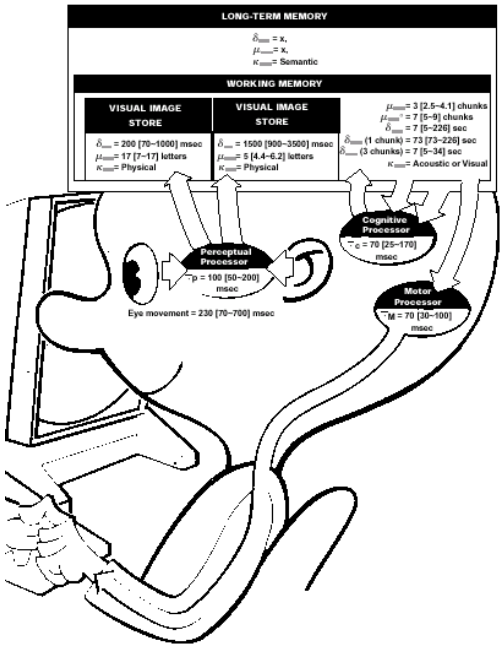
Universidade de Aveiro
Departamento de Electrónica,
Telecomunicações e Informática

The User



www.id-book.com

Outline

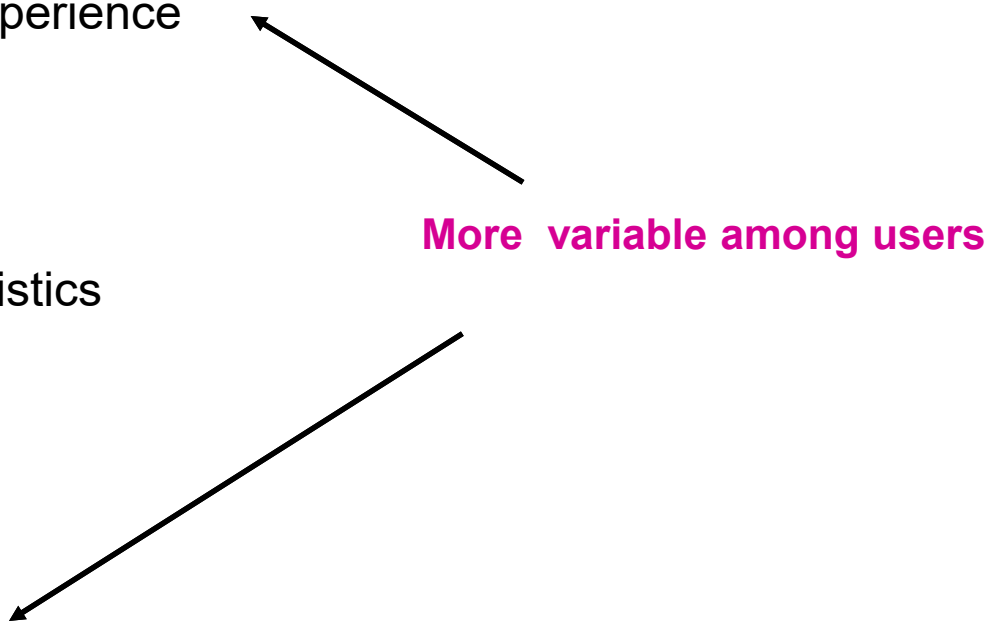
- Users Profile – relevant characteristics for interactive systems

- Human Information Processing System (HIPS)
  - Perceptual sub system
  - Senses
    - Sight, Hearing, Touch, Smell, Taste
      + Proprioception, Kinesthesia …
  - Cognitive sub-system
  - Memory

- Some implications on the design of interactive systems

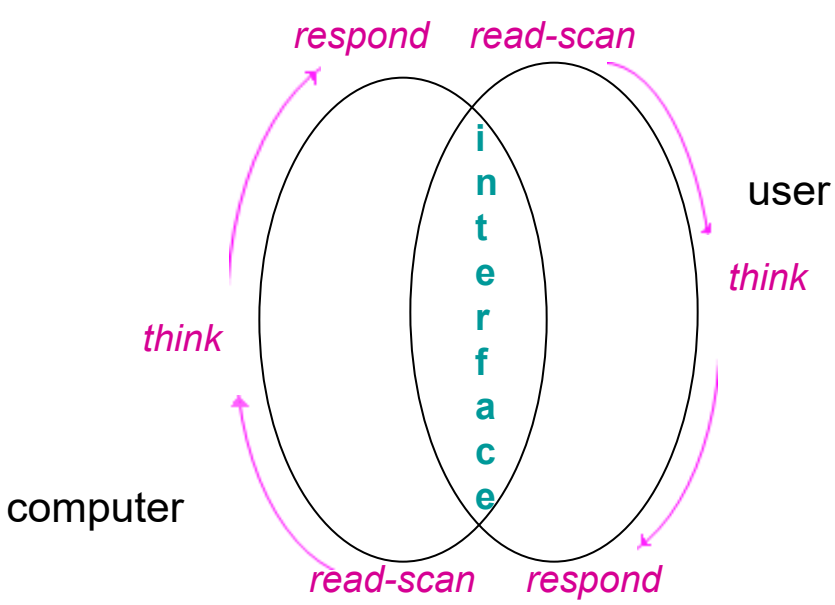
Users' profile

- Human Information Processing System (HIPS)
- Knowledge and experience
- Work and task
- Physical characteristics
- Environment
- Tools



There are many user models to be used in the design of Interactive systems (e.g. personas, GOMS, KLM, …)

Dialog in an interactive system



Perceptual sub-system

Cognitive sub-system

Motor sub-system

Human Information Processing System (HIPS)

- Humans have different capabilities that might be considered when designing interactive systems
- Information is received through various I/O channels
- Information is stored in memory
- Emotions may influence capabilities
- Users share common characteristics but differences that cannot be ignored

Human Information Processing System (HIPS): main aspects relevant to interactive systems design

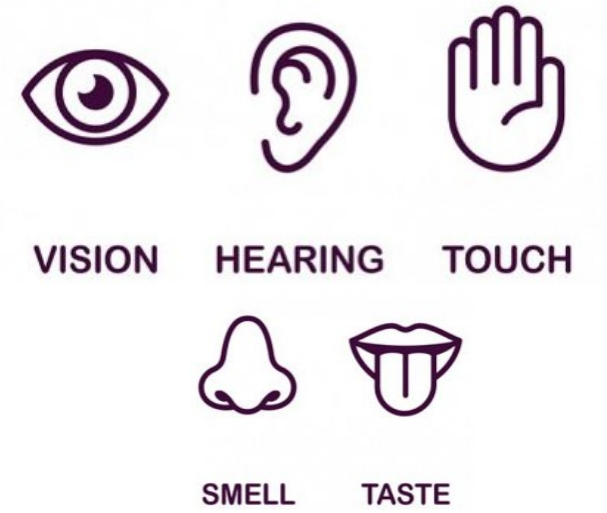
Perceptual sub-system
- memory – perceptual buffer (iconic, echoic, …)
- process – pattern recognition

Cognitive sub-system
- memory -
  - short term/working memory (STM)
  - long term memory (LTM)
- processes -
  - selective attention
  - problem resolution
  - learning
  - …

HIPS bottleneck

Motor sub-system

Perceptual sub-system – I/O



The five Aristotelian senses

- Input: 5+ senses

  Sense is a physiological capacity of organisms that provides data for perception

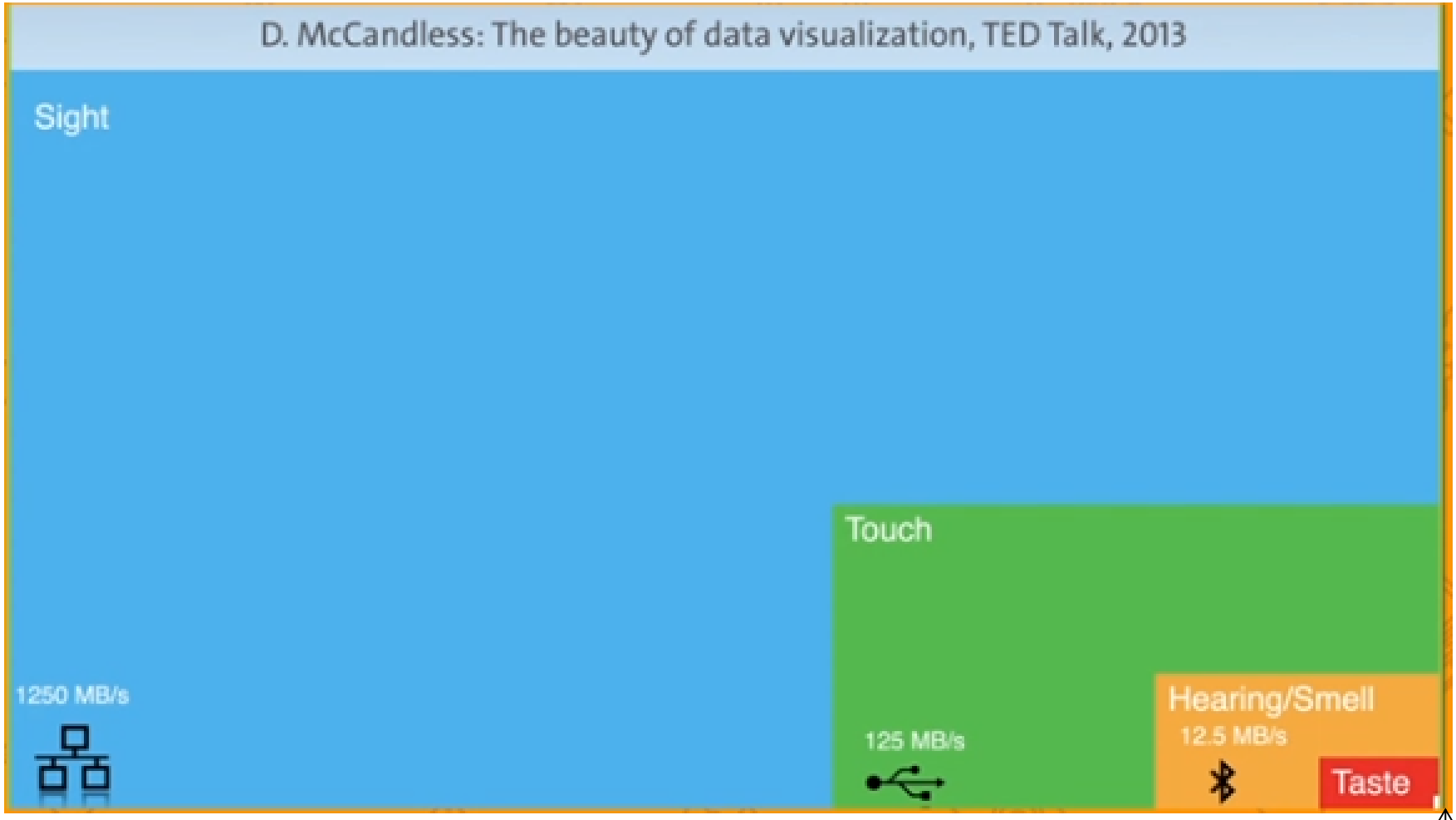
  – Some more relevant than other

  – For HCI, vision is preferred,

    but hearing and touch are more and more important …

- Output: communication system
  – vocal, gestures, eye gaze, ,…

Why vision is preferred

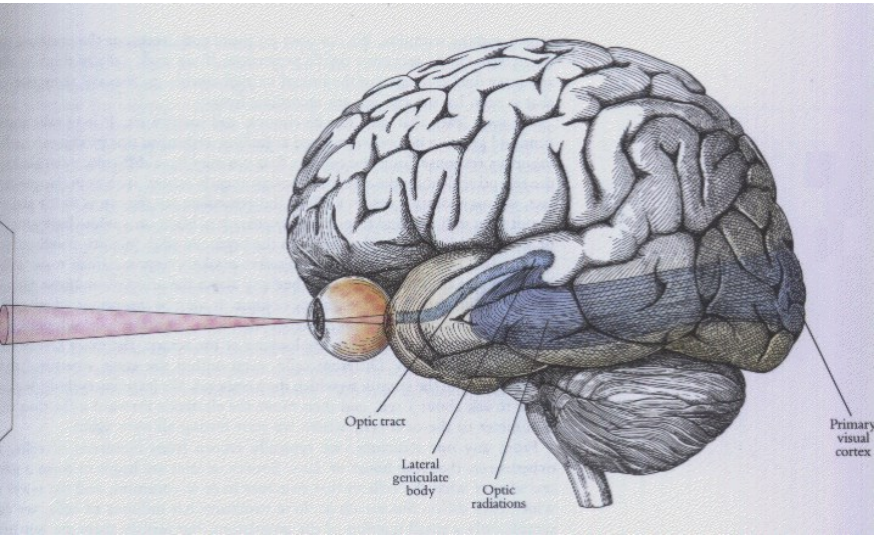


Bandwidth of our senses proposed by Danish Physicist - Tor Nørretranders

we are aware of only 0.7% of reality

Vision

- Relevant for HCI:
  - Compensation of movements and illumination changes
  - Context used to solve ambiguities
  - May be tricked: Visual illusions come from excessive compensation.



Eye – sensor

Brain - processor

(Hubel, 1988)

Pattern Recognition

Process that matches information from a stimulus with information retrieved from memory

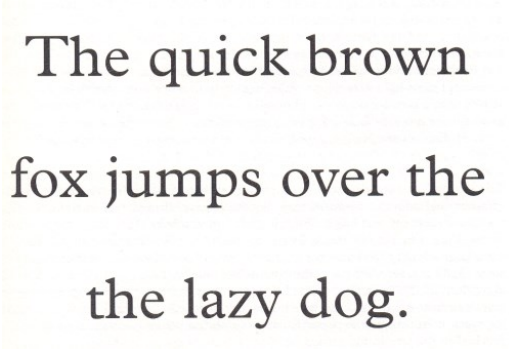
- It is a very powerful process

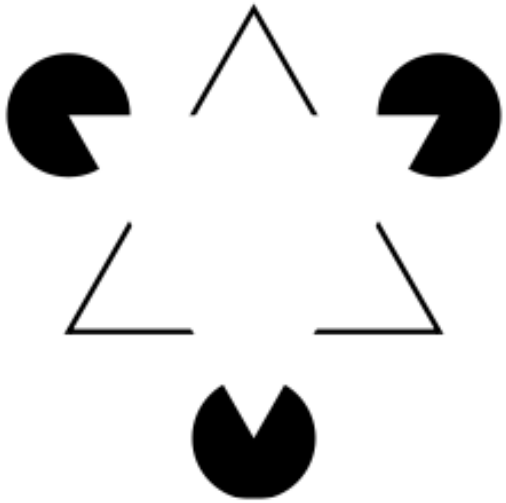
- It is subconscious

- It does not use only current data

- It solves ambiguities

- Occurs also in other senses

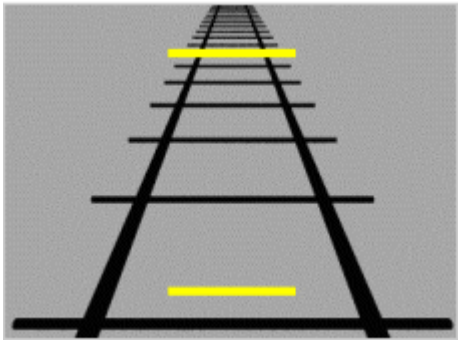




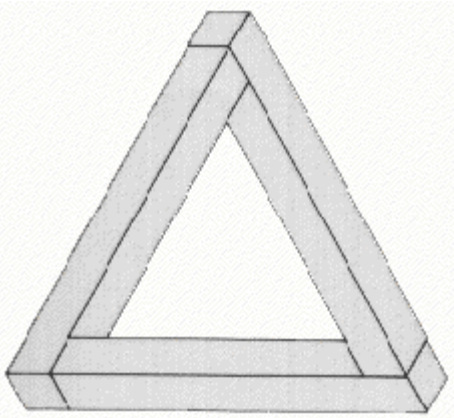
(Kaniza illusion, Wikepedia)

Visual Illusions illustrate that **what we see does not depend only of the stimulus**

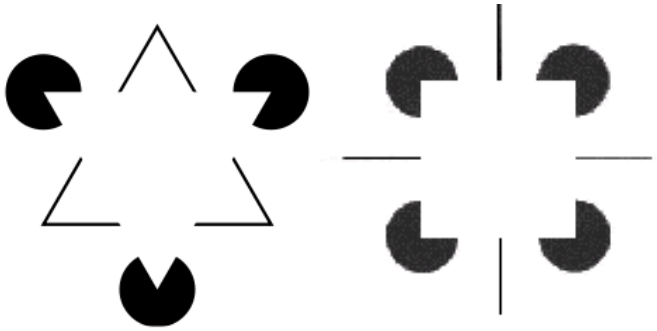
- bring out good adaptations of our visual system to standard viewing situations
- under artificial manipulations can cause inappropriate interpretations of the scene



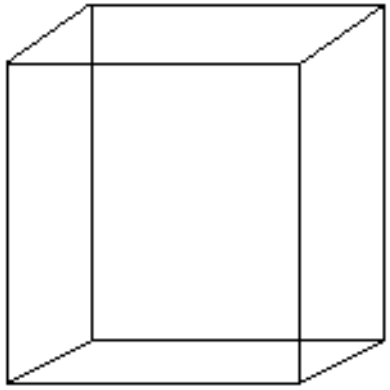
Ponzo illusion



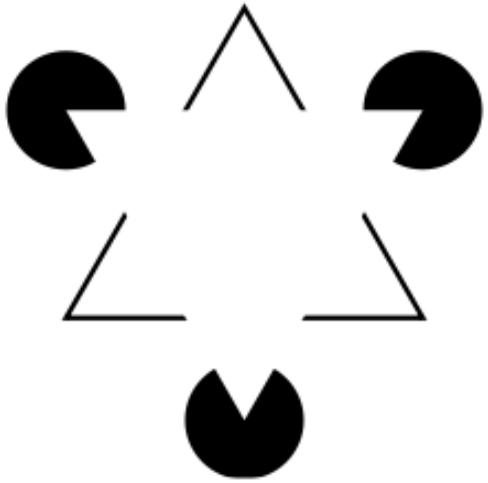
Pennrose triangle:
Impossible object?



Kanizsa illusion



Necker cube



Kanizsa illusion:

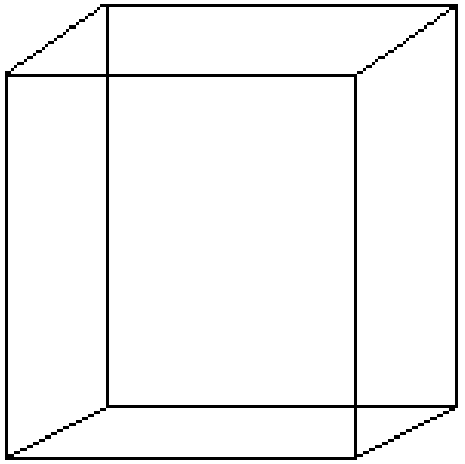
Although there are no actual triangles a sort of pattern recognition phenomenon is triggered and the image is interpreted as two overlapping triangles (simple explanation)

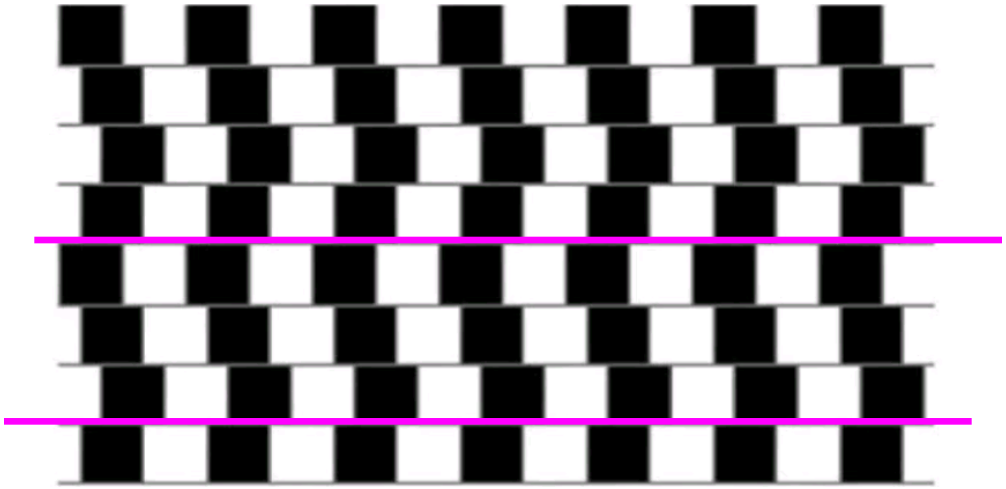
https://en.wikipedia.org/wiki/Illusory_contours

Necker cube:

Cube with no visual cues as to its orientation; it can be interpreted to have either the lower-left or the upper-right square as its front side

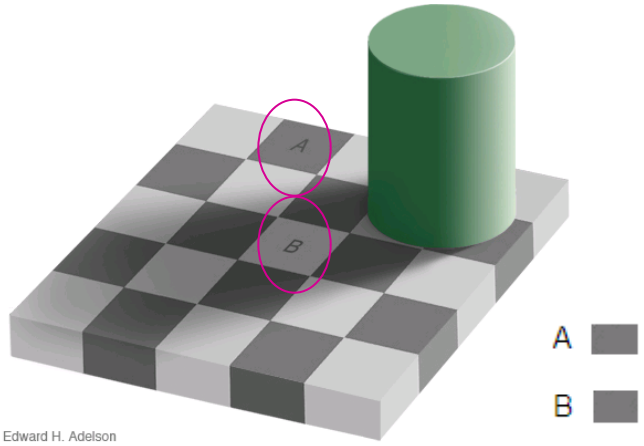
https://en.wikipedia.org/wiki/Necker_cube





http://www.youtube.com/watch?v=2XqPOJLUM1s

http://www.youtube.com/watch?v=URLRdcnU6Hk&NR=1



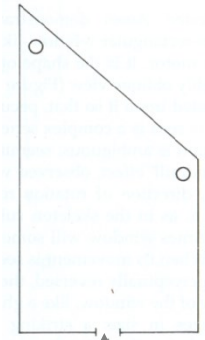
http://www.michaelbach.de/ot/

https://www.youtube.com/watch?v=-IWk5NkxQF8&ebc=ANyPxKoRFxfOSCgdPavBoMpgPrXjRRVqZmhiAvlBDgThnPfndq-gheNYZ-6cNRv2yYwN5SqX52DQGDWjvBnzUQQ-_N6iCVgMdQ

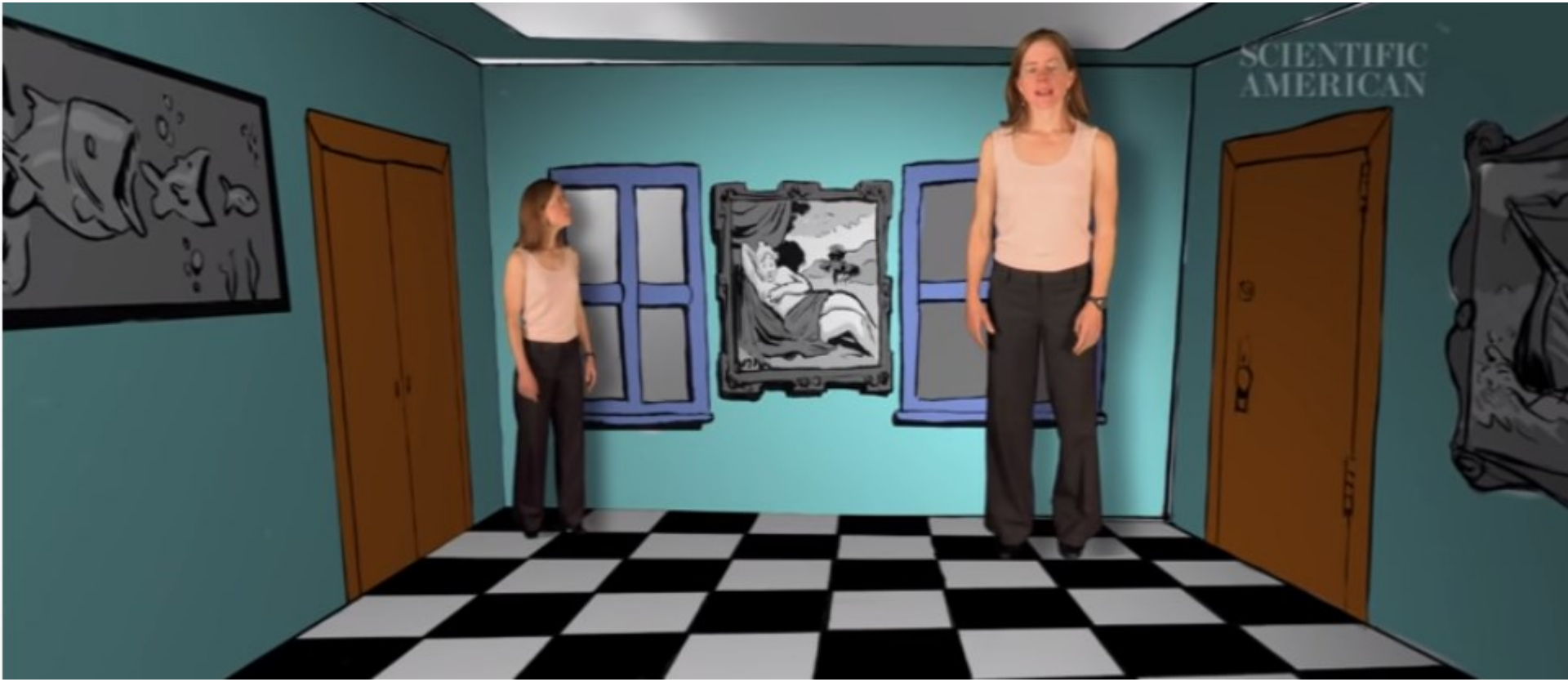
Ames Room

(what we see does not depend only of the stimulus)

A room that pushes the boundaries of human perception...



Point of view



https://www.youtube.com/watch?v=gJhyu6nlGt8

https://www.youtube.com/watch?v=aS-vzPuZzuk

Other senses

https://en.wikipedia.org/wiki/Sense

- Hearing
  - Information on direction, objects and distance
  - Only sense that is really 3D
  - Cannot be “turned off”
  - Human hearing - 20Hz to 15KHz
  - Filtering is possible (Background noise – “cocktail party” example)

Other senses

https://en.wikipedia.org/wiki/Sense

- Touch
  - Important feedback
  - Key senses for people with sight problem
  - Several receptors in skin:
    - Termoreceptors: cold and hot
    - Nociceptor: pain
    - Mecanoreceptor: pressure
  - Some areas more sensitive (fingers)

Simulators are complex interactive systems that stimulate several senses…

https://www.the737experience.co.uk/

https://surgicalscience.com/systems/lapsim/

https://en.wikipedia.org/wiki/Flight_simulator

Other senses

https://en.wikipedia.org/wiki/Sense

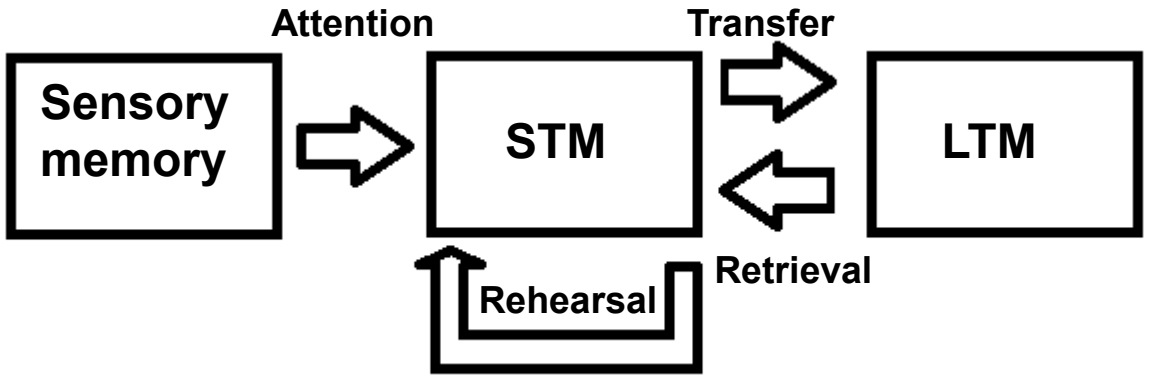
- Smell and Taste
  - Complex chemical senses
  - High latency
  - Difficult to use in HCI
  - Some experimental work exists (and some commercial products)
- And others (as proprioception - awareness of your body position)

https://www.khanacademy.org/test-prep/mcat/processing-the-environment/somatosensation/v/proprioception-kinesthesia

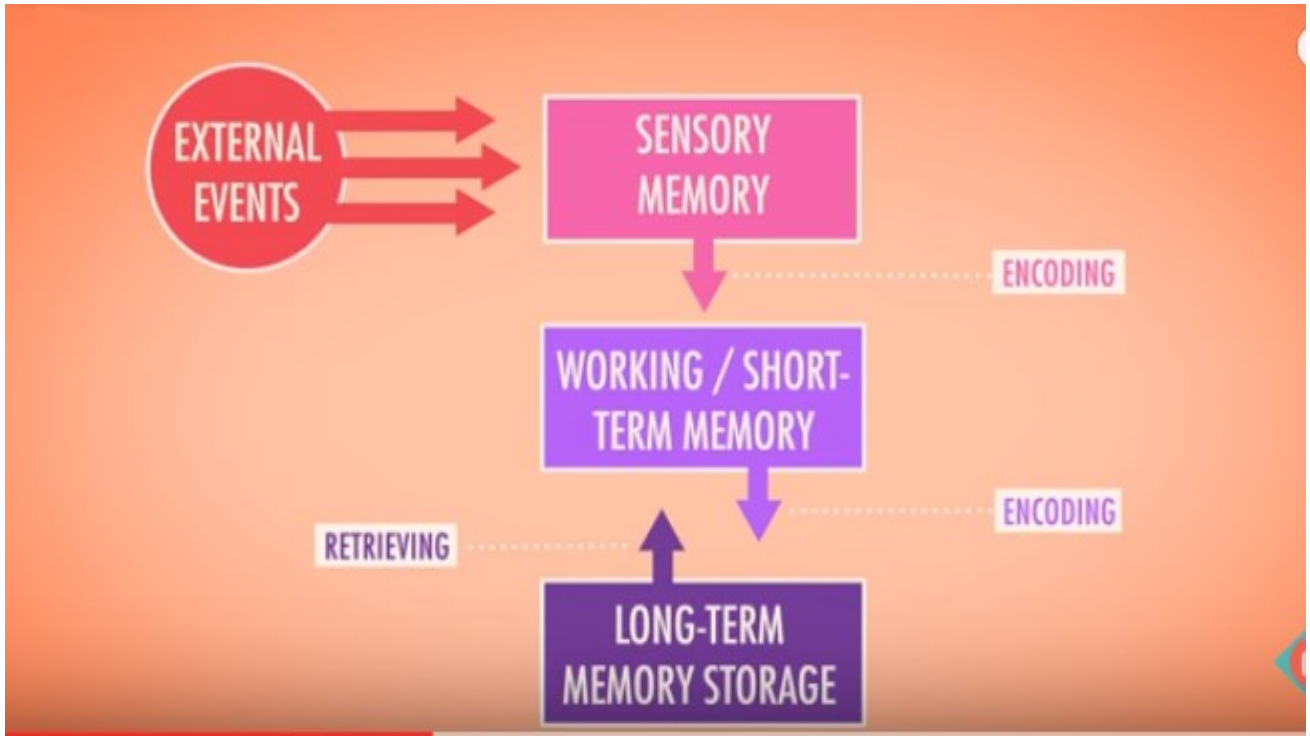
Memory

The **Atkinson–Shiffrin model** (1968) (a.k.a. multi-store model or modal model) asserts that human memory has three components:

- Sensory memory
- Short-term memory / working memory
- Long-term memory



https://en.wikipedia.org/wiki/Atkinson%E2%80%93Shiffrin_memory_model



How we make memories - Crash Course Psychology #13

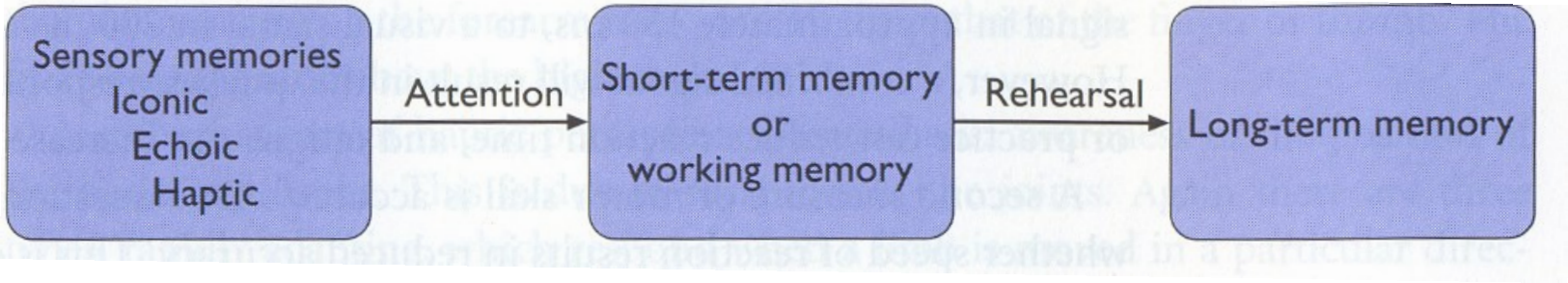
https://www.youtube.com/watch?v=bSycdIx-C48

How we remember and forget - Crash Course Psychology #14

https://www.youtube.com/watch?v=HVWbrNls-Kw

Memory

- The Atkinson–Shiffrin model (1968) memory has three components
  - Sensory memory / iconic memory, very short
    - A few seconds
  - Short-term memory / working memory
    - +/- 18 seconds, 7+/-2 items
  - Long-term memory
    - ~Infinite capacity

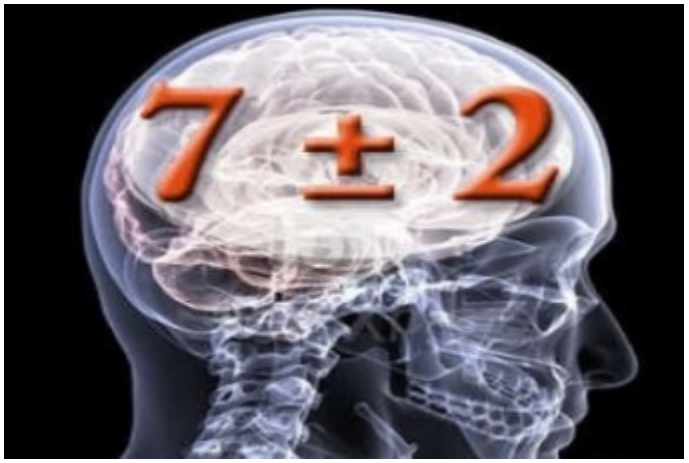


Short Term Memory (STM) / Working memory

- Working memory:
  - Mental calculus (6*35)
  - Reading (understand a sentence)
  - …
- Characteristics:
  - Quick access +/- 70ms
  - Quick forget
  - Limited capacity 7 +/- 2

  - Can be increased with chunking, to enter long-term memory

Short Term Memory (STM) / Working memory



a few characteristics:

- Short duration: a few seconds (<30s)
- Limited capacity: 7±2 elements

what is an element?

example: try to memorize the following numbers 649325401741
111122223333

which is easier?

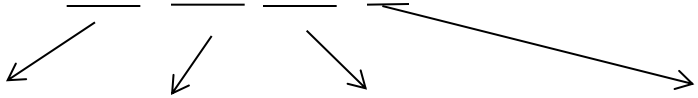
and this one: 3512343705 17

Short Term/ working Memory (STM)

649325401741 ⟶ 12 digits

111122223333 ⟶ 3 digits and a rule

234370200 ⟶ 351 234 370 517



Portugal Aveiro University area IEETA building

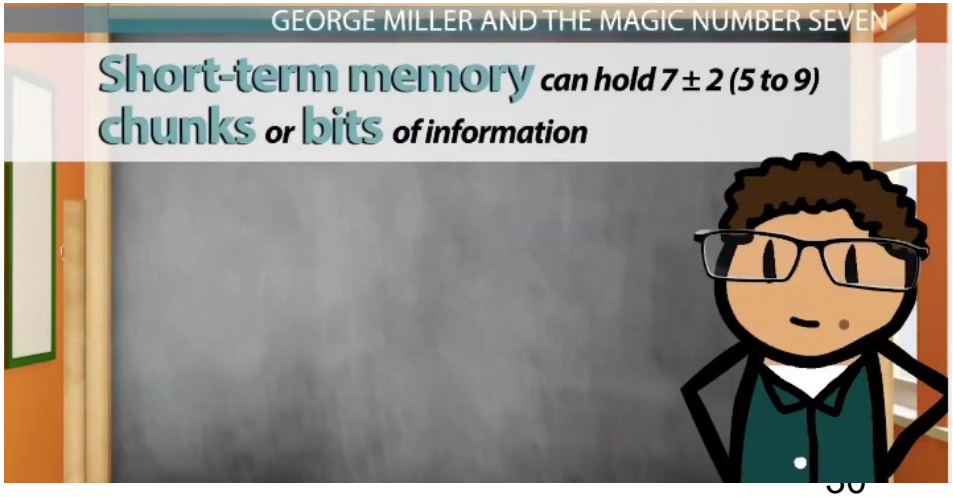
These numbers correspond to different “chunks”

Chunk: the largest meaningful unit that a person recognizes; depends on the person knowledge

- Chunking refers to an approach for making more efficient use of short-term memory by grouping information

- Resulting chunks are easier to commit to memory than a longer uninterrupted string of information.

- Can be used for making more efficient use of short-term memory by grouping information



http://study.com/academy/lesson/george-miller-psychologist-theories-on-short-term-memory-lesson-quiz.html

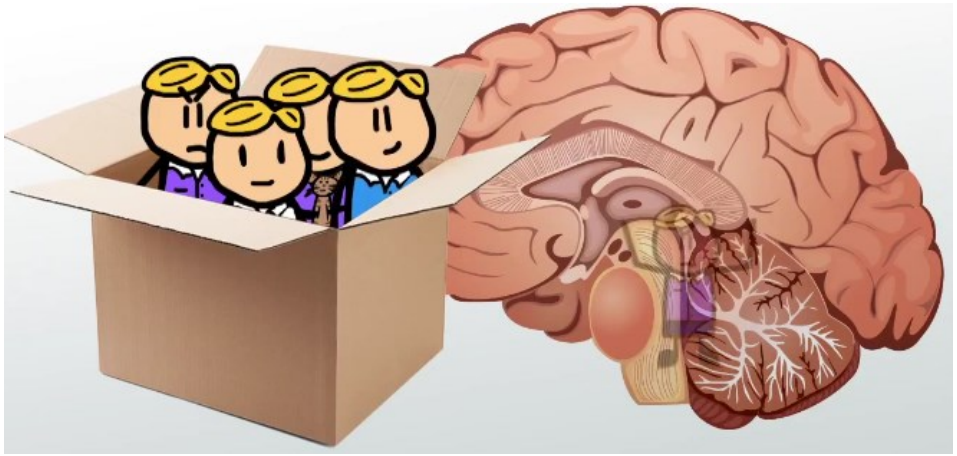
Long Term Memory

Stage of the dual memory model (Atkinson-Shiffrin memory model) informative knowledge can be stored for long periods of time

Main characteristics:

- “Infinite” capacity and duration

- non reliable access



http://study.com/academy/lesson/long-term-memory-definition-types-examples.html

Long-term Memory - Recognition vs. Recall

- Information retrieval - Recognition vs. Recall
  - Recognition: remembering with the help of a visible cue
    - aka “Knowledge in the world”
  - Recall: remembering with no help
    - aka “Knowledge in the head”

- Recognition is much easier
  - so menus are more learnable than command languages

Design Implications

Memory

- Reduce cognitive load by avoiding long and complicated procedures for carrying out tasks.

- Design interfaces that promote recognition rather than recall by using familiar interaction patterns, menus, icons, and consistently placed objects.

- Provide users with a variety of ways of labeling digital information (e.g. files, emails, and images) to help them easily identify it again through the use of folders, categories, color, tagging, time stamping, and icons.

Selective attention

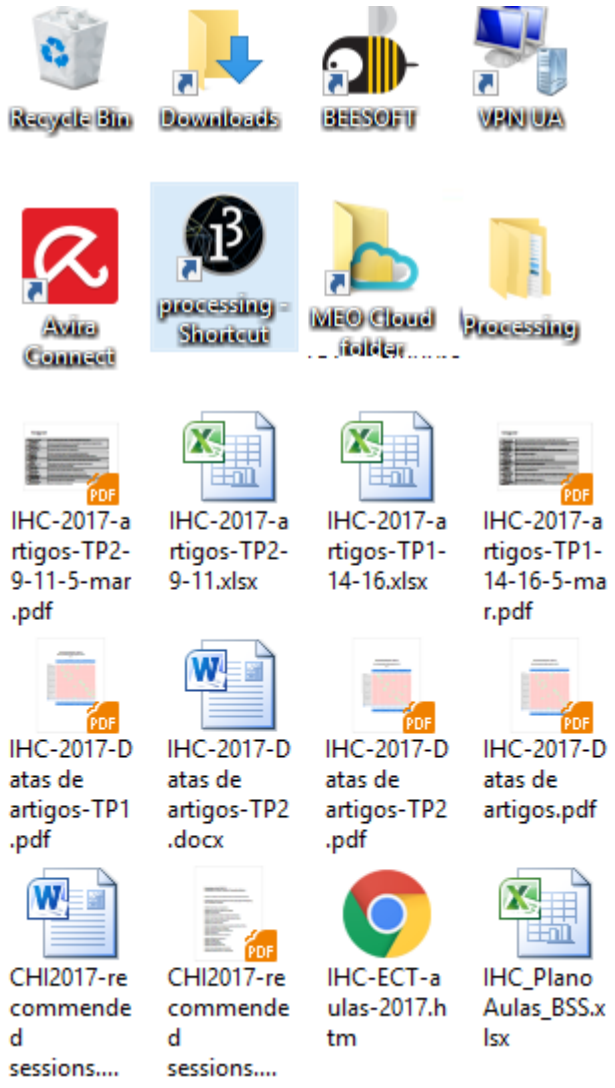
Occurs when we block out certain features of our environment and focus on one particular feature

It may be:

- Voluntary

- Involuntary

Both can be (and are) exploited in UIs



Calling your attention to an application

https://dictionary.apa.org/selective-attention
https://www.khanacademy.org/test-prep/mcat/processing-the-environment/attention-language/v/selective-attention

Design Implications

Attention

- Consider context. Make information salient when it requires attention at a given stage of a task.
- Avoid cluttering visual interfaces with too much information.
- Consider designing different ways of supporting effective switching and returning to a particular interface.

Design Implications

Learning

Design interfaces that encourage exploration

Design interfaces that constrain and guide users to select appropriate actions when initially learning.

Design Implications

Problem solving

- Provide information and help pages that are easy to access for people who want to understand more about how to carry out an activity more effectively (e.g., web searching).

- Use simple and memorable functions to support rapid decision-making and planning.

- Enable users to set or save their own criteria or preferences

HIPS Strengths and weaknesses (*versus* computer)

Strengths	Weakesses
LTM ~infinite capacity	STM limited capacity
LTM duration and complexity	STM limited duration
Capacity to learn	Error prone processing
Powerful selective attention	Non reliable access to LTM
Powerful pattern recognition process	Slow processing

Recommendation:
Assign tasks between user and computer according to the capacities of each

Example: minimize the users STM load
do not ask the user to perform computations

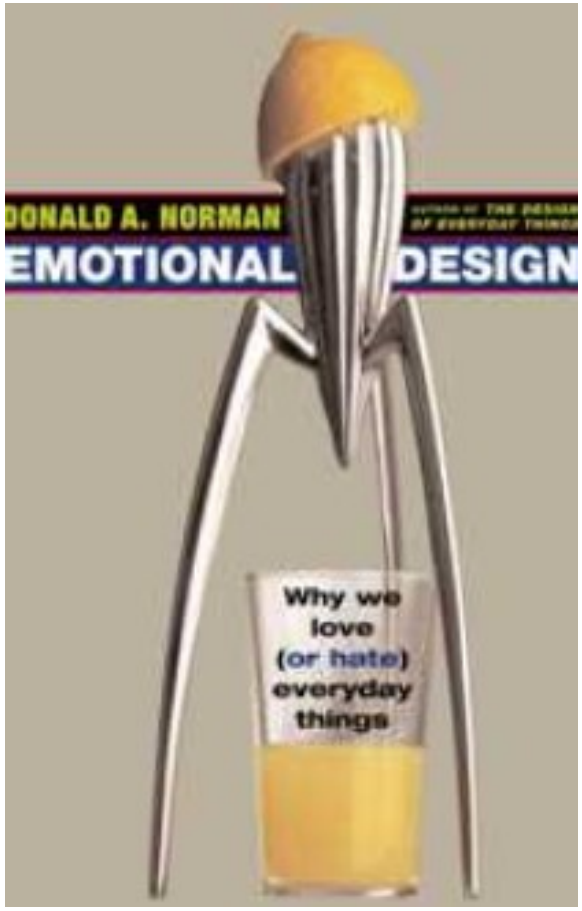
Emotion

- Various theories on how it works
- Involves cognitive and physical response to stimuli
- Biological response to a physical stimuli is called affect
- Affect Infuences how we react to situations

> “Negative affect can make it harder to do even easy tasks; positive affect can make it easier to do difficult tasks”
>
> (Donald Norman)

Not only the cognitive system is important

But also the **emotional system**



- Emotional design is a critical part of design

- Other Donald Norman videos:

http://www.youtube.com/watch?v=WI2LkzIkacM

http://www.youtube.com/watch?v=_PM3uqPNrWY

https://www.interaction-design.org/literature/book/the-encyclopedia-of-human-computer-interaction-2nd-ed/affective-computing

- As … moved from designing and evaluating work-oriented applications towards dealing with **leisure-oriented applications**, … we have had to consider e.g. what constitutes an *experience*, how to deal with users' ***emotions***, and understanding ***aesthetic*** practices and experiences"

https://www.interaction-design.org/literature/book/the-encyclopedia-of-human-computer-interaction-2nd-ed/affective-computing

User Profile- other characteristics (besides HIPS)

- Experience and knowledge - education and reading level
  experience with the system and task
  mother language
  computer literacy …

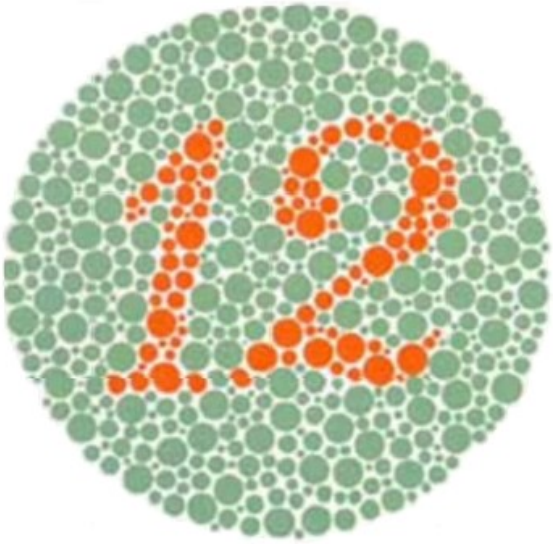
- Work and task - usage frequency
  training
  usage type (mandatory, optional)
  usage of other systems …

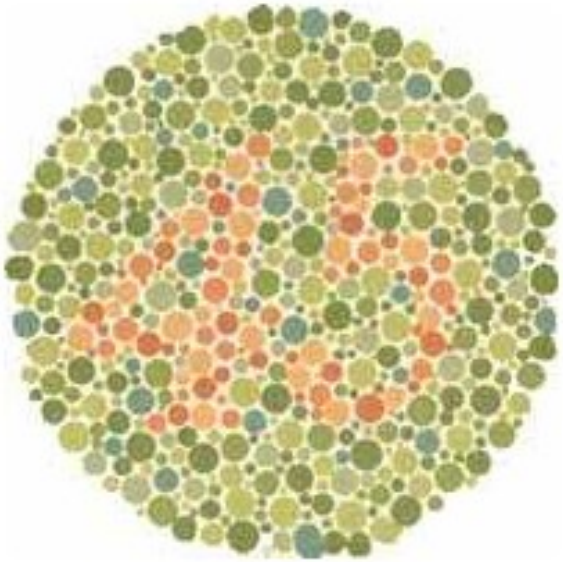
- Physical Characteristics – color vision deficiencies
  physical deficiencies
  handedness
  age …

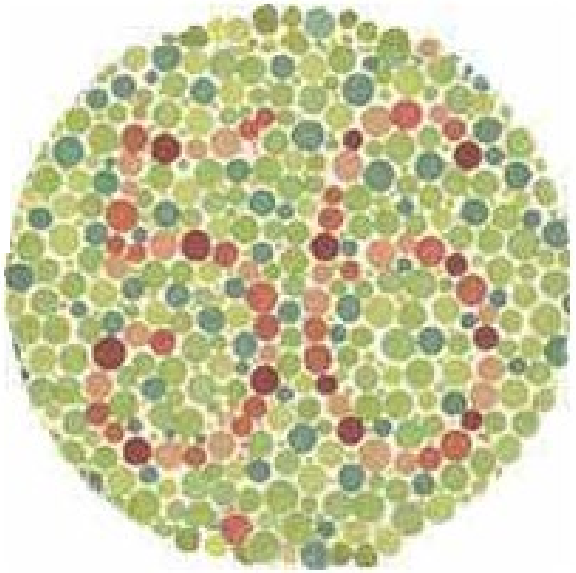
Don’t forget cultural aspects!!…

Color blindness

Ishihara test for red-green blindness (daltonism or deuteranopia)







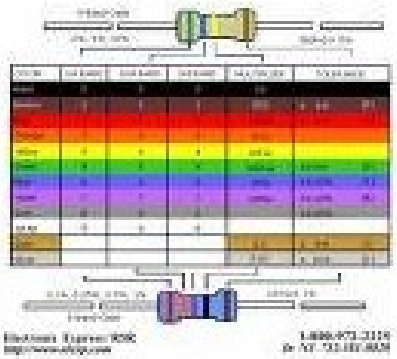
(Shinobu Ishihara,1917)

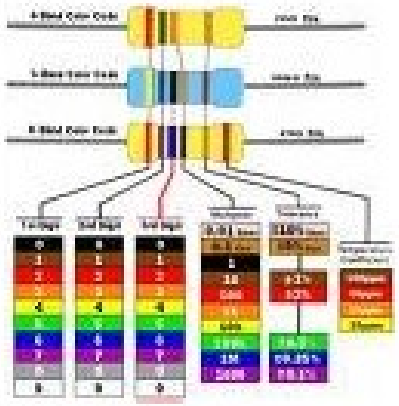
- The test includes 38 figures

A common color code
(that uses color as the only visual cue to convey information)

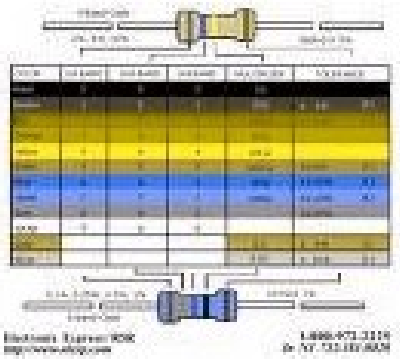
Does not work for deuteranopes !!

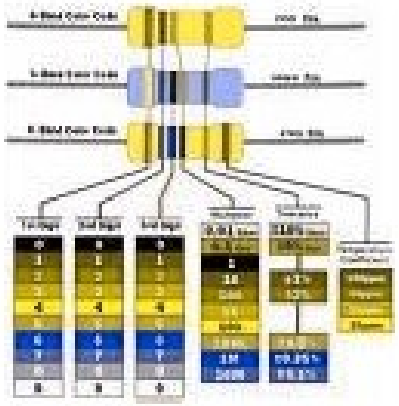
Original Image





as seen by a deuteranope (daltonic) observer





https://www.color-blindness.com/coblis-color-blindness-simulator/

User Profile - overview

- Human Information Processing System

- Experience and knowledge - education and reading level
  experience with the system and task
  mother language
  computer literacy …

- Work and task - usage frequency
  training
  usage type (mandatory, optional)
  usage of other systems …

- Physical Characteristics – color vision and physical disabilities
  handedness
  age …

Don’t forget Cultural aspects!!…

How do these characteristics influence UI design?

- Much system experience, but low task experience -> more semantic help
- Much task experience but low system experience -> more syntactic help
- High usage frequency -> easy to use
- Low usage frequency -> easy to learn and remember
- Mandatory -> easy to use
- Optional -> easy to learn and remember
- Color (particularly red and green) should not be used as only cue to convey information
  - Etc., …

The take away:

- Users are much different from designers/developers

- Users vary a lot among thenselves

- Users change along time (evolve, forget...)

Final recommendation:

We should consider the users as an unknown species and study them scientifically

Main bibliography

- Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, *Human-Computer Interaction*, 3rd edition, Prentice Hall, 2004 – chapter 1

Main bibliography

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