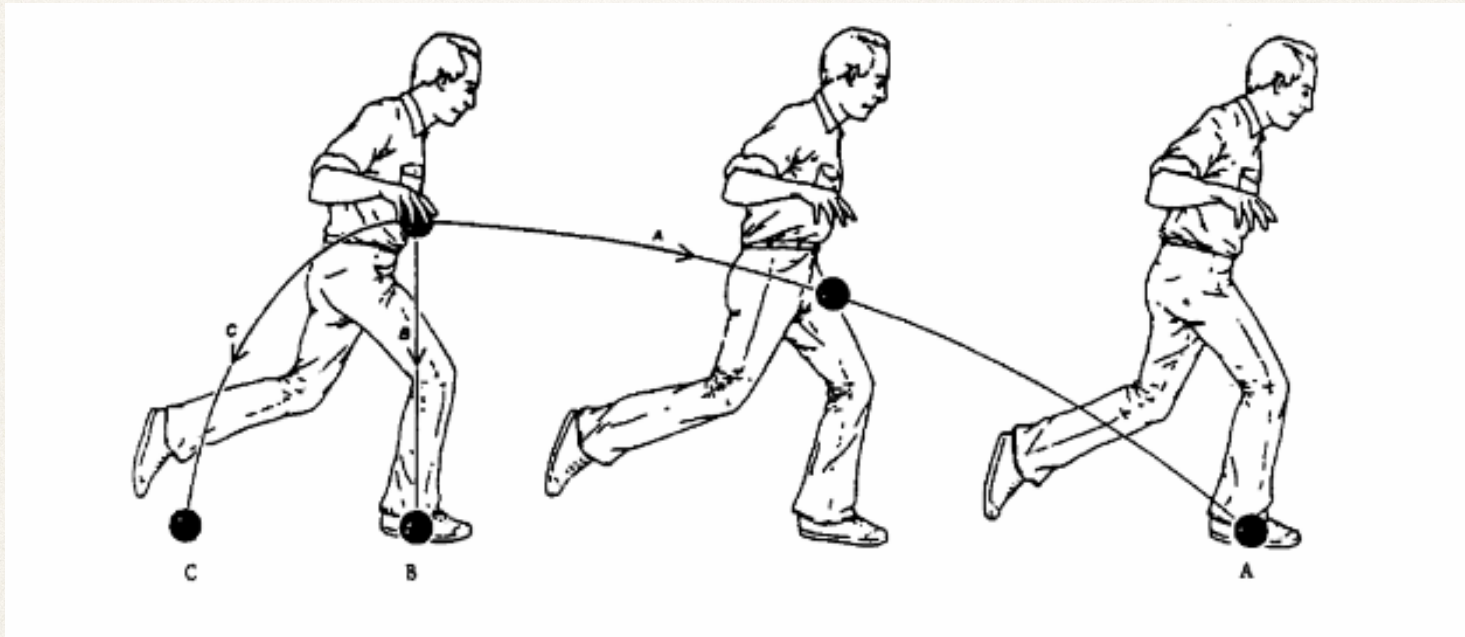
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# Naïve Physics

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Imagine someone running across a field carrying a ball. As you watch, the runner drops the ball. Which path A, B, or C in does the ball take as it falls to the ground?





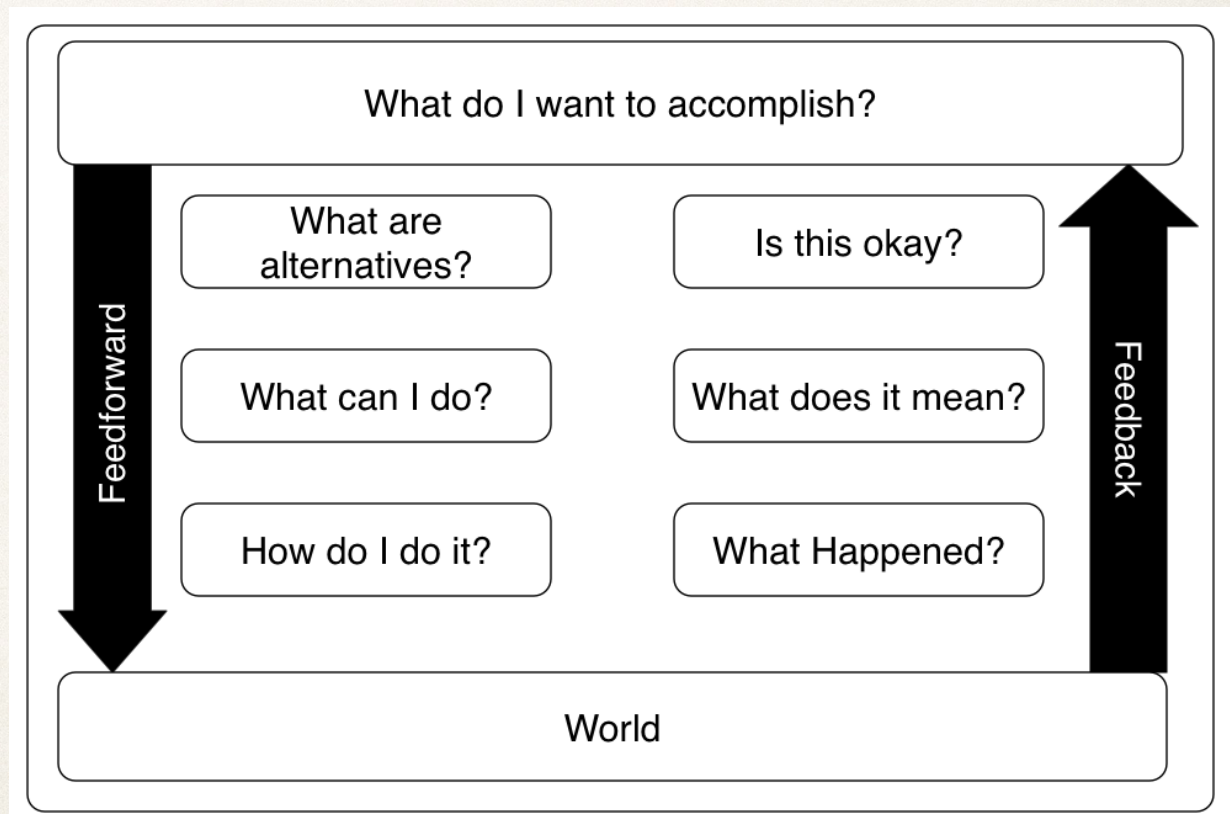
# The Two Gulfs

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- ❖ Gulf of Evaluation
  - ❖ How do I work this? What can I do?
- ❖ The Gulf of Execution
  - ❖ What happened? Is this what I wanted?

# 7 Stages in Design

1. Discoverability
2. Feedback
3. Conceptual Model
4. Affordances
5. Signifiers
6. Mappings
7. Constraints



# Which is the Canadian One Cent Coin?

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# Systems Thinking: Emergence

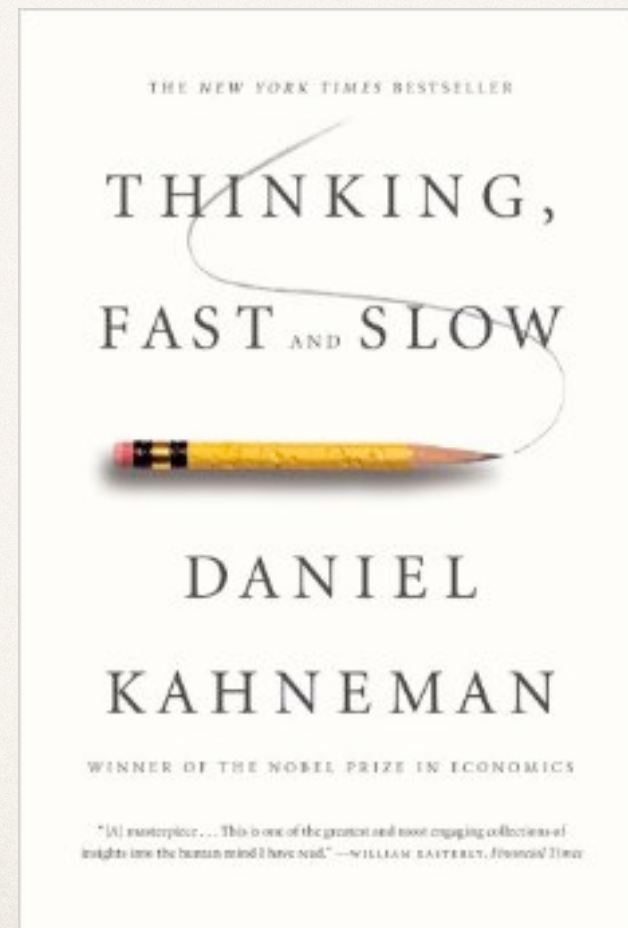
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“In an earlier book, *Things That Make Us Smart*, I argued that it is this combination of technology and people that creates super-powerful beings. Technology does not make us smarter. People do not make technology smart. It is the combination of the two, the person plus the artifact, that is smart. Together, with our tools, we are a powerful combination. On the other hand, if we are suddenly without these external devices, then we don't do very well. In many ways, we do become less smart.” Textbook p. 112

# Thinking, Fast and Slow

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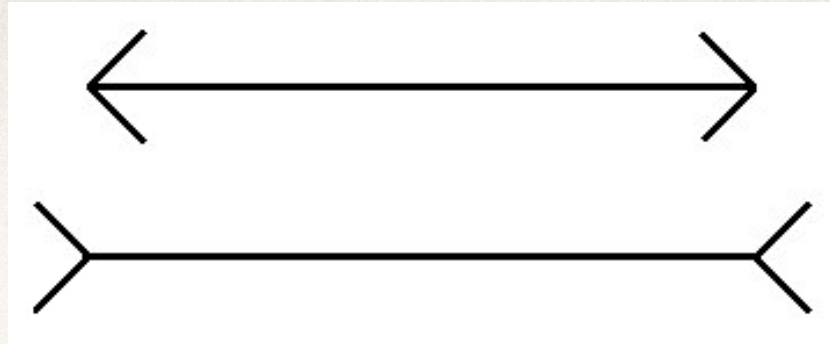
- ❖ Kahneman, D. (2013). Thinking, fast and slow. New York: Farrar, Straus and Giroux.



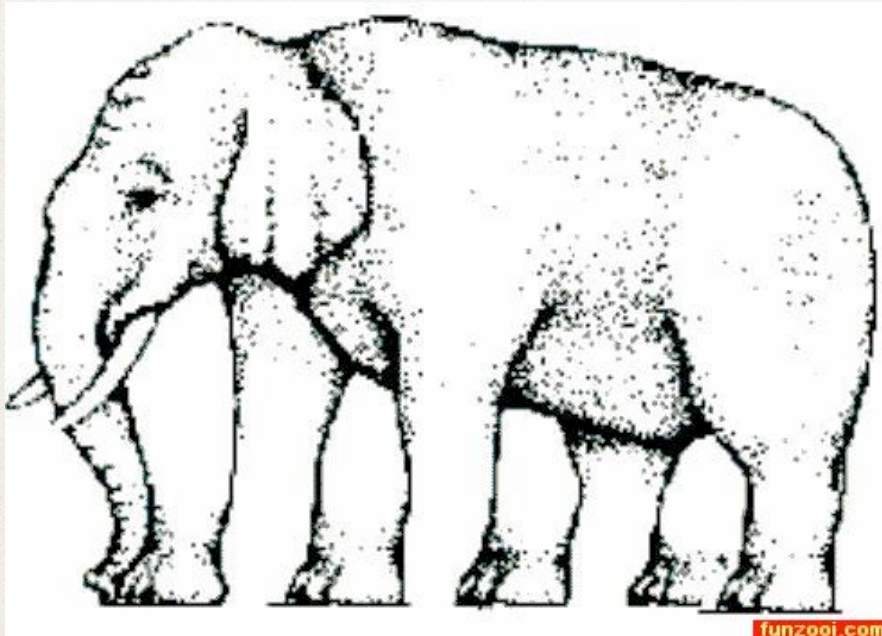
# Two Systems

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- ❖ “System 1 [automatic system] operates automatically and quickly, with little or no effort and no sense of voluntary control.” p 20
- ❖ “System 2 [effortful system] allocates attention to the effortful mental activities that demand it, including complex computations. The operations of System 2 are often associated with the subjective experience of agency, choice, and concentration.” p. 21
- ❖ This model of two systems is a useful approximate model for how people think.

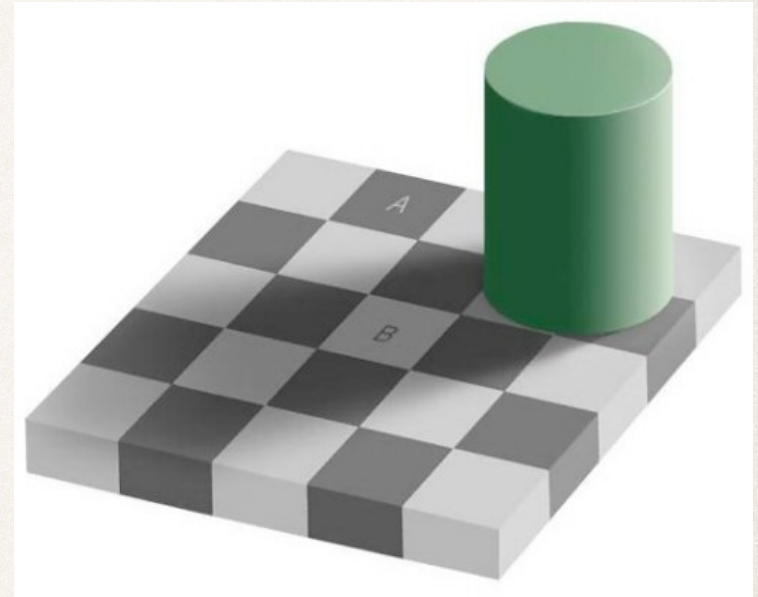


<http://www.psychologyconcepts.com/category/visual-illusions/>



funzooi.com

<http://boomeryearbook.com/blog/2009/03/15/psychological-article-types-of-online-optical-illusions/>



<http://boomeryearbook.com/blog/2009/03/15/psychological-article-types-of-online-optical-illusions/>

# Add 1 to each digit of the number

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5294 becomes 6305

5478

7823

2398



<http://www.alibaba.com/counter-digit-wheel-promotion.html>



Add 3 to each digit of the number

---

2474

5478

7823

2398

# Lazy System 2

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- ❖ A bat and ball cost \$1.10.
- ❖ The bat costs one dollar more than the ball.
- ❖ How much does the ball cost?

10 cents? Ball = \$.10 => Bat = \$1.10, so the total is \$1.20

Correct answer is 5 cents for the ball

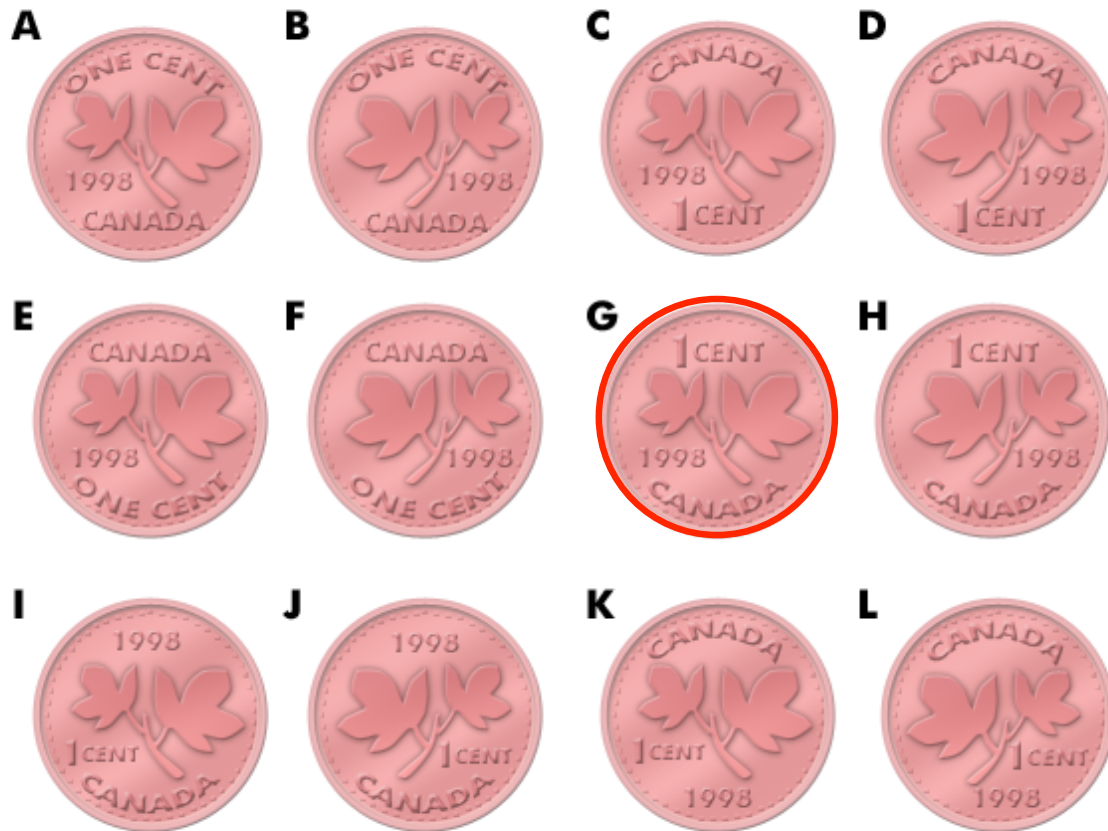
# What you see is all there is (WYSIATI)

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- ❖ “System 1 is radically insensitive to both the quality and the quantity of the information that gives rise to impressions and intuitions.” p. 86

# Which is the Canadian One Cent Coin?

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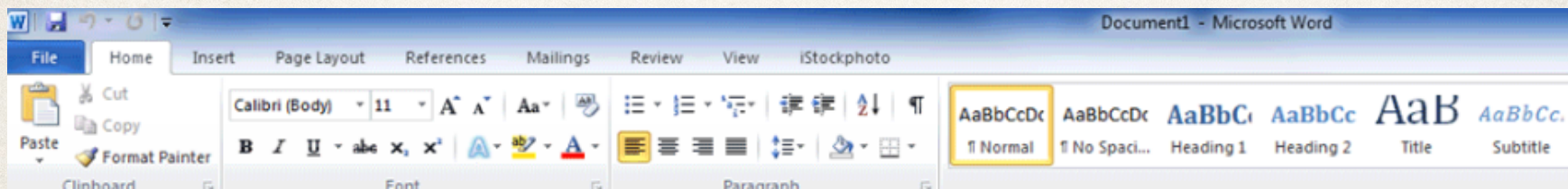
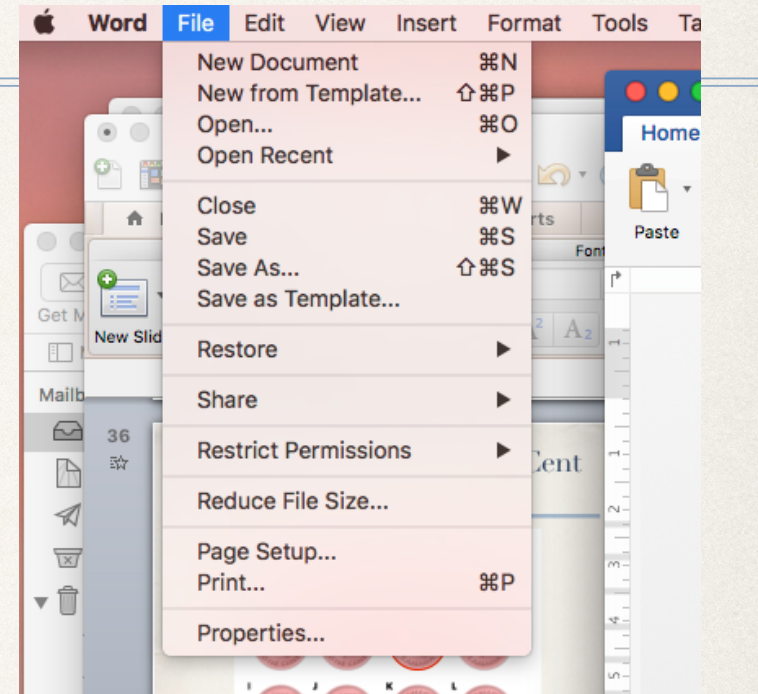


<b>Property</b>	<b>Knowledge in the World</b>	<b>Knowledge in the Head</b>
<b>Retrievability</b>	Retrievable whenever visible or audible.	Not readily retrievable. Requires memory search or reminding.
<b>Learning</b>	Learning not required. Interpretation substitutes for learning.	Requires learning. It can be facilitated if there is a structure to the material.
<b>Efficiency of use</b>	It is slowed by the need to find and interpret the external information.	Can be very efficient.
<b>Ease of use</b>	High	Low
<b>Aesthetics</b>	Can be unaesthetic and inelegant especially if there is lots of information.	Nothing is visible.

Table from first edition of the book, p. 79. Interesting to note the changes

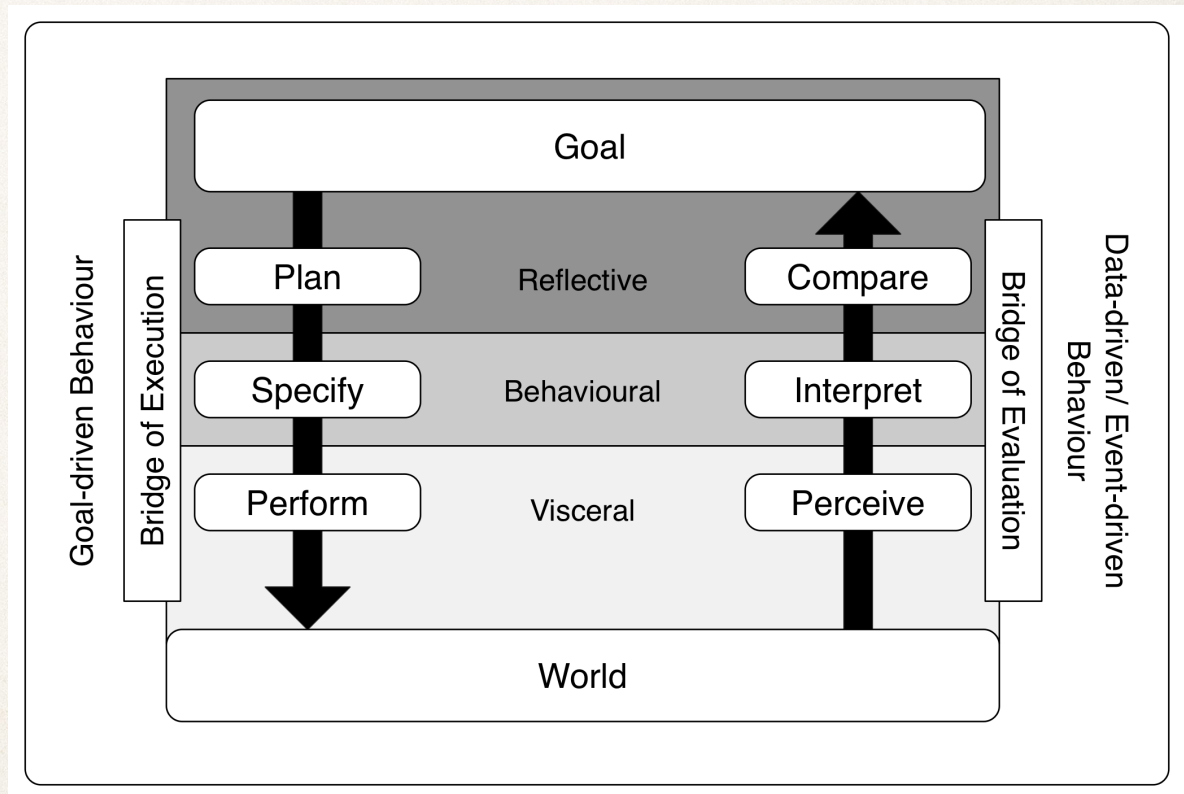
# Memory: STM & LTM

```
Documents -- -bash -- 124x33
~/documents -- -bash
Last login: Mon Jan 30 10:18:48 on console
d207-023-176-219:~ admin$ ls
Creative Cloud Files  Documents          Library            Pictures            socnetv-data
CytoscapeConfiguration  Downloads          Movies            Public
Desktop              Dropbox           Music              Wine Files
d207-023-176-219:~ admin$ cd documents
d207-023-176-219:documents admin$ ls
SFU_LogoSuite_2014          Photos
02_Nov_11_01_Grades-ENSC100W_D100___ENSC105W_D100.csv  Possible_Topics.pdf
Adobe                      Red Dwarf
Adobe Flash Builder 4.7    Reference Check for Irene Burrell_RefMikeSjoerdsma.docx
Articulate                 ResumeStuff
AssemblyDemo               SFUFA
Bio_Michael_Sjoerdsma.docx  SOTW_25concert
Bio_Michael_Sjoerdsma_Sept23_2016.docx  Sadies_Concert
CV                           School
Courses                     ScivenerLicense.pdf
DesignLibrary_Photoshop.log  Scrivener Scratch Pad Notes
Digital Editions            SevenStages_copy.graffle
Documents                   Signature.png
Downloads                   SignedForms.pdf
EDUC950_ResearchProposal_MikeSjoerdsma_March26.pdf  SystemsTheory.scap
ENSC100_Fall2016_6.3.xlsm    TLC
ENSC220_Summer2016_1.4.xlsm  TestVersion_FCMapper_bugfix_27.1.2016.xls
ENSC305                     ThesisStructure_copy.graffle
ENSC406_Spring2016_March2_..xlsx  Training
ENSC440.scap                Tutorial.scriv
Firefox_39.0.app            WebCourse
Grades_Dec21b_upload.xlsx   WebEx
H-Drive                     WritingMindMap.scap
Hapkido                    academic-referee-report-Chi Ki Wong.pdf
IABC_Vincent_no_music.mov   attempt.net
MATLAB                      ensc820
```



# Three Level of Processing

- ❖ Visceral: sensitization or desensitization
- ❖ Behavioural: learned skills, pattern matching
- ❖ Reflective: conscious cognition; deep understanding



# Mappings

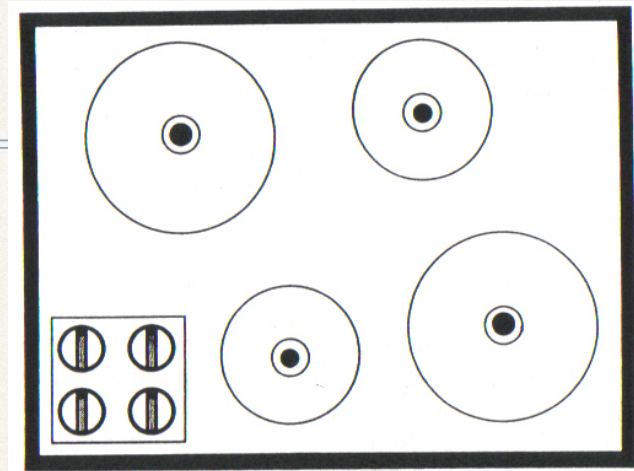
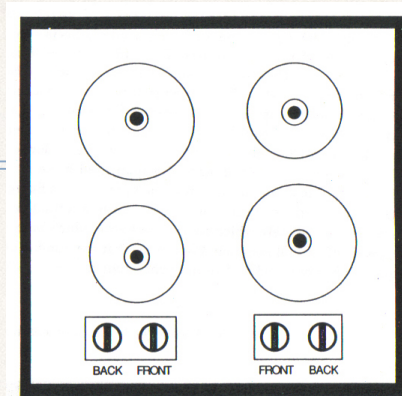
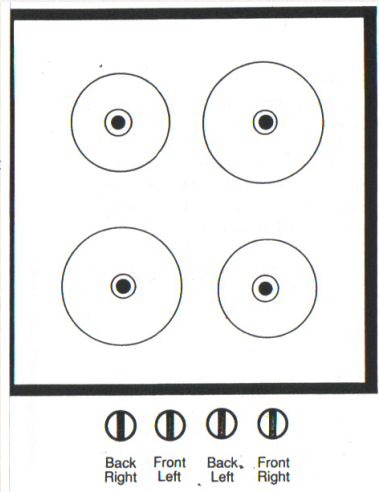
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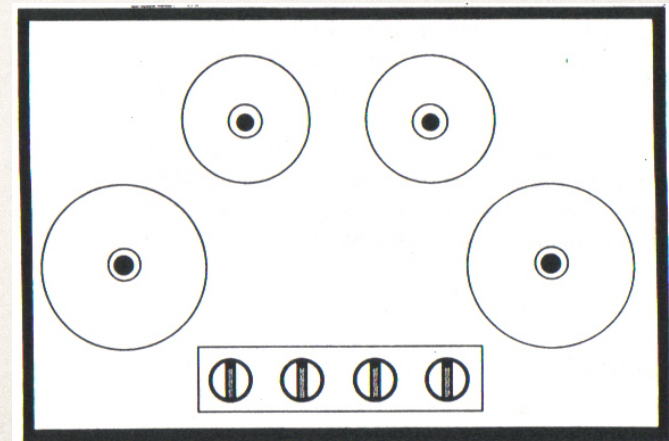
Which knob turns the front left burner?



# Mappings



- ❖ Best mapping: controls are mounted on the item to be controlled
- ❖ Second-best mapping: controls are as close as possible to the object to be controlled
- ❖ Third-best mapping: controls are arranged in the same spatial configuration as the objects to be controlled



# Constraints

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Imagine what the Lego pieces would look like properly put together



- ❖ Physical
- ❖ Cultural
- ❖ Semantic
- ❖ Logical



# Constraints

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- ❖ Physical: based on physical limitations; no training needed; watch out for brute force.
- ❖ Cultural: cultural norms learned that represented in mind as schema
- ❖ Semantic: meaning of the situation; what are the possible actions
- ❖ Logical: relates to mapping

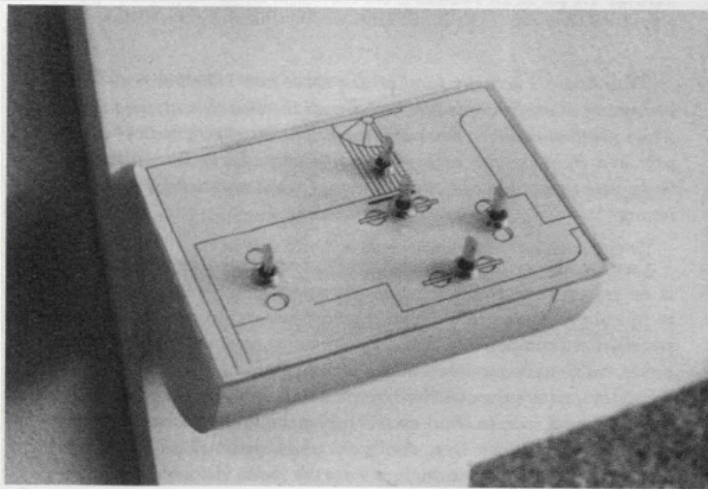
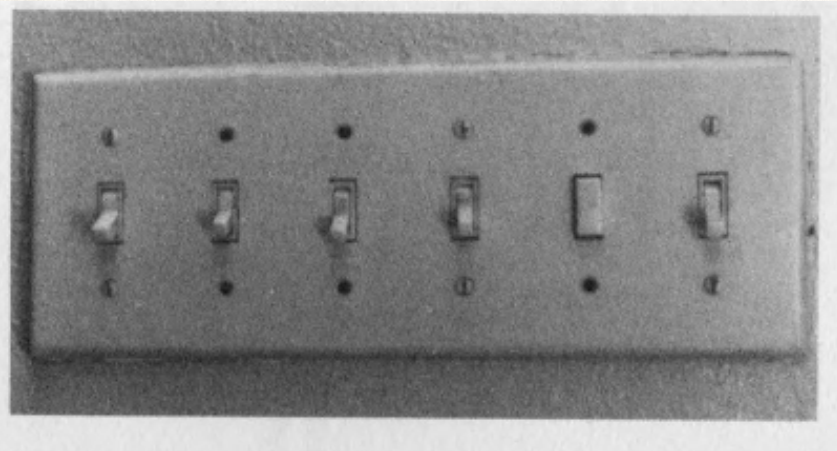
# Legacy Problem

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- ❖ Old designs can be codified into standards, and people can become comfortable with what they already know. So a better design may not be accepted even if it is objectively better.
- ❖ **!Consider legacy problems associated with your project!**

# Light Switches

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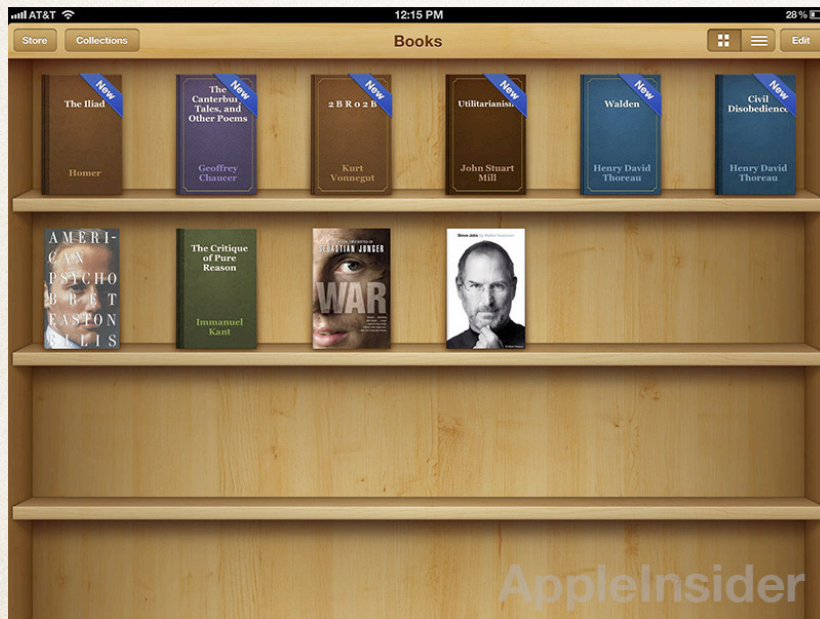


<http://www.yankodesign.com/2011/03/02/know-your-switches/>

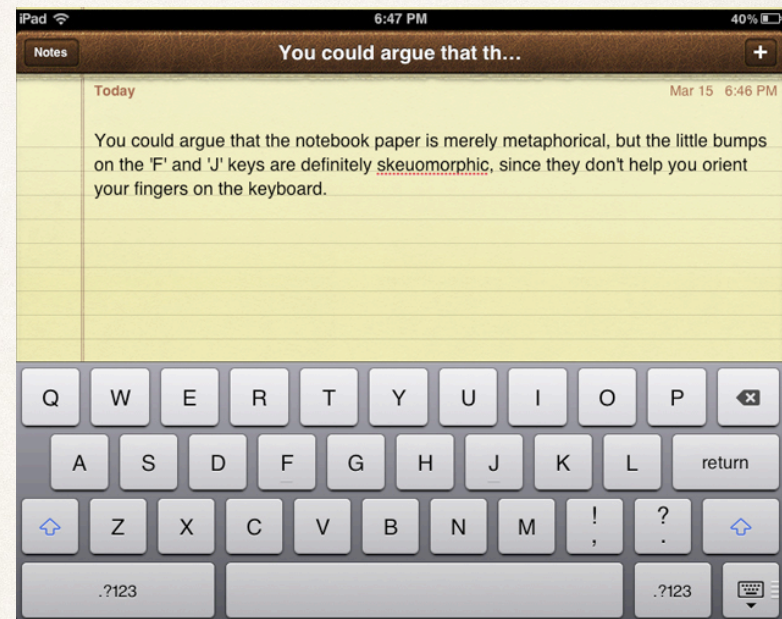
# Faucets



# Skeuomorphic



[http://appleinsider.com/articles/12/09/11/apple\\_designers\\_reportedly\\_divided\\_over\\_use\\_of\\_skeuomorphic\\_uis](http://appleinsider.com/articles/12/09/11/apple_designers_reportedly_divided_over_use_of_skeuomorphic_uis)



<http://www.theblogazine.com/2012/09/apple-software-philosophy-skeuomorphic-design/>

# Start

Justin Harrison

Wendy Teo  
RE: Dinner tonight? Sounds good. How about the new place with the back patio?  
Mail 8

Soccer practice  
Rec Center  
5:30 PM – 8:00 PM  
8  
Monday

Internet Explorer

Store

Photos

Photos

Maps

SkyDrive

Bing

Games

Weather

Smiley face icon

71°  
Seattle  
Mostly sunny 53° / 72°

Hot air balloon festival takes off in the valley this weekend

Music

10:25 Friday October 19

- Search
- Share
- Start
- Devices
- Settings



# Using Sound as Signifiers

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<http://www.pixqiu.com/electric-cars/>

# Auditory Displays

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Auditory Perception: The ability to identify, interpret, and attach meaning to sound

- Mechanical sounds
- Electro-acoustic sound
- Digital audio sound



Note: Digital audio can be used to simulate almost any other type of auditory display!

# What Caused This?



<http://www.zmescience.com/science/domestic-science/traffic-jam-sollution-30092013/>

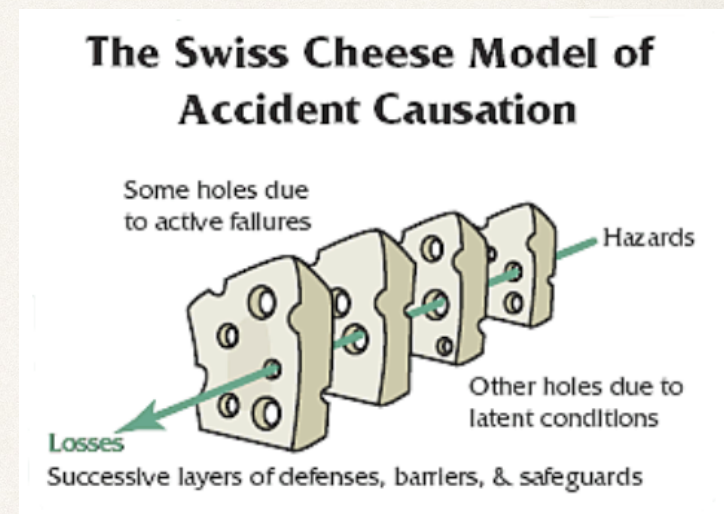
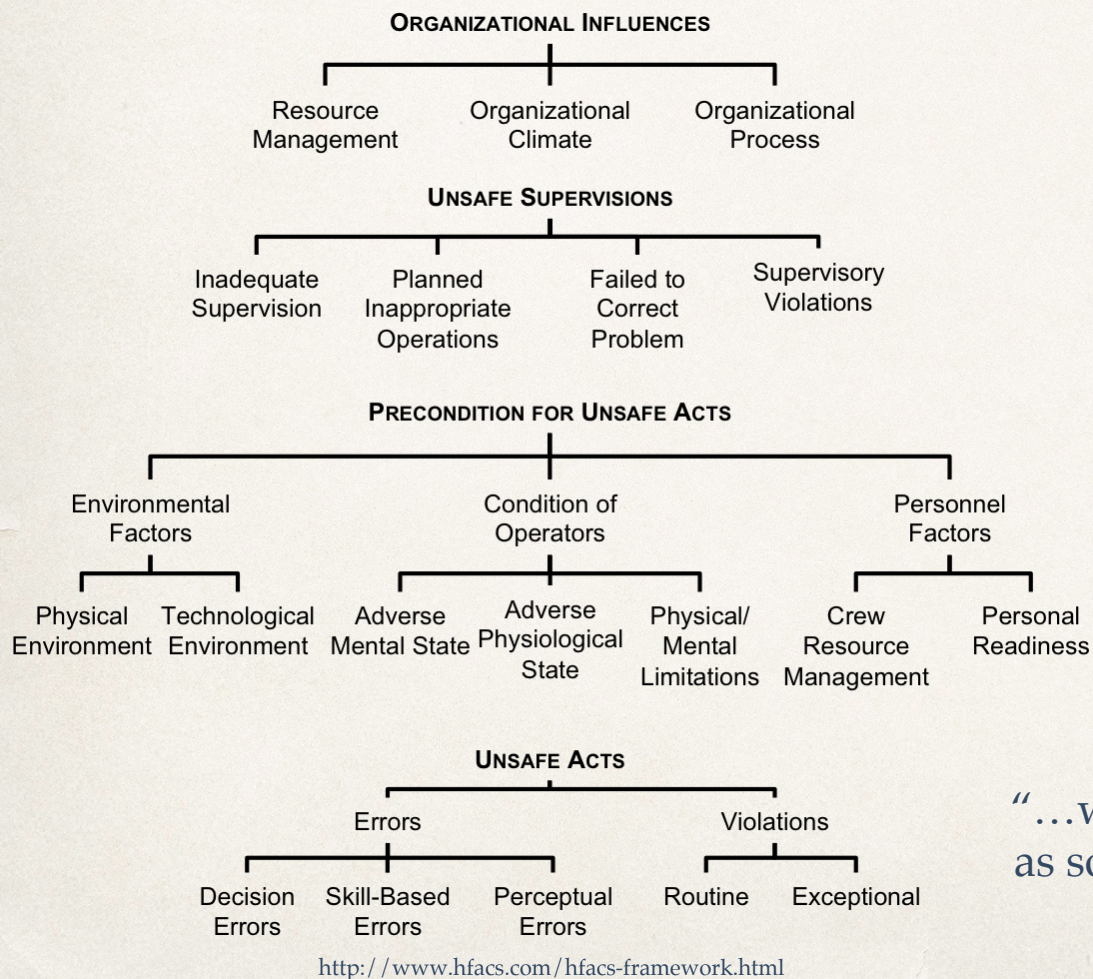
# Root Cause Analysis

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Systems theorists offered a formidable challenge to the accepted views of causality, which emphasized the search for causal linkages, where independent and dependent variables were linked in linear – “the former causes the latter” – sequences. Alternative explanations emphasized the possibility of the dynamic interplay of variables in mutually-causal, deviation-reducing, and/or deviation-amplifying relationships, where no linear sequences are discernible, and indeed, questioning the very premise on which the search for linear sequences is based. – pg ix

Ackoff, R. L., & Emery, F. (1972). *On purposeful systems*. Chicago: Aldine-Atherton.

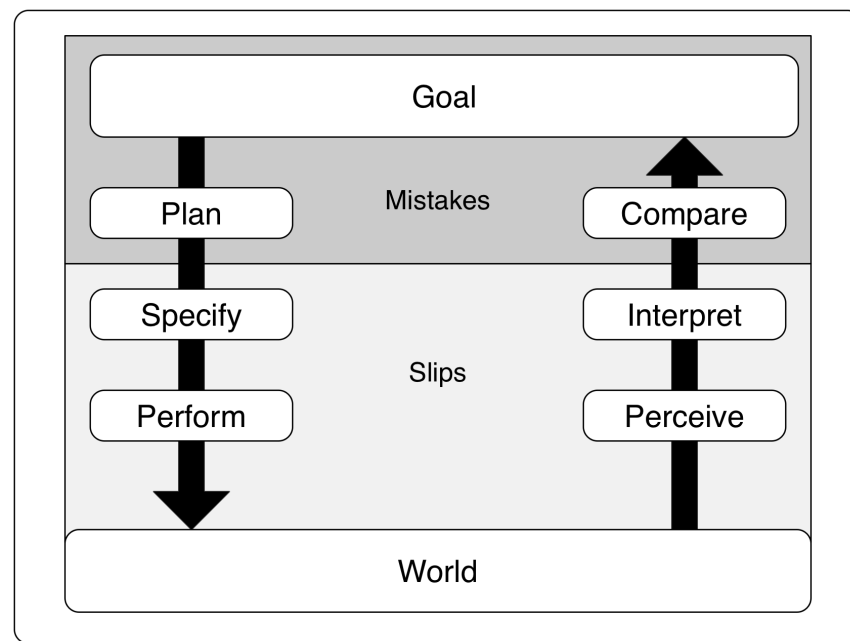
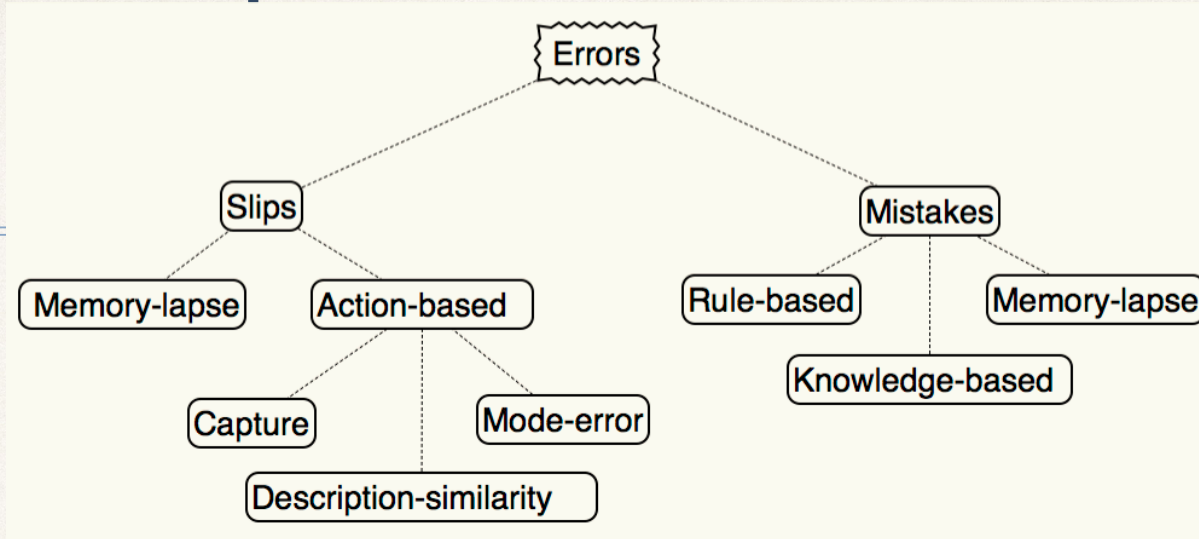
# Swiss Cheese Model of Accidents



[http://www.nine2three.com.au/blog\\_article.asp?articleid=101](http://www.nine2three.com.au/blog_article.asp?articleid=101)

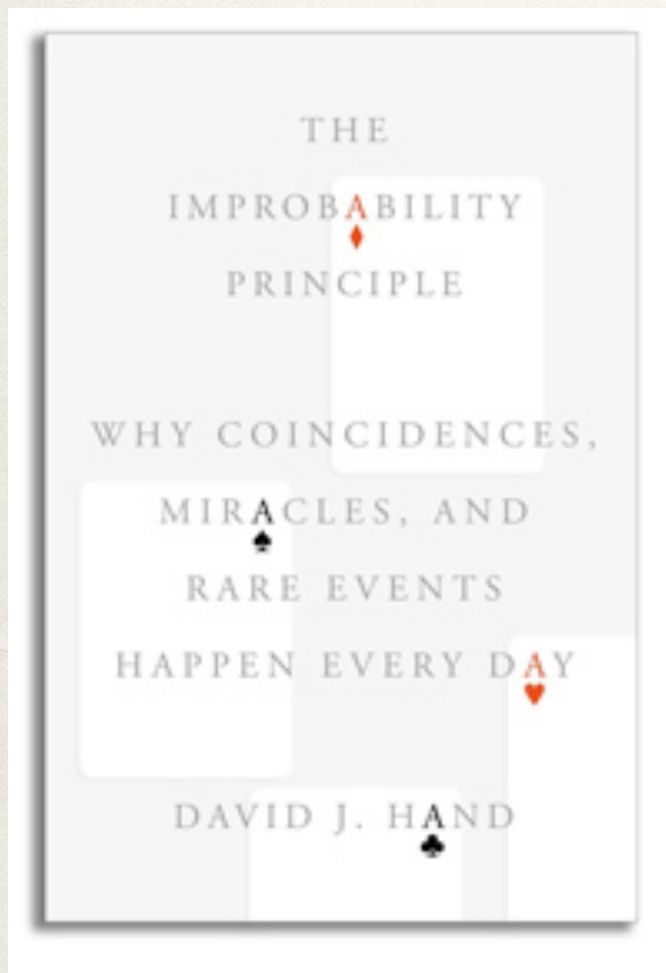
“...why does the root cause analysis stop as soon as human error is found?” p. 164  
Textbook

# Errors: Slips & Mistakes



- Slips are the result of subconscious actions getting waylaid en route.
- Mistakes result from conscious deliberations
- Mistakes may seem reasonable to the person making them
- Mistakes may be difficult to detect
- Social pressure to explain away mistakes

# Improbability Principle



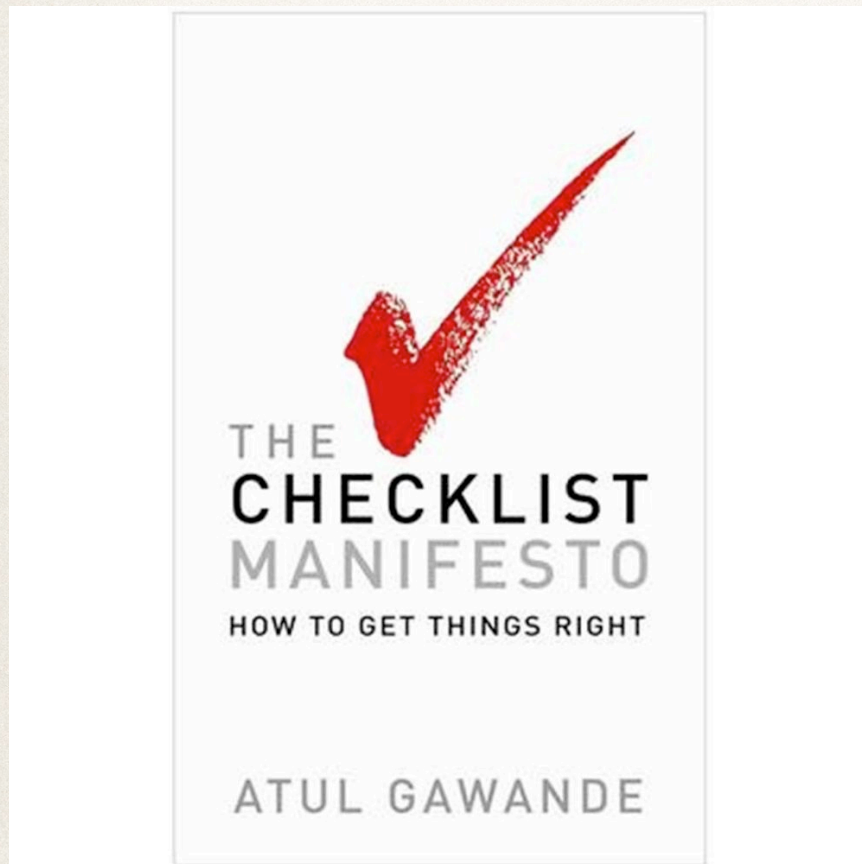
<http://www.fsgworkinprogress.com/2014/12/our-favorite-science-books-of-2014>

- ❖ Relates to Pg 183 textbook RE Hindsight
- ❖ “By looking back at what *actually* happened, instead of looking forward and trying to see what *will* happen, we change our probability of being right from uncertain to certain. This practice has been called *postdiction*, paralleling the word ‘prediction’.” p. 121

THE IMPROBABILITY PRINCIPLE: Why coincidences, miracles, and rare events happen every day (2014). Austin: Kirkus Media LLC.

# Checklist Manifesto

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- ❖ Relates to Textbook page 189
- ❖ Gawande, A. (2010). The checklist manifesto: How to get things right. New York: Metropolitan Books.



# Designer's role in preventing error

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Designers must consider how errors will affect their system and how users will recover from errors.

Designers should

- 1) Understand the causes of errors and design to minimize those causes.
- 2) Make it possible to reverse actions—to undo them—or make it harder to do what cannot be reversed.
- 3) Make it easy to discover the errors that do occur, and make them easy to correct.

# Designer's role in preventing error

---

- 4) Change attitude toward errors: People aren't doing something that's wrong, they are approximations of what is desired.
- 5) Put the required knowledge in the world-rather than rely on the users' memory-without hindering advanced users.
- 6) Use the power of constraints, forcing functions and natural mappings.
- 7) Narrow the gulfs of execution and evaluation.

# Design Philosophy

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Put the required knowledge in the world. Don't require all the knowledge to be in the head.

Allow for more efficient operations after the user has learned the operations and has gotten the knowledge in the head.

Use the power of natural and artificial constraints: physical, logical, semantic, and cultural.

Use forcing functions and natural mappings.


Narrow the gulfs of execution and evaluation. Make things visible, both for execution and evaluation.

Make options (execution) readily available and make the results of each action (evaluation) readily apparent.

Make it possible to determine the system state readily, easily, and accurately, and in a form consistent with the person's goals, intentions, and expectations.

## Conscious and Subconscious Behavior

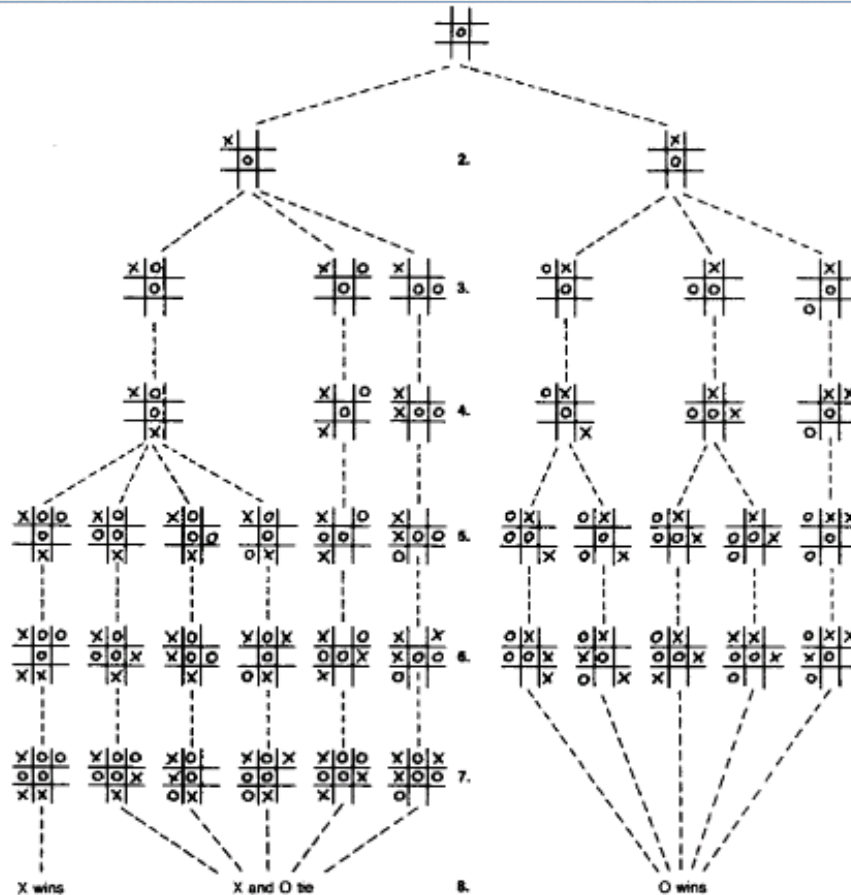
*Start with 9 numbers between 1 to 9. You and your opponent alternate, each time taking a number. Each number can be taken only once. The first person to have any three numbers that total to 15 wins the game.*



# Decision Trees

## The Structure of Tasks

- Decision trees for a task can characterize the task as:
  1. wide or narrow, and
  2. shallow or deep
- More available options make a task wider.
- More subsequent, dependent options make a task deeper.
- Most everyday tasks are narrow and/or shallow.
- Tasks that are wide and/or deep are considered unusual and difficult



# The Structure of Tasks

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- ❖ In general, wide and deep tasks are found in games and leisure activities in which we challenge ourselves to the difficult task.
  - ❖ Shallow structure: the menu of an ice cream shop
  - ❖ A narrow structure: a cookbook recipe
- ❖ A narrow structure arises when there are only a small number of alternatives. If each possibility leads to only one or two further choices, then the resulting tree structure can be said to be narrow and deep.
- ❖ Sequence of steps required to start a car is a narrow and deep structure.

# Social Pressure and Mistakes

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- A subtle issue that seems to play a role in many accidents is social pressure.
- In industrial settings, social pressures can lead to misinterpretation, mistakes and accidents.
- In 1983 Korean Air flight 007 strayed over the Soviet Union and was shot down probably because of an error in programming the inertial navigation system (INS) of the airplane.
- Although each checkpoint was discrepant, apparently the deviations were easily explained away if the crew substituted for each point the checkpoint reading from the previous INS point.
- But there were significant social pressures operating as well.

# Social Pressure and Mistakes

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- The crew of flight 007 probably misprogrammed the INS, but the INS couldn't be reprogrammed in flight: if an error were detected the aircraft would have to go back to the original airport, land and then reset the INS and take off again – clearly an expensive proposition.
- Three Korean Air flights had returned to their airport in the six months preceding the flight 007 incident, and the airline had told its pilots that the next pilot who returned would be punished. Was this a factor in the accident? It's hard to know, but the design of the INS sounds badly deficient. Punishment for following a safety procedure is never wise. The proper approach would be to redesign either the INS's or the procedures for using them.



# Role of Design in Human Error

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- The real fault, almost always, is in the design.
- **Design that makes it easy to make wrong settings, or to misread an instrument, or to misclassify an event is a bad design!**
- **Design of social structures that makes false reporting of danger punishable is a huge problem!**
  - Turn a nuclear power plant off by mistake and you cost the company hundreds of thousands of dollars; you'll probably lose your job.
  - Fail to turn it off when there is a real incident, and you might lose your life.

# Designing for Error

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- As much as possible, designs should be foolproof. Systems should be fault, and error tolerant, so that errors are not catastrophic and can be corrected easily.
- Error is natural in human behavior.
- To assume that people can be selected and trained so as not to commit errors is just foolish.
- Designers need to take errors into account when they design.

# How to Deal with Error

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- ❖ How can designers help prevent errors (mistakes and slips)?

# How to deal with error

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- An **interlock** forces operations to take place in the proper sequence. Example: Microwave open that the interlock disconnects the power the instant the door is opened.
- A **lockin** keeps an operation active preventing someone from prematurely stopping it (until other actions occur). Saving your file before quitting a word processing program.
- A **lockout** prevents an event from occurring or prevents a person from entering a place that is dangerous. Example is the blockage of the basement stairs in the emergency exit stairs. New washing machines not letting their door be opened when water inside.

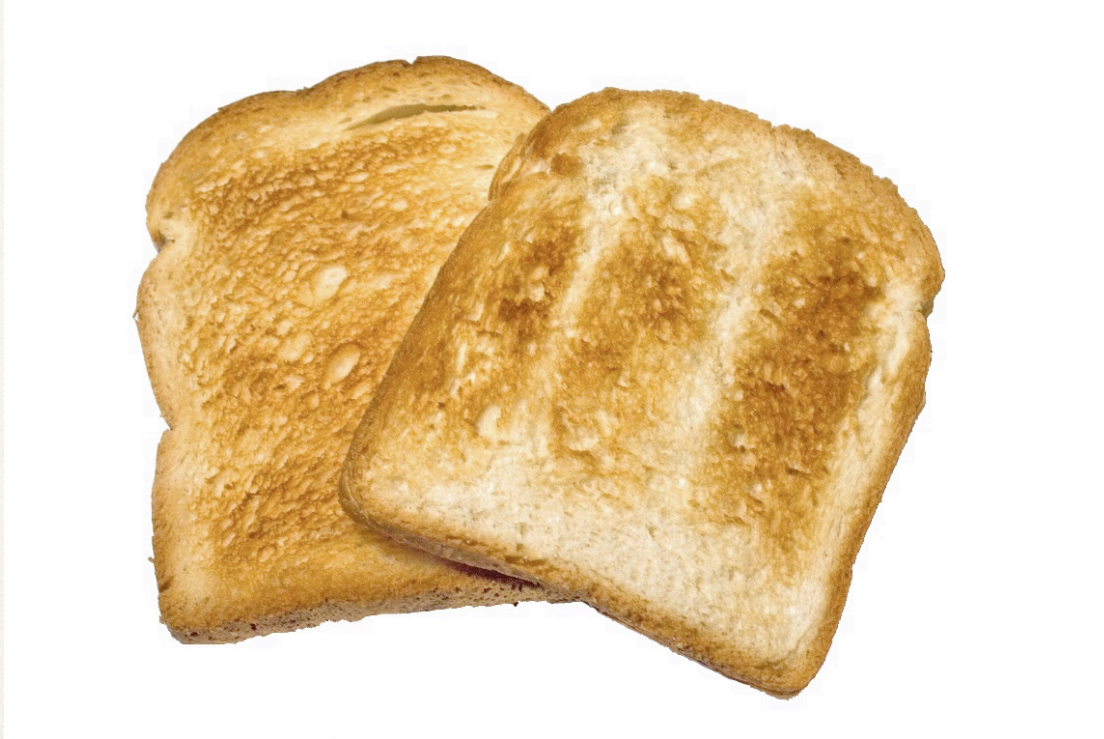
# Forcing Functions

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- Forcing functions are almost always a nuisance in normal usage.
- The clever designer has to minimize the nuisance value while retaining the safety of forcing function mechanism to guard the occasional tragedy.
  - Making copies but leaving the original inside the machine and walking off.
  - Using bank or credit cards to withdraw money from an ATM machine and walking away without the card.

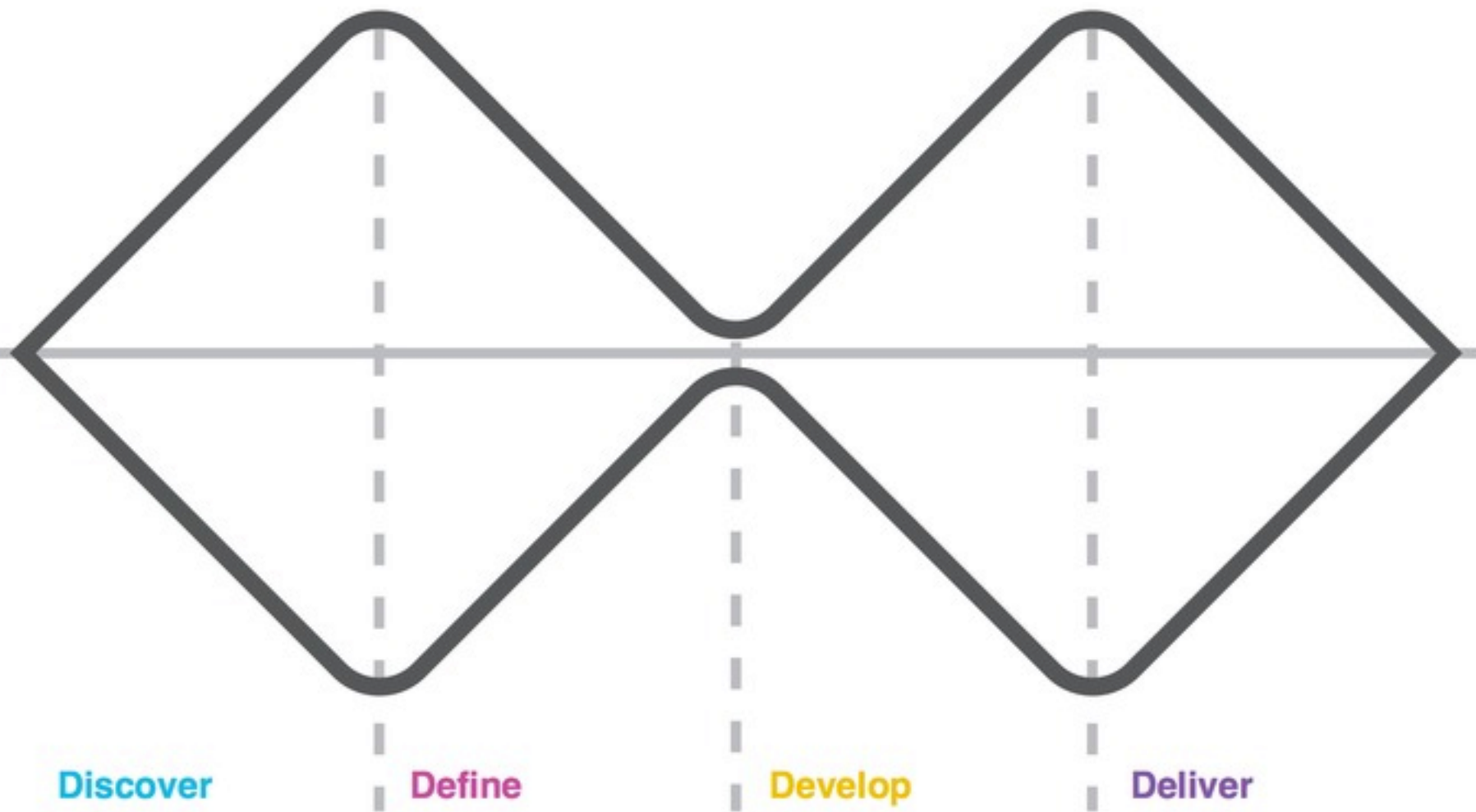
# Draw Toast

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<http://www.ahealthiermichigan.org/2014/09/22/transform-a-slice-of-toast-into-an-amazing-breakfast/>

❖ <http://www.drawtoast.com/index.html>



## Discover

Initial Ideas or Inspiration  
& Establishment of User  
Needs

Market Research  
User Research  
Design Research  
Technology Research  
Interviews & Insights Gathering  
Observation & Shadowing  
Empathic Modelling  
Information Management

## Define

Interpretation & Alignment  
of Findings to Project  
Objectives

Information Analysis  
Synthesis & Identification  
Project Refinement  
Project Management  
Project Sign-off

## Develop

Design-Led Concepts &  
Proposals Iterated &  
Assessed

Ideation  
Multi-Disciplinary Working  
Visual Management & Progress  
Testing & Prototyping  
Review & Improvement

## Deliver

Process Outcome(s)  
Finalised & Implemented

Final Testing & Approval  
Production  
Launch of Outcome(s)  
Evaluation & Further Feedback  
Future Work

# IDEO Human Centered Design

To recall these phases, simply remember H-C-D.

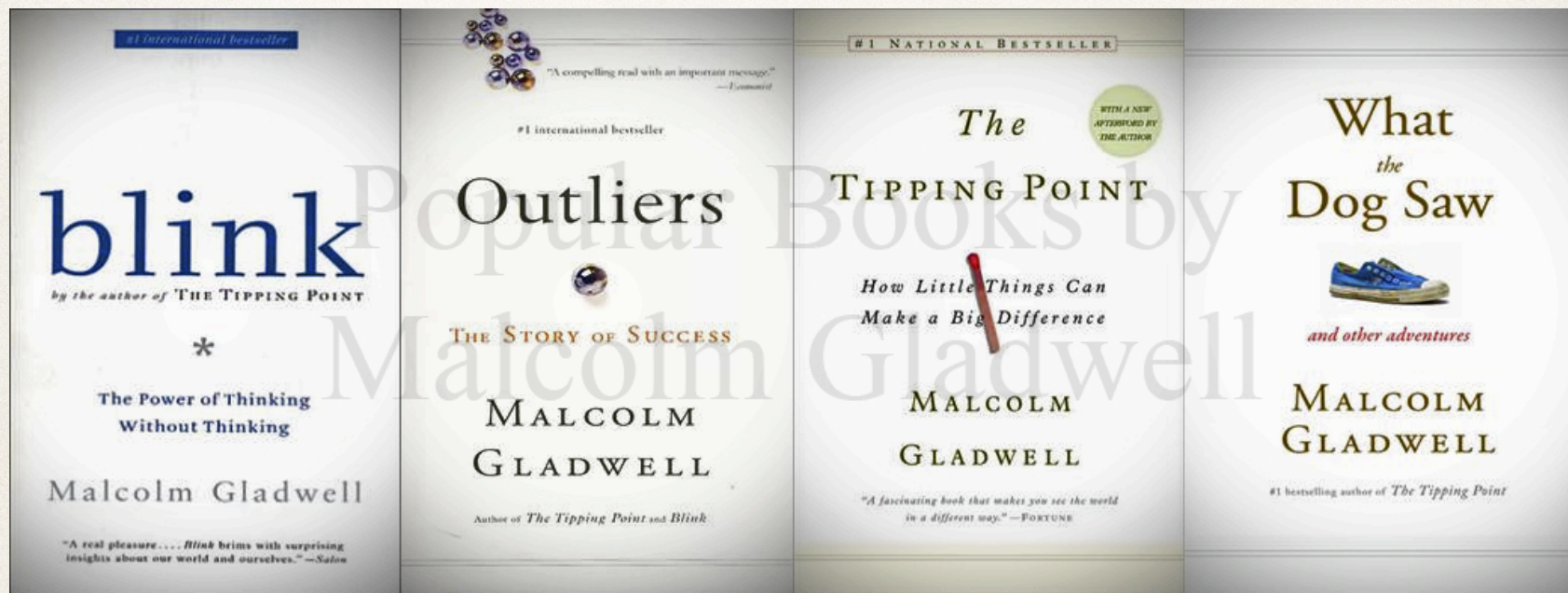
From IDEO Human Centered Design Toolkit





# Malcolm Gladwell: Choice, happiness and spaghetti sauce

[http://www.ted.com/talks/malcolm\\_gladwell\\_on\\_spaghetti\\_sauce?language=en#t-6934](http://www.ted.com/talks/malcolm_gladwell_on_spaghetti_sauce?language=en#t-6934)



<https://judgebyitscover.files.wordpress.com/2011/02/malcolm-gladwell-books.jpg>

# Designers V. Marketers

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- ❖ “Designers understand what people really need.”
- ❖ “Marketing understands what people actually buy.”
  - ❖ Textbook pp. 225 & 226

# Improving a System

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- ❖ Improving the parts does not necessarily lead to an improvement of the system.
- ❖ “When you get rid of something you don’t want, you don’t necessarily get what you do want.”
- ❖ “An improvement program must be directed at what you do want, not at what you don’t want.”

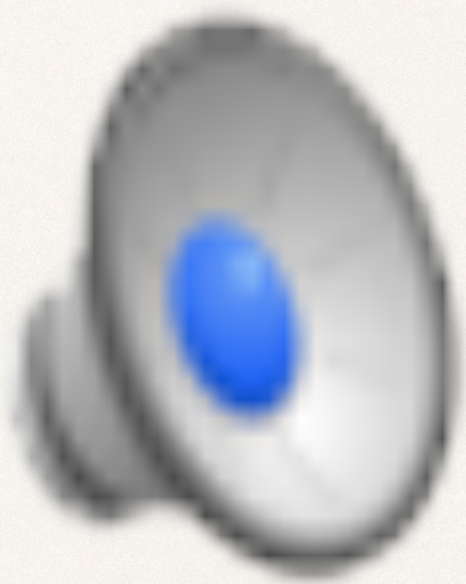
# Siegfried's Mechanical Music Museum in Rudesheim

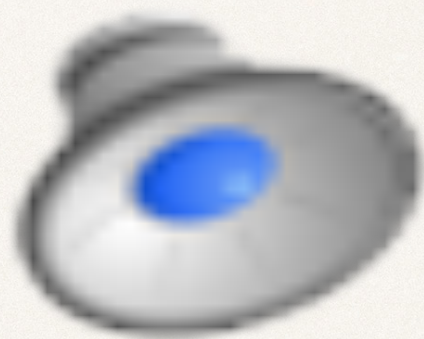
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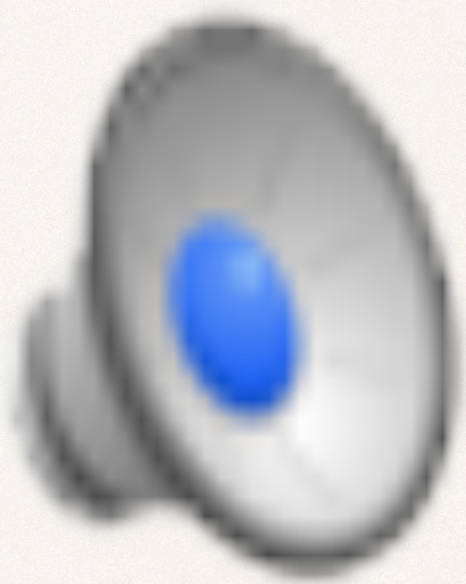


<http://walkingwiesbaden.blogspot.ca/2010/08/rudesheim-day-tour.html>











# Discontinuous Change

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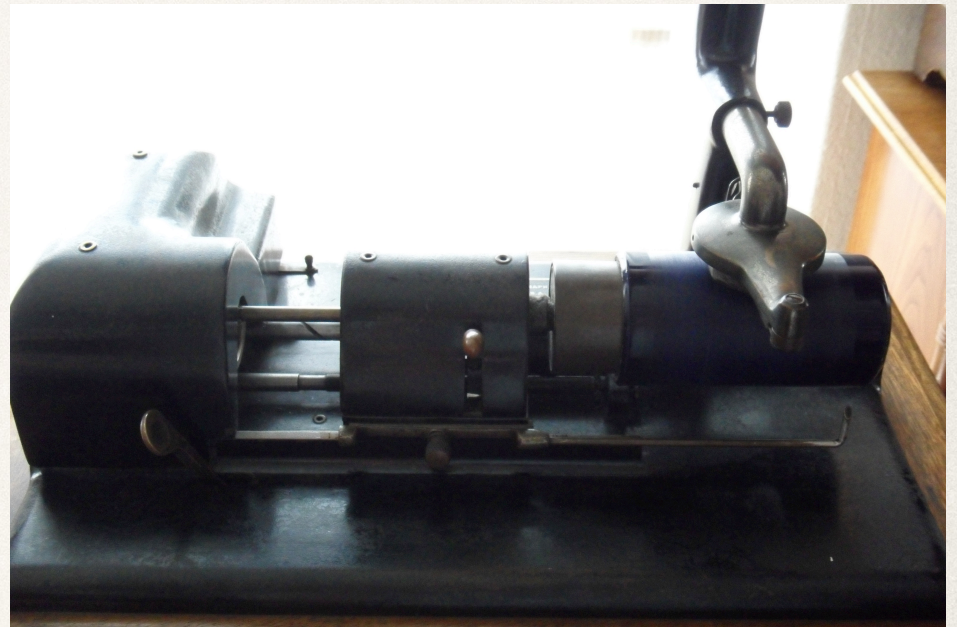
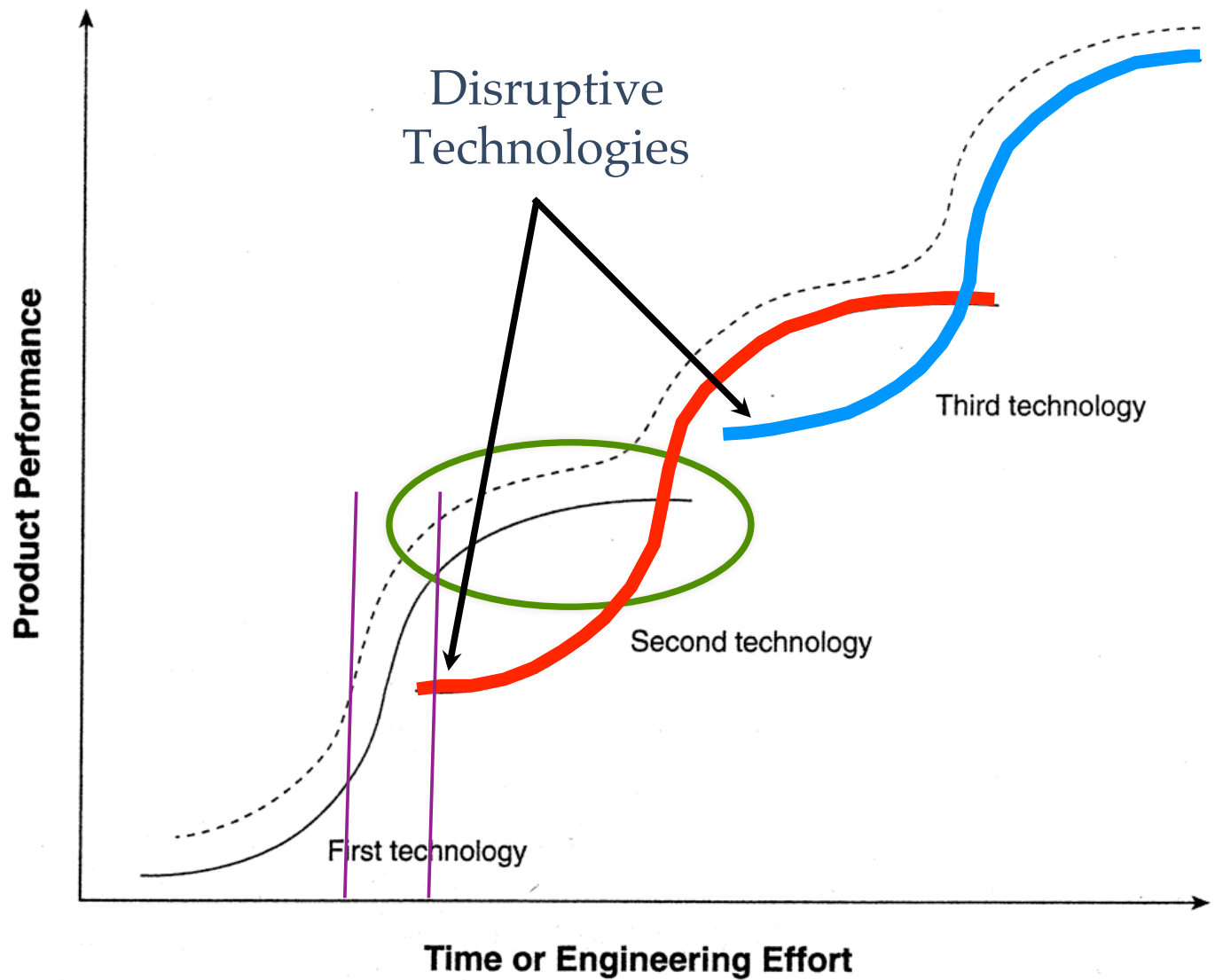


Figure 2.5 The Conventional Technology S-Curve



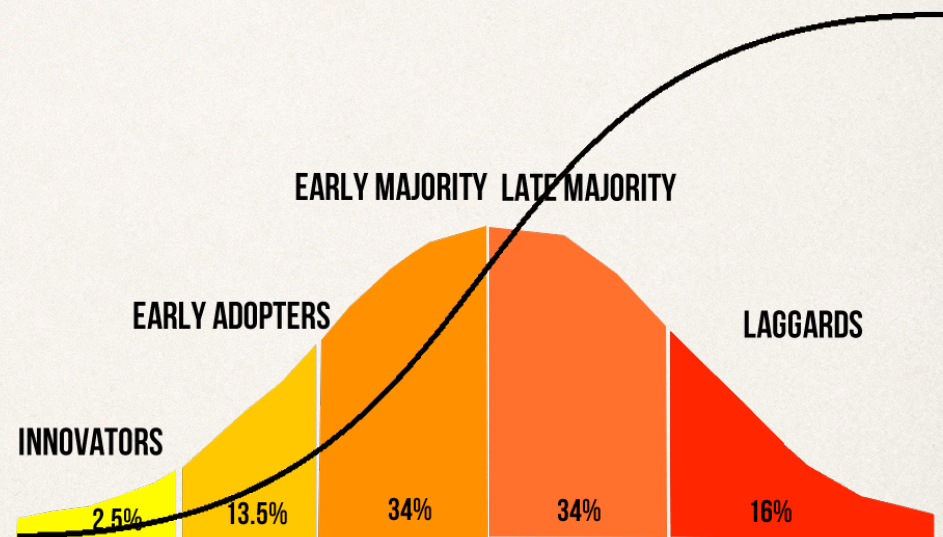
Source: Clayton M. Christensen, "Exploring the Limits of the Technology S-Curve. Part I: Component Technologies," *Production and Operations Management* 1, no. 4 (Fall 1992): 340. Reprinted by permission.

# Two Forms of Innovation

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- ❖ Incremental (evolution)
- ❖ Radical (revolution)

## CRITICAL MASS & MARKET SATURATION



<http://www.firebellymarketing.com/2014/08/late-adoptionprofitability-paradox.html>

# The Keyboard War



<http://fortune.com/2008/09/24/g1-vs-iphone-the-tale-of-the-tape/>



<http://www.fonearena.com/blog/2524/google-phone-vs-apple-iphone-and-nokia-e71-photo-gallery.html/google-phone-g1-iphone-e71-4>

# Evolution of the Desk

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- ❖ <http://bestreviews.com/best-home-office-desks#evolution-of-the-desk>

# Disk Drives



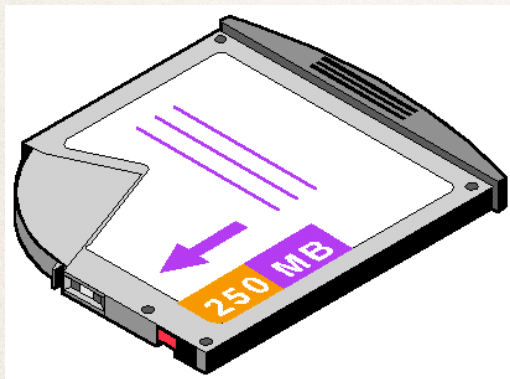
[http://en.wikipedia.org/wiki/Floppy\\_disk](http://en.wikipedia.org/wiki/Floppy_disk)



[http://en.wikipedia.org/wiki/Zip\\_drive](http://en.wikipedia.org/wiki/Zip_drive)



<http://www.snipview.com/q/Jaz%20drive>



<http://www.pcmag.com/encyclopedia/term/51253/shark-disk>



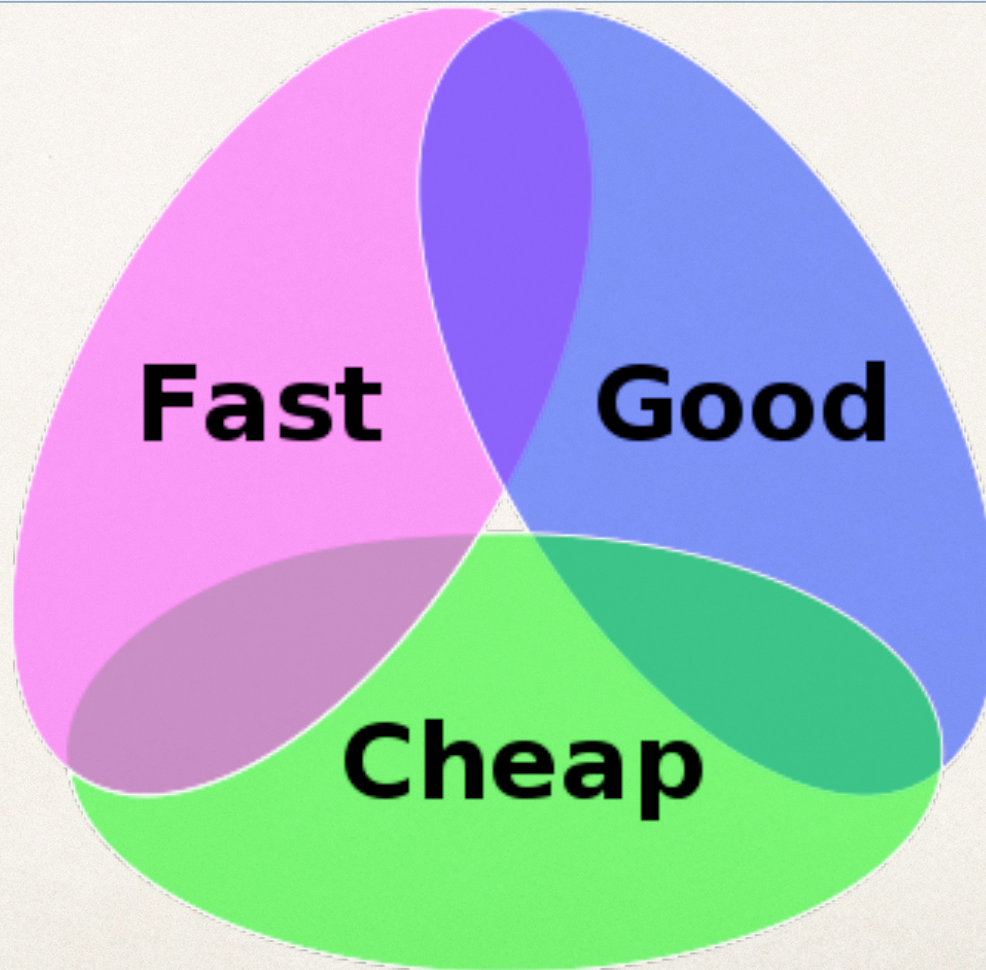
<http://www.coursupe.com/tuto/maintenance-informatique/architec/31-lecteur-cd-rom.html>



[http://en.wikipedia.org/wiki/USB\\_flash\\_drive](http://en.wikipedia.org/wiki/USB_flash_drive)

# Design in the World of Business

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[http://en.wikipedia.org/wiki/Project\\_management\\_triangle](http://en.wikipedia.org/wiki/Project_management_triangle)

# Some Terminology

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- ❖ Competitive forces: typically price, features, and quality
- ❖ Zeitgeist – “spirit of time”: products are successful based on the larger needs and wants of society at a particular time
- ❖ Featuritis: increase in features due to competitive forces

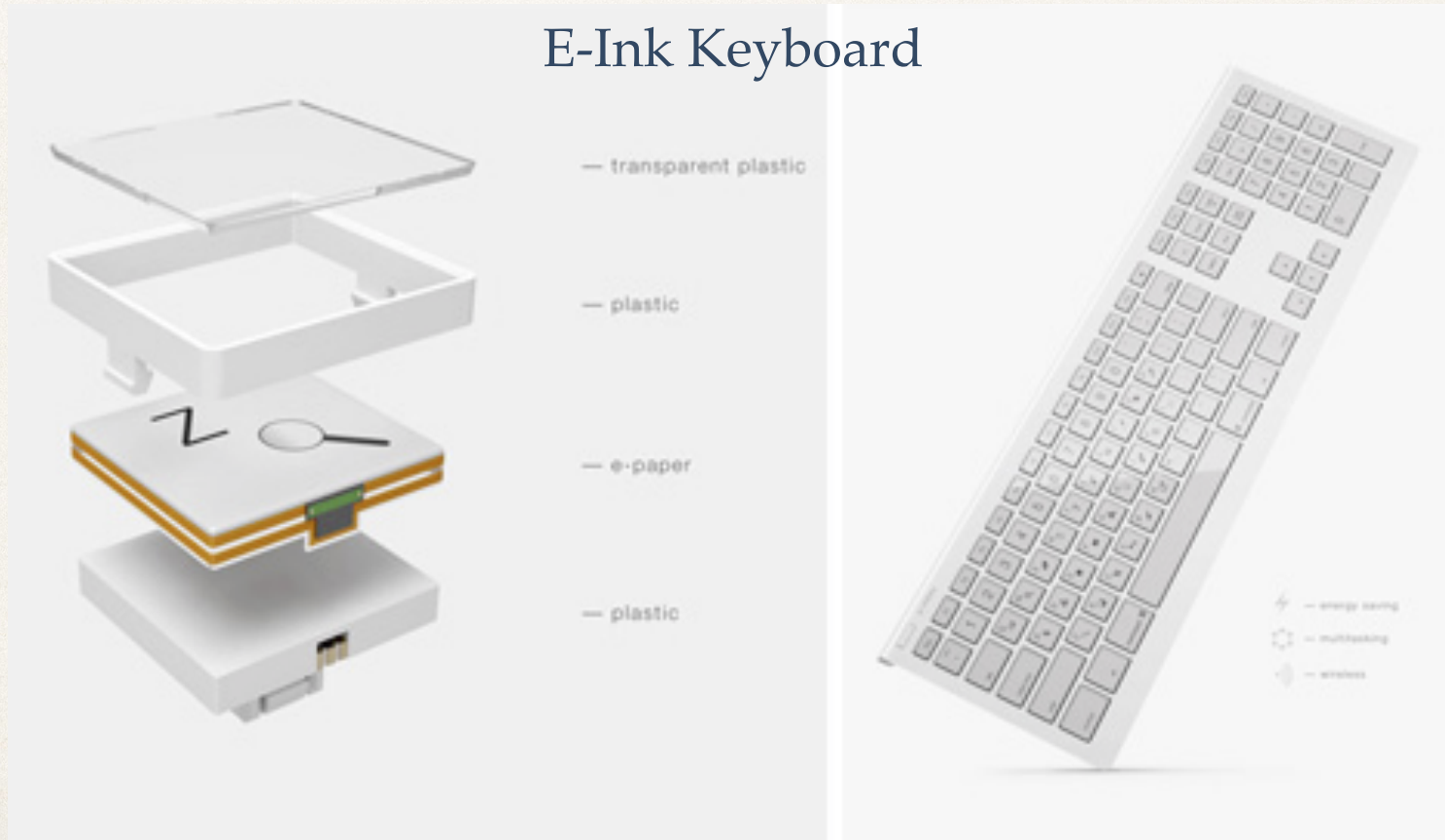


# QWERTY



<http://www.publicdomainpictures.net/view-image.php?image=1983>

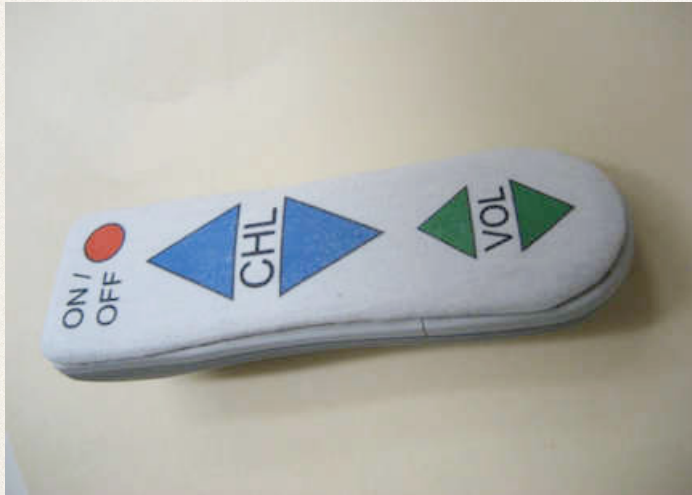
## E-Ink Keyboard



<http://weburbanist.com/2013/02/06/e-ink-keyboard-letter-keys-morph-into-custom-symbols/>

# Designing for Special People

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<http://s3files.core77.com/blog/images/bigremote.jpg>



<http://www.digitpedia.com/wp-content/uploads/2010/04/sony-big-button.jpg>

# Usability Testing – Two Types

---

- ❖ Analytical

- ❖ Testing without users
- ❖ Generally easier and faster
- ❖ Usually less effective

- ❖ Empirical

- ❖ Testing with users
- ❖ Much more planning required
- ❖ Efforts varies:
  - ❖ Simple informal tests are fast
  - ❖ Experimental testing of specific issues can be time-consuming

# Usability – Empirical Testing

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- ❖ Types of Usability Tests:
  - ❖ Testing a finished product – does it meet the design goals?
  - ❖ Testing a prototype – what changes are required to meet the design goals?

# Empirical Testing: Methods

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- ❖ Thinking out loud
- ❖ Constructive interaction (co-discovery learning, usually 2 or more participants)
- ❖ Questionnaires
- ❖ Test of user's knowledge before / after using
- ❖ Log user actions
- ❖ Observe users in their environment (video)
- ❖ Observe users on set of standard tasks (video)

# Empirical Testing – Sequence

---

- ❖ Testing Session:
  - ❖ Meet and greet by test monitor
  - ❖ Read info sheets & provide consent
  - ❖ Entry survey
  - ❖ Perform tasks
  - ❖ Exit survey
  - ❖ Optional question and answer

# Empirical Testing - Measures

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- ❖ Time and average time to completion
- ❖ Accuracy, errors, error rate
- ❖ Number of tasks completed
- ❖ Sequence analysis

# Qualitative Testing

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- ❖ Usually 5 users is enough
- ❖ In a usability test with  $n$  users, the average number of problems found is

$$N \times (1 - (1 - L)^n),$$

where  $N$  is the total number of usability problems, and  $L$  is the proportion of problems found by testing a single user (typically 30 %).

- ❖ **Better off performing more tests with fewer user per test**



# Qualitative Testing

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- ❖ How bad is a problem?
- ❖ Severity can be ranked on the following scale:
  - ❖ 0 = not a problem
  - ❖ 1 = cosmetic
  - ❖ 2 = minor, low priority to fix
  - ❖ 3 = major problem
  - ❖ 4 = catastrophe, must be fixed before product is released

# Qualitative Testing

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- ❖ How bad is a problem?

## Proportion of Users Who Experience a Problem

		Few ←	→ Many
Impact of a Problem	Large ↔ Small	Low	Medium
		Medium	High

# Moral Obligation of Design

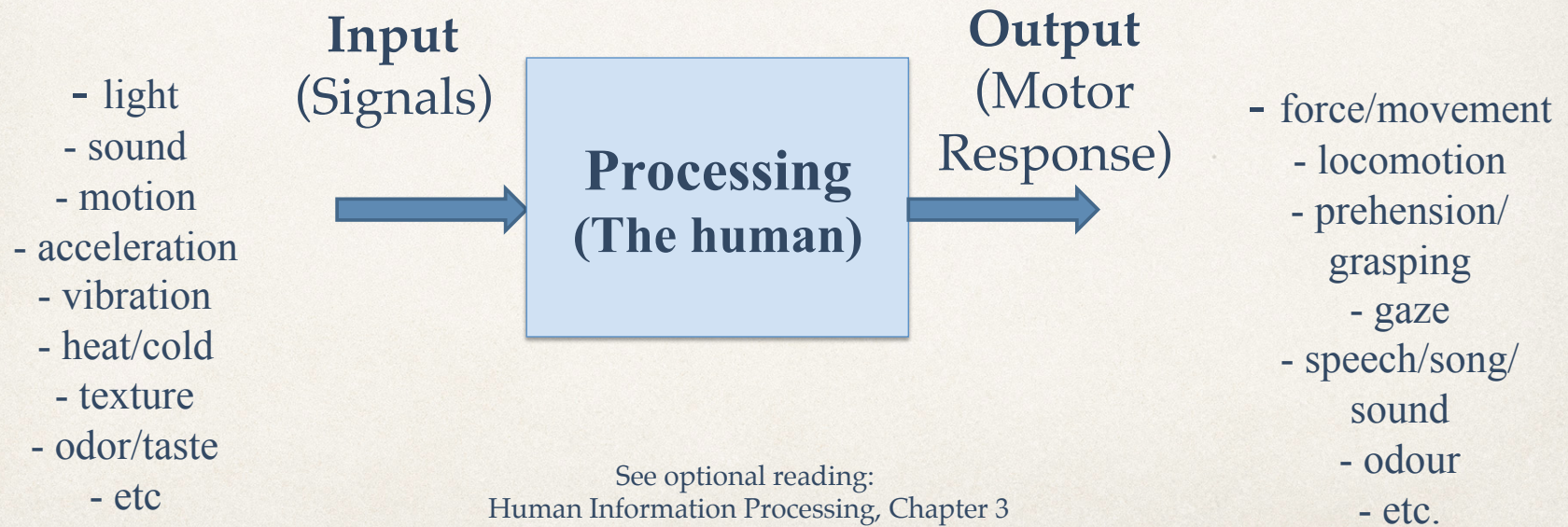
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“In Western cultures, design has reflected the capitalistic importance of the marketplace, with an emphasis on exterior features deemed to be attractive to the purchaser. In the consumer economy, taste is not the criterion in the marketing of expensive foods or drinks, usability is not the primary criterion in the marketing of home and office appliances. We are surrounded with objects of desire, not objects of use.”

textbook, p. 291

# The Information Processing Model

The information processing model of functioning begins with the input of information from the environment through one or more of the sense organs and then analyzes what happens to this information (signal) inside the system.



See optional reading:  
Human Information Processing, Chapter 3  
Schmidt, R. A. (1988). Motor control and learning: A behavioral emphasis. Champaign, Ill: Human Kinetics.

# Three Stages of Information Processing

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**Example: Traffic signal (a change from green to yellow)**

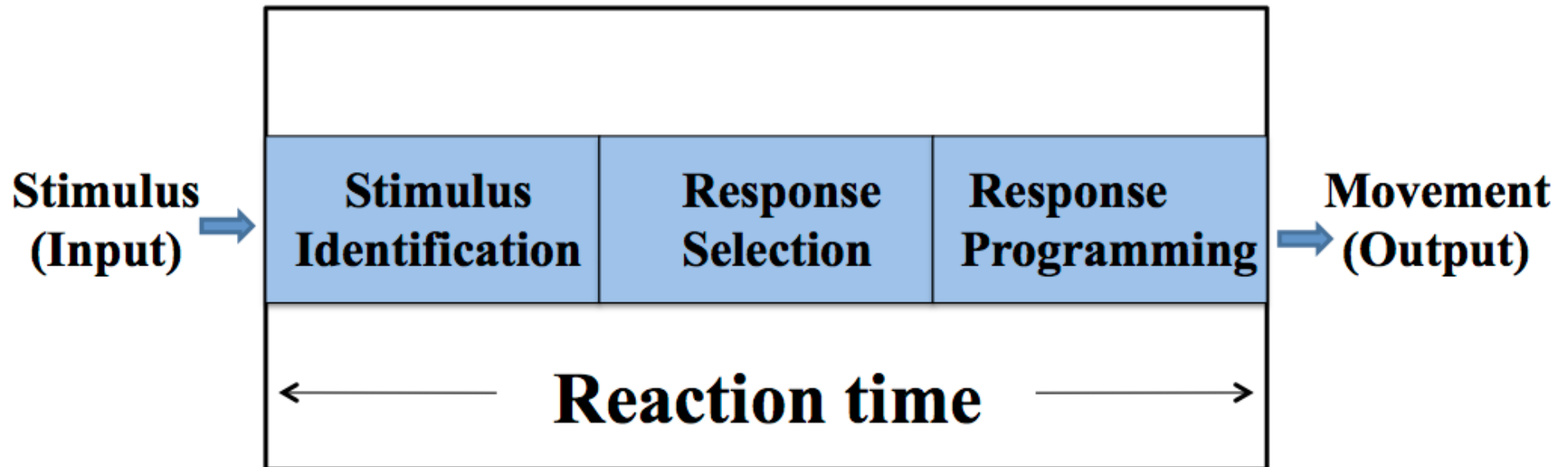
Action: Either continue or stop

- \* How fast the car is travelling to the distance it is required to cover.
- \* Proximity of the car behind (recent memory).
- \* Width of the intersection and duration of the yellow light (learned information).
- \* Red light camera? (learned information).
- \* If you continue: same speed or accelerate
- \* If you stop: remove the foot from the accelerator and apply the break.



# Three Stages of Information Processing

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**The human**

# Three Stages of Information Processing

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**1) *Stimulus-identification*:** The individual must sense that a stimulus has occurred and identify it.

***Stimulus-Detection*:** An environmental stimulus acts on the body, and it must be transformed into the code of neurological impulses that are sent to the brain.

The stimulus is processed further at each level of analysis until it's contact memory, meaning that some memorized aspect of the stimulus is aroused (such as name or an attribute with which it has been associated in the past).

# Three Stages of Information Processing

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**2) *Response selection*:** As a product of the stimulus-identification stage, the information in the stimulus has been the basis for knowing what happened in the environment. *In this stage the subject decides what response to make.*

***Number of Stimulus-response alternatives*:** Scientists believe that processing information relevant to the selection of a response requires more time (response time (RT) ) when there are a large number of alternatives.

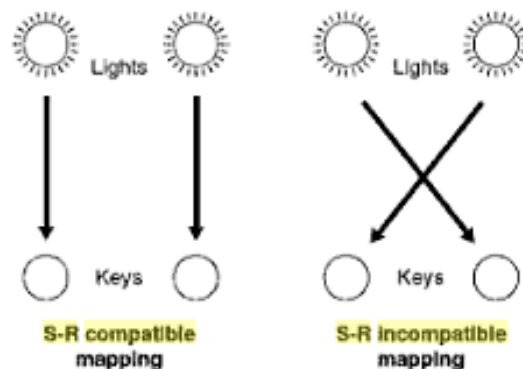
***Stimulus-Response compatibility*** : This refers to the specific relationship between a stimulus and a response.



# Stimulus-Response compatibility

***Population stereotypes:*** Many of the stimulus-reaction relationships which are arbitrary become natural through practice and experience. E.g., moving a light switch up to turn a light on in North America.

***Spatial and anatomical relationships :*** There is an overlap of the mental representation of the tasks dimensions associated with the stimuli and the response.



# Three Stages of Information Processing

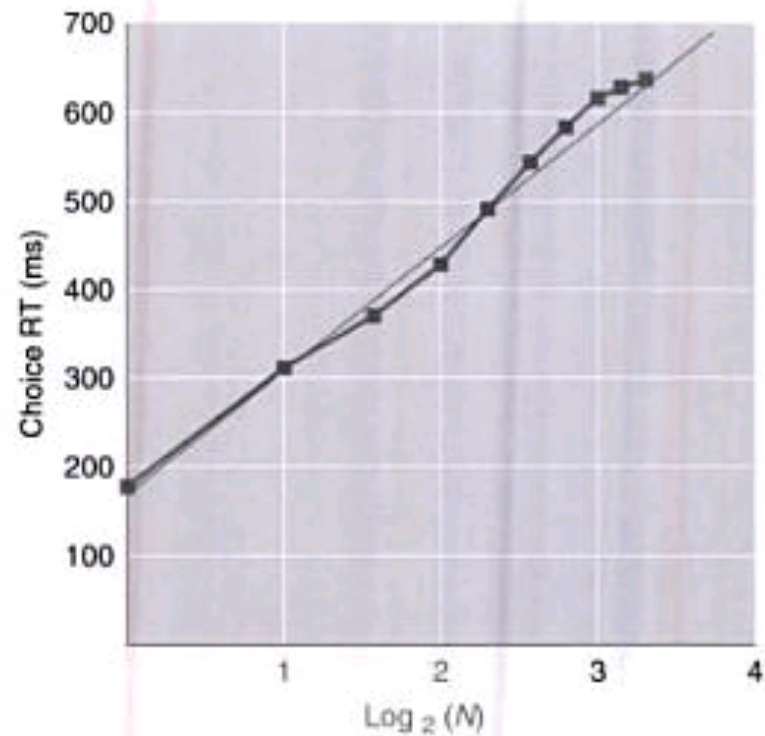
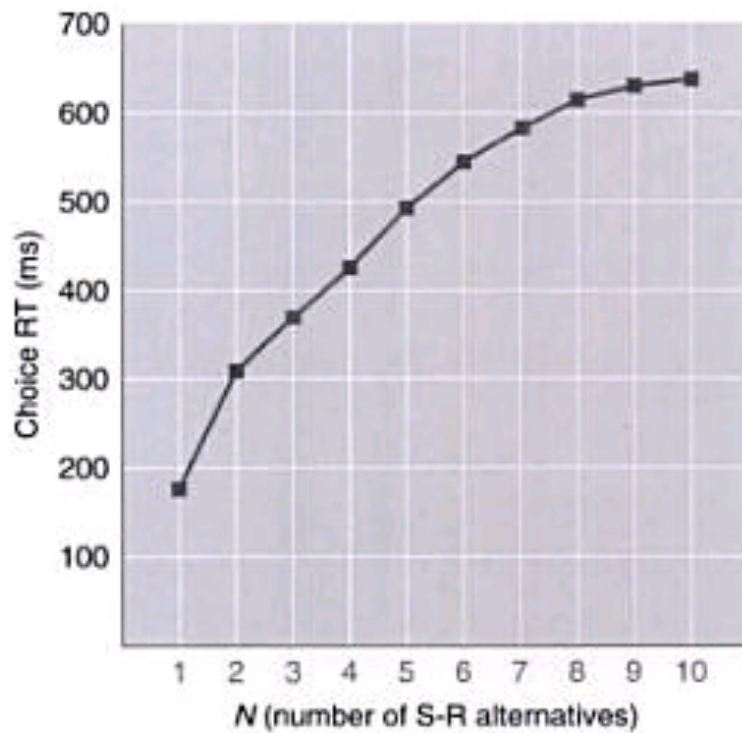
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**3) *Response-programming*:** After the response has been selected, the system must be prepared for the appropriate action and must initiate that action.

## **Parameters that affect response programming:**

- ❖ Number of moving parts (number of words),
- ❖ Movement accuracy (target size),
- ❖ Movement duration (complex movements require much more time)

# Choice Reaction Time



# Attention - Stroop Effect

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The **Stroop effect** is a demonstration of the reaction time of a task. When the name of a color is printed in a color different from the name, naming the color of the word takes longer and is more prone to errors.

grey

green

red

blue

yellow

grey

green

red

blue

yellow

# Questions

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