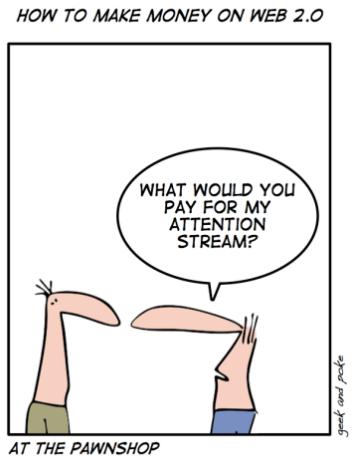
Topics in Cognitive Science … attention, memory & reasoning

12.06.2015
N.Lewandowski

MGK Lecture
SoSe 2015

What is attention?



Experiment:

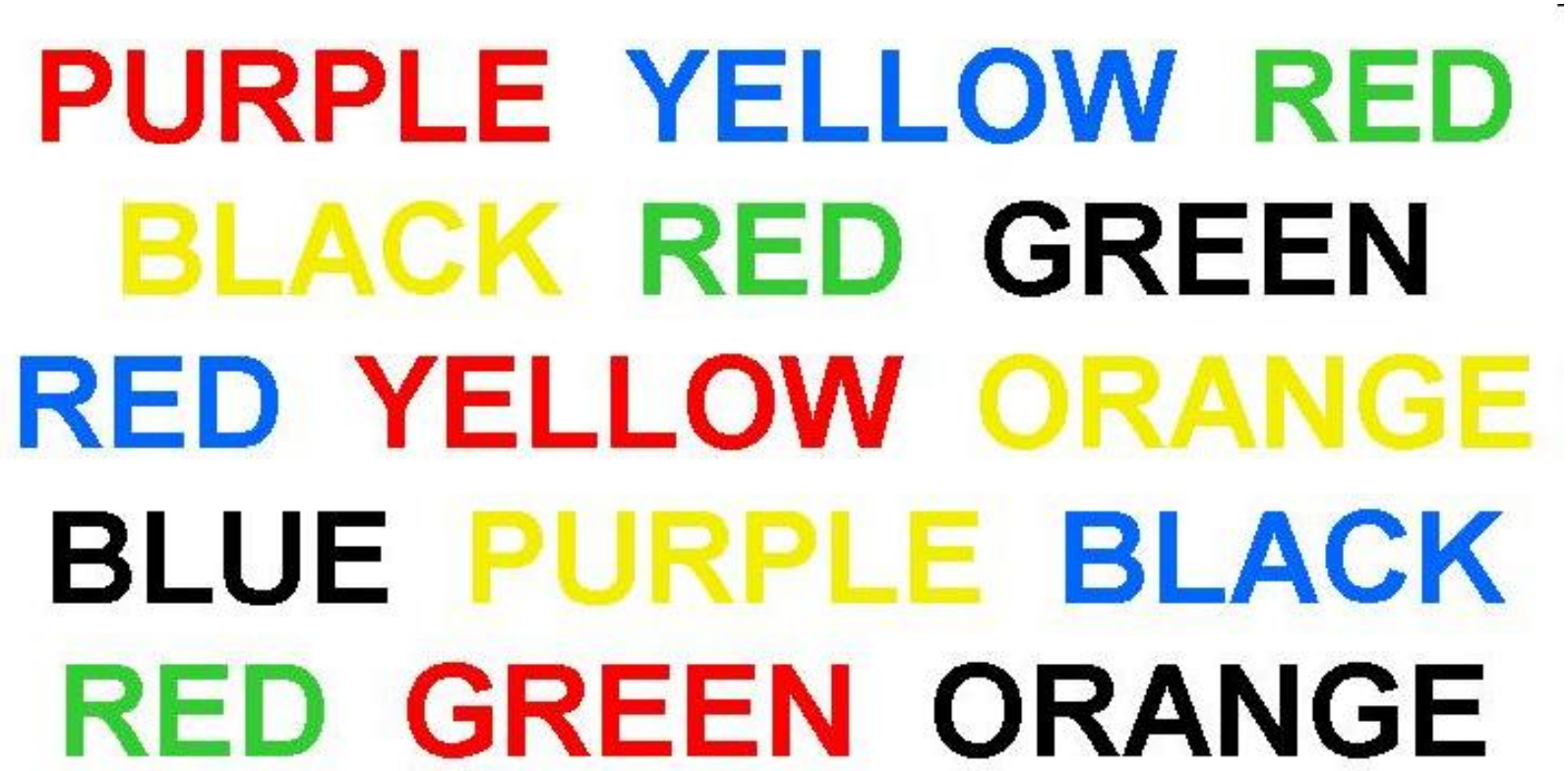
*Try to notice all the **objects and people** that surround you here in this room: all the shapes, sizes, colors, locations. Try at the same time to notice all **sounds** around you.*

Did you experience your visual & auditory attention to be overworked?

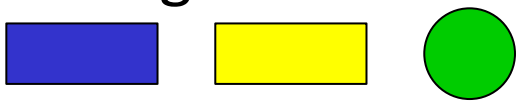
Attention is a concentration of mental activity that allows you take in a limited portion of the vast stream of information available from both your sensory world and your memory. (Matlin 2009)

The Stroop effect

Find yourself a partner & try to name the **color of the ink/print** as fast as you can!!



The Stroop effect

- People need a longer time to name the color of the ink if the ink prints an incongruent color name.
- When the color appears as a solid block, rectangular or circle – the task is very easy and much faster. 
- It happens because people get distracted by another feature of the stimulus.
- There is an emotional Stroop task for people who are suspected to suffer from a psychological disorder, e.g. phobic disorder, depression or being addicted to drugs or alcohol.
- Explanations for the Stroop effect:
  - parallel distributed processing (PDP) -> two pathways are active and competing
  - reading is the more automatic task

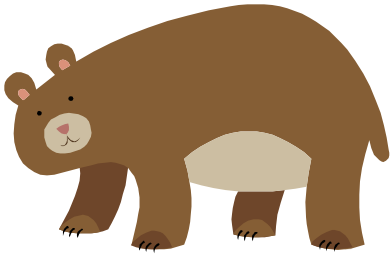
Test your perception!

Watch the movie and follow the instructions they give!

https://www.youtube.com/watch?v=vJG698U2Mvo

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

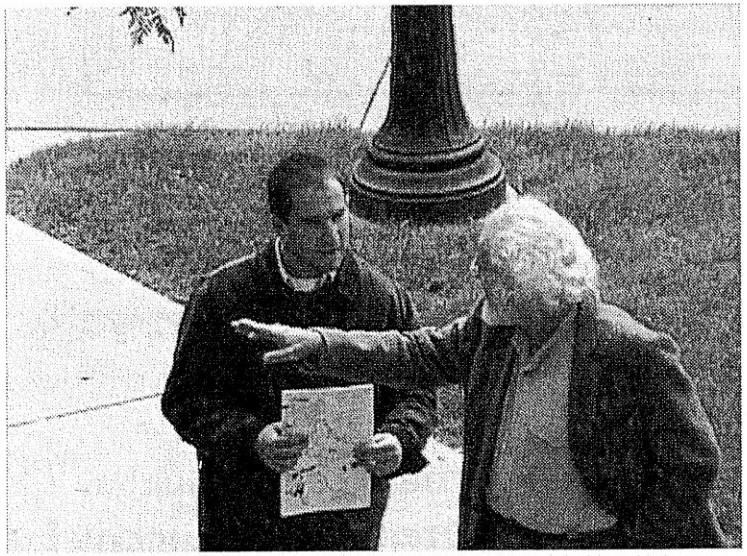
Inattentional blindness



- Inattentional blindness occurs when you are paying attention to something but you fail to notice an unexpected but completely visible object.
- When there is only a partial change of the stimulus we speak of change blindness**.** An example is the study of Simons/Levin (1998) – where a stranger asking for directions was replaced by another stranger in the middle of the conversation. Only half of the test subjects noticed that they are talking to a different person!
- When perceiving a scene, we assume that it will stay stable, which is a rational assumption.

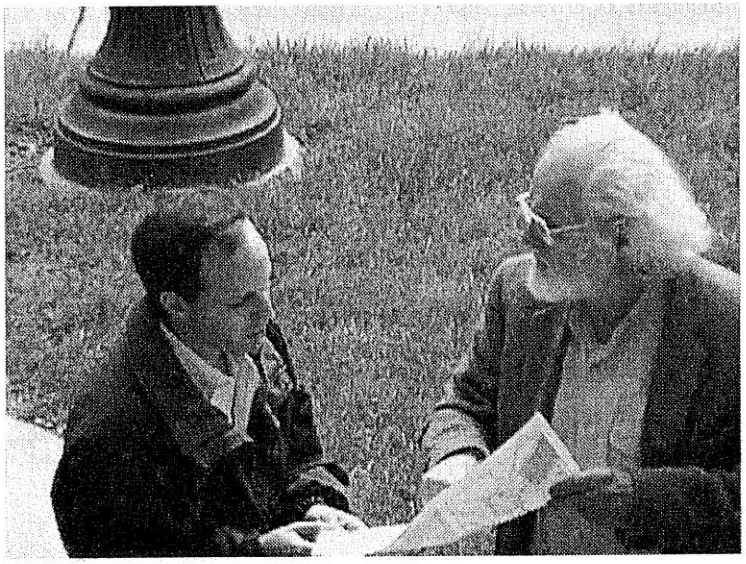
Change blindness (Simons/Levin 1998)

A

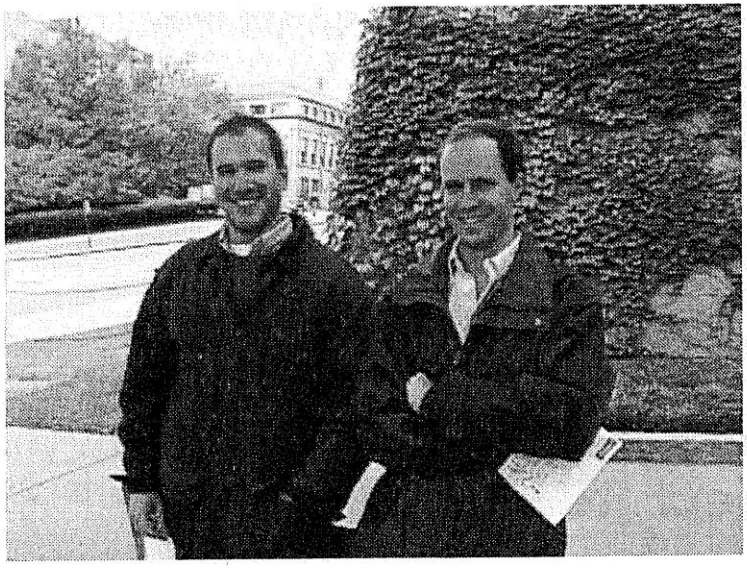


B

C



D



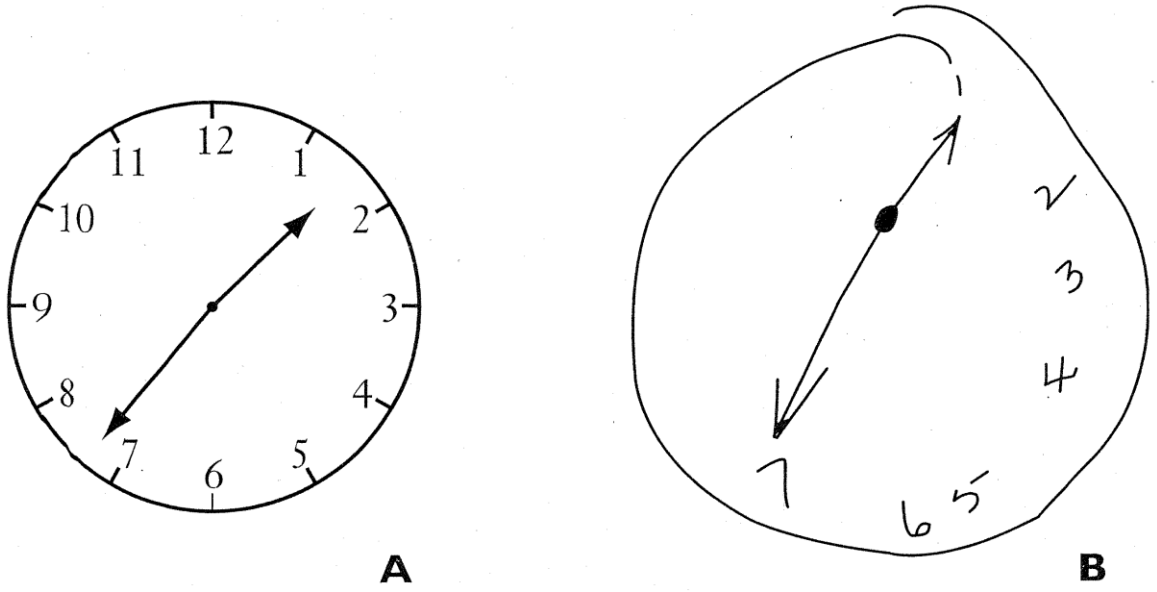
The Orienting Attention Network

- The orienting attention network is required e.g. in visual search where it is necessary to switch attention to various spatial locations.
- It is settled in the parietal lobe, on both sides (left responsible for the right-hand side, right for the left-hand side).
- If a person has a lesion in one of the two hemispheres in the parietal lobe at those spots they might suffer from unilateral neglect.

Unilateral neglect

FIGURE 3.3

The Original Figure (A) Presented to a Man with a Lesion in the Right Parietal Lobe, and the Figure He Drew (B).



Source: Bloom & Lazerson, 1988.

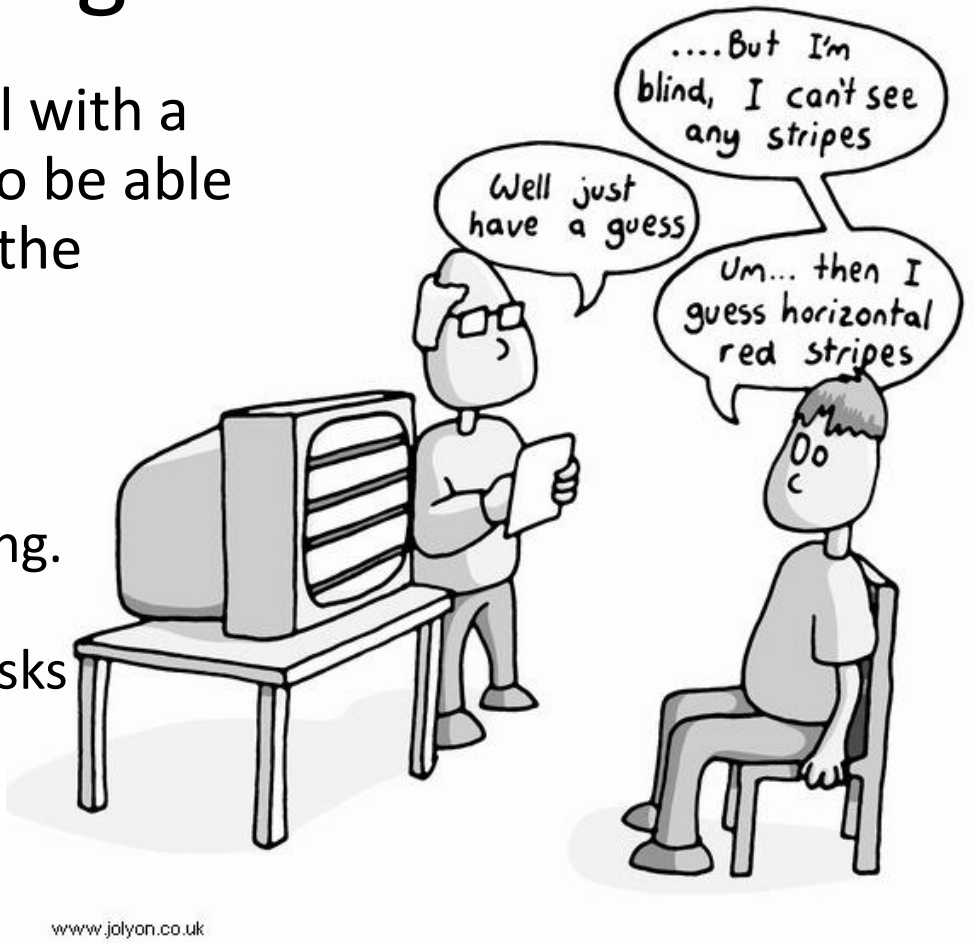
Top down & bottom-up processing

- Attention also allows us to combine sensory input with items in our memory (our [world] knowledge, our lexicon…)
- What we perceive does not meet with a "blank space"
- Bottom-up processing (from sensory input to our brain) meets with top-down processing (in the direction of our brain resources towards the input).
- A human being always has EXPECTATIONS!
- Examples: recognizing words or melodies, failing to notice unexpected gorillas in a scene, understanding speech (with "delay").

Blindsight

= a condition in which an individual with a damaged visual cortex claims not to be able to see an object but he/she can at the same time accurately report some characteristics of that object, e.g. its location.

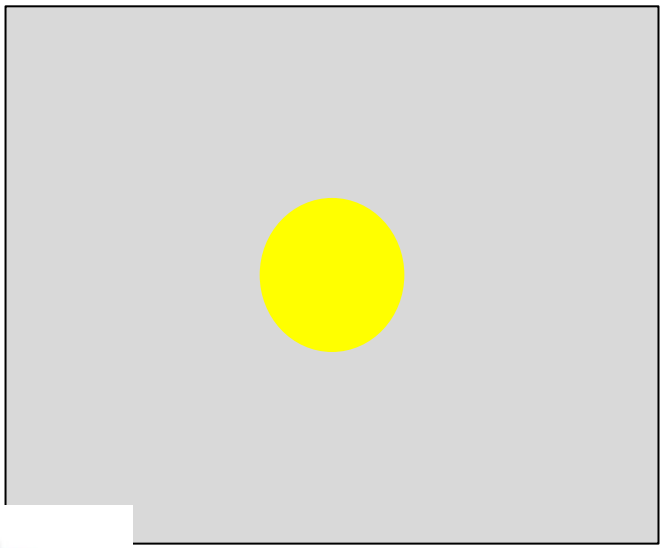
The patients say they can‘t see anything. Experiments though have shown that they perform better than chance in tasks as pointing to the light (which they claim not to see).



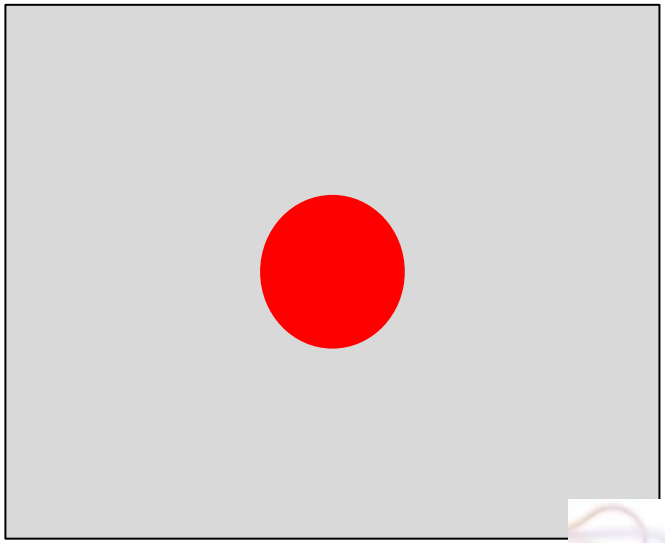
Current explanation: not all information from the retina travels to the visual cortex but to other locations as well – which allows the person to recognize some of the characteristics. However – it seems as if the info. needs to pass through the visual c. in order to be consciously registered – if it does not, the patient is not aware of his perception.

Example task with executive attention network active

Click **LEFT** if the dot is yellow

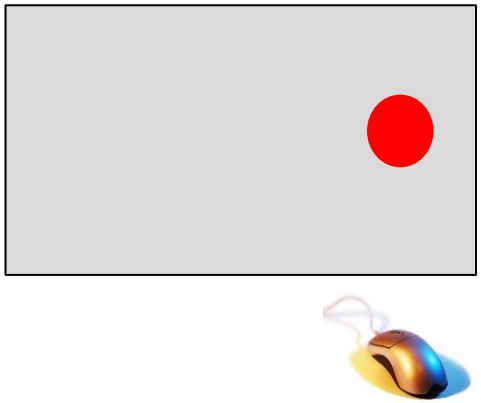


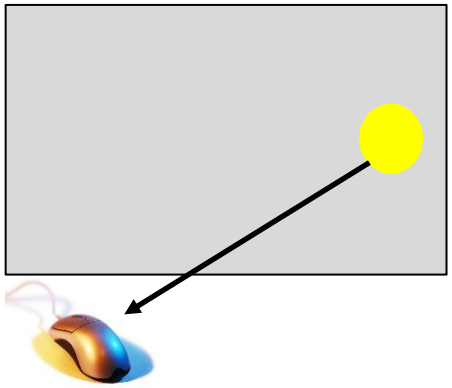
Click **RIGHT** if the dot is red



Simon test – for mental flexibility

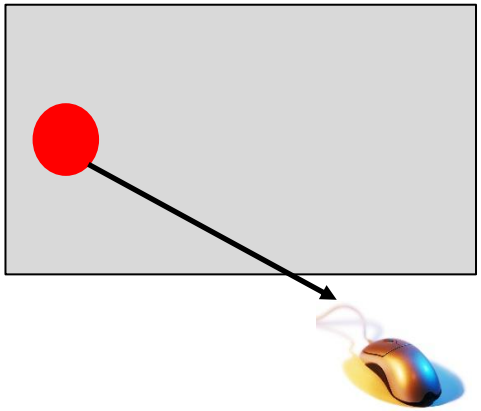
congruent = easy





incongruent =

difficult



-> <u>slower RTs</u> + more errors

Memory

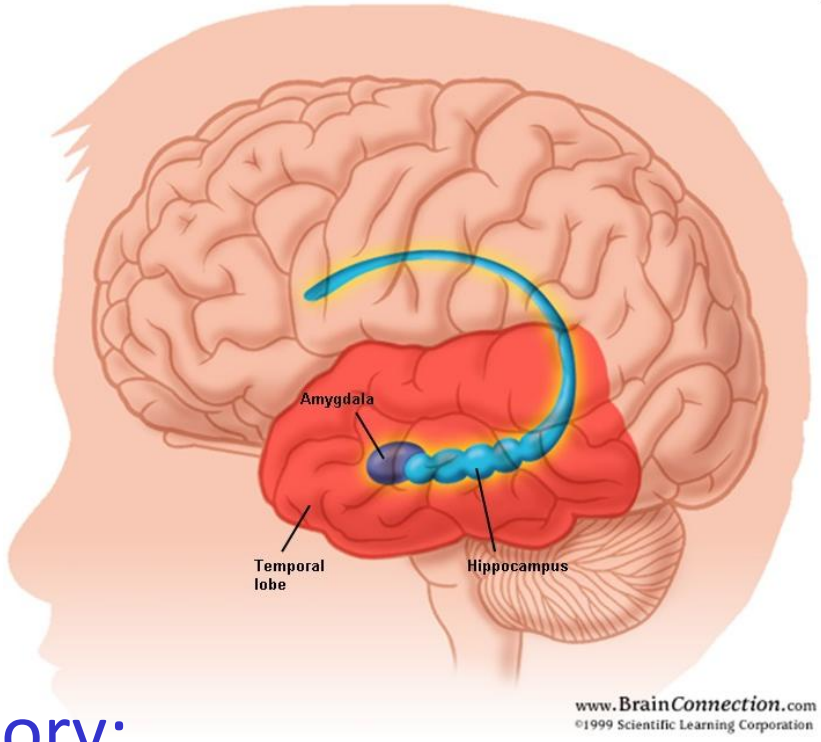
Superiority & Failure

What would we be
w i t h o u t memory?

?

And what if we could remember
e v e r y t h i n g?

When memory amazes!



Superior autobiographical memory:
https://www.youtube.com/watch?v=oHeEQ85m79I

(start approx. 1min)

When memory fails…

When damaged →severe cases of amnesia:

Short movie extract from a BBC program on amnesia:
https://www.youtube.com/watch?v=Vwigmktix2Y

- Anterograde amnesia: inability to store new information after the accident/stroke/illness on a long-term basis. The patients remember only what is within the short-term memory span.

- Retrograde amnesia: loss of memory from before the incident, it can even extend as far back as three years time.

- The hippocampus seems to "file away" memories. Where to? They are probably ultimately stored (=consolidated) close to or in the areas that were active during their initial encoding (sensory areas). In the meantime (up to 3 years) the hippocampus stores the information.

Reasoning

D. Kahneman “Thinking, fast and slow”

Introducing D.Kahneman's ideas

- Our mind works with the help of two systems:

System 1 – impulsive, intuitive & automatic

System 2 – thoughtful, calculating & deliberate

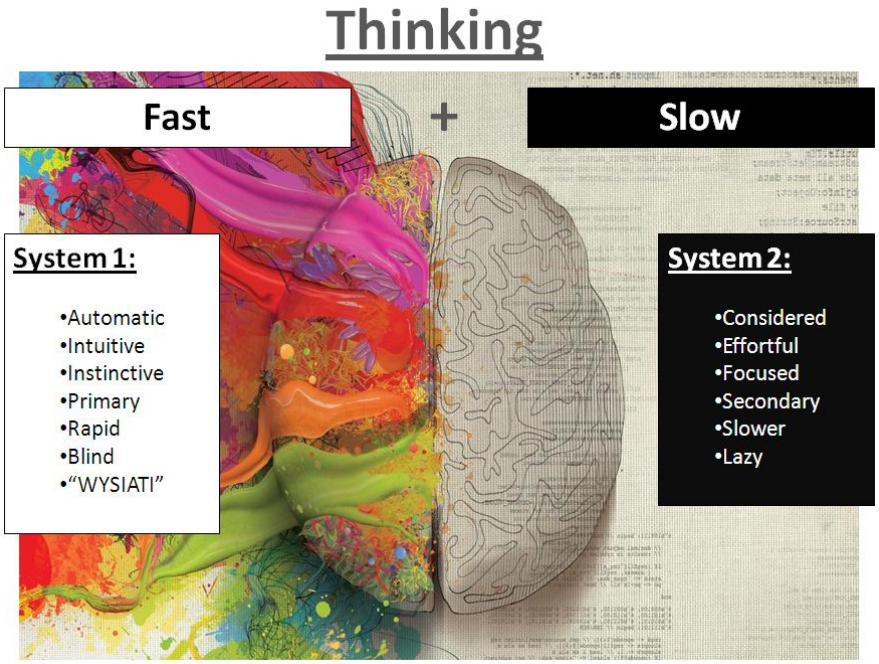
Examples of System 1 acting:

- Orient towards a sudden sound
- Answer 2+2
- Detect different distances of objects
- Understand simple sentences
- Read large print
- complete the phrase "Fish and … "

Examples of System 2 acting:

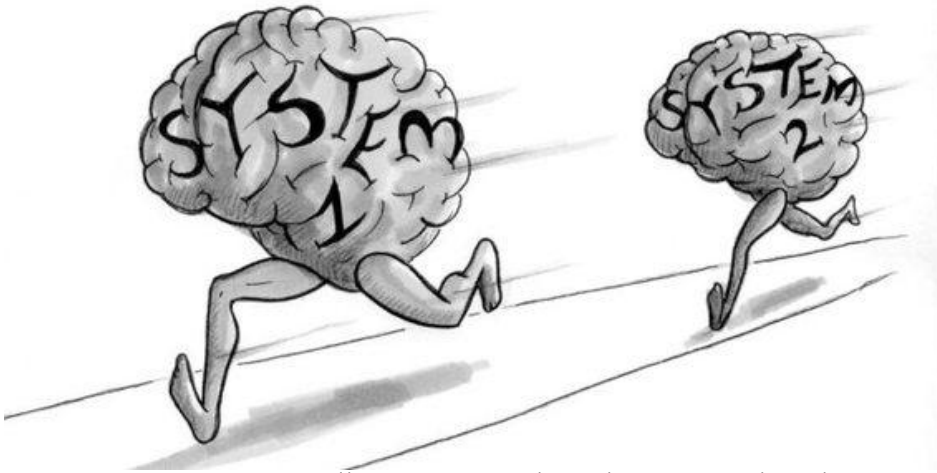
- Focus attention on basketball players wearing white
- Focus on the voice of 1 person in a crowd
- maintain a faster walking speed than normal
- monitor the appropriateness of your behavior in a social situation
- look for a guy with blue glasses

System 1



- Is largely automatic
- Does not require conscious attention
- Is quick (much quicker than system 2)
- Delivers first intuitions & judgments
- Is the "lazy mode" of our brain
- Whatever can be done only by using System 1, will be done so - > our mind wants to save energy!

System 2



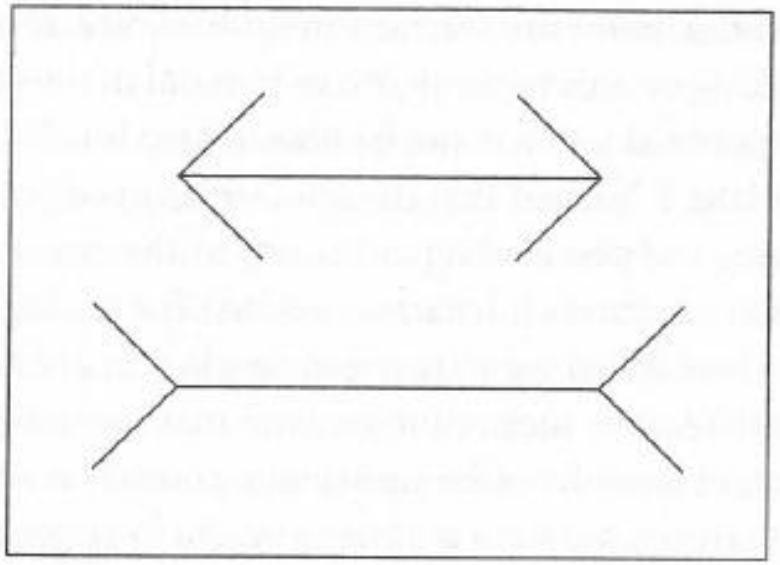
http://assets4.bigthink.com/system/idea_thumbnails/54524/headline/BigThink_System_1_2.jpg?1394211473

- Slow
- analytic
- effortful
- what we think of as “This is ME”
- self-controlling
- needs focused attention

Examples of conflicts between the two systems

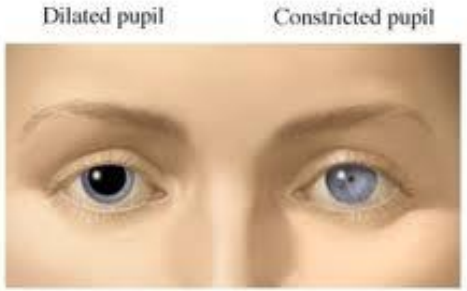
Your first task is to go down both columns, calling out whether each word is printed in lowercase or in uppercase. When you are done with the first task, go down both columns again, saying whether each word is printed to the left or to the right of center by saying (or whispering to yourself) "LEFT" or "RIGHT."

LEFT	upper
left	lower
right	LOWER
RIGHT	upper
RIGHT	UPPER
left	lower
LEFT	LOWER
right	upper



Both figures from Kahneman 2012: Thinking: fast and slow.

Mental effort



http://www.primehealthchannel.com/wp-content/uploads/2011/06/dilated-pupils-image-11.jpg

- The more difficult the task, the more your pupils get dilated.
- Dilation proceeds in an inverted V curve – as effort increases, pupils dilate and start constricting again when your working memory gets unloaded.
- Our brain is constantly trying to save attention capacities = the law of least effort

⇒ If there are several solutions to one problem, people tend to choose the least demanding way (which often means relying on System 1)

⇒ indicators: less dilated pupils and less brain activation

- What requires most effort?
  - Keeping in memory several ideas that require separate actions or need to be combined according to some rule
  - System 2 is needed here: for deliberate choices, comparisons between objects/features and also following rules

Self-control

- System 1 has more influence on behavior when System 2 is busy: the sinful chocolate dessert problem – demanding cognitive task + tempting choice.

- System 2 is responsible for controlling thoughts and behaviors.
- An effort of will/self-control is tiring. Example: people forced to resist a temptation or stifle emotional reactions are later on giving up earlier in a test of physical (!) strength.

System 2 is lazy

- The ball and bat problem:

For an example, here is a simple puzzle. Do not try to solve it but listen to your intuition:

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

- Problem: System 1 delivers a fast, intuitive and appealing answer – which is, however, wrong.
- Overcoming the wrong answer costs some effort, System 2 has to be switched on to check the answer System 1 is suggesting, and to reject it.

Self-control and intelligence

- The Oreo/ Marshmallow experiment with 4-year-olds (originally designed by W. Mischel)

https://www.youtube.com/watch?v=NLXYkuJ6SyU
https://www.youtube.com/watch?v=Yo4WF3cSd9Q

- Longitudinal results: 10-15 years later the kids who resisted the temptation
  - had higher measures of executive control in cogn.tasks
  - higher ability to reallocate their attention effectively,
  - were less likely to take drugs
  - and had much higher scores on intelligence tests

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Cognitive Ease & Exhaustion

- Our mind strives for cognitive ease:
  - effortless operations, intuitions, first guesses,
  - good mood,
  - easy to decipher fonts (in reading), easy to understand messages (in listening)

  –> this can be done with S1
- Introducing strain mobilizes System 2 (often to a good effect): e.g. the Cognitive Reflection Test (CRT)

Answer according to your first intuition only!!! Be quick!!

If it takes 5 machines 5 minutes to make 5 widgets, how long would it take 100 machines to make 100 widgets?

100 minutes OR 5 minutes

In a lake, there is a patch of lily pads. Every day, the patch doubles in size. If it takes 48 days for the patch to cover the entire lake, how long would it take for the patch to cover half of the lake?

24 days OR 47 days

- Experiment at Princeton: 40 students, 2 groups, one saw it in small and washed out font, the other in normal font
- In one group 90% made at least 1 mistake, in the other only 35% - which group produced which results? (picture source "CRT questions": Kahneman 2011, p.65)

To believe or not to believe

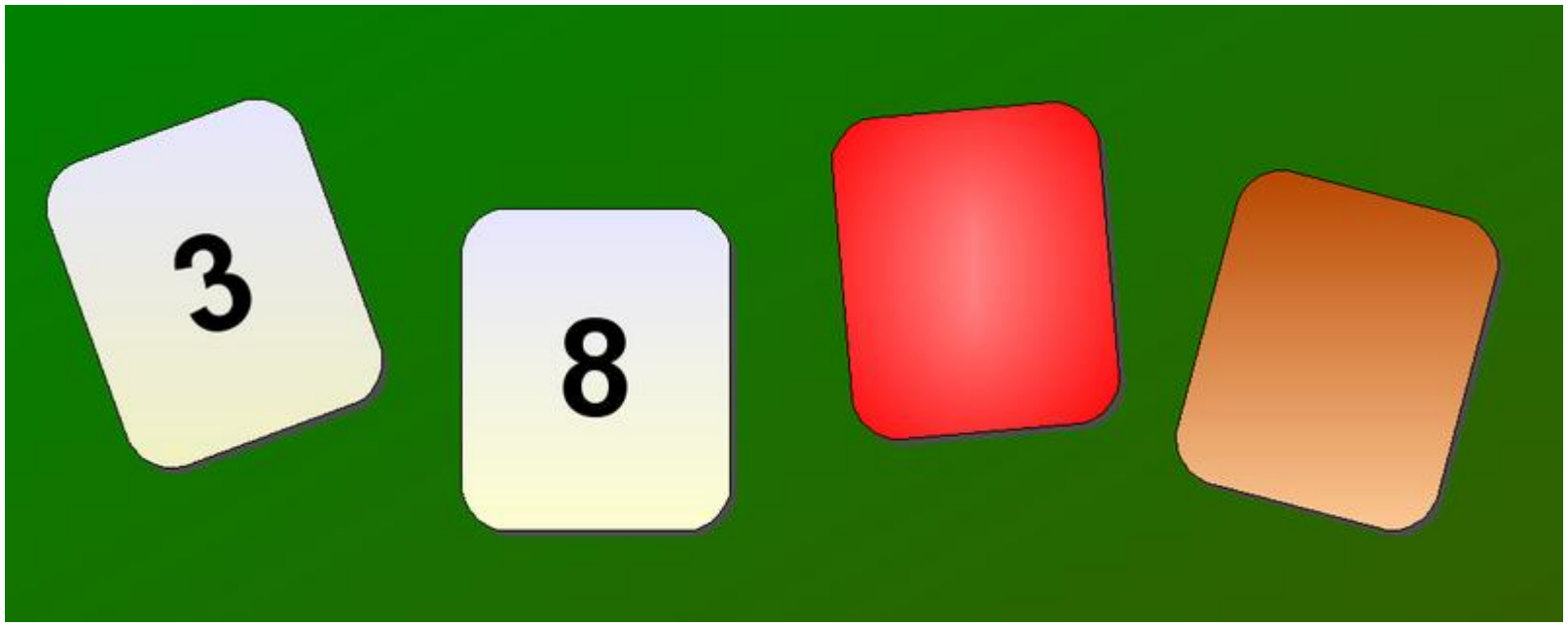
- System 2 is responsible for verification of truths/beliefs and for "unbelieving" false statements
- If System 2 is busy, our mind (S1) will believe almost anything: experiment "Nonsense sentences" (Kahneman 2011, p.81)
  - "A dinca is a flame" -> True/False -> memory test in the end (2 conditions: one "normal" and one with holding digits in memory
- Same effect when tired and depleted: we are faster influenced!

  -> do you have own examples?

Wason Selection Task experiment

(Wason,1968)

- Which card(s) should you turn over in order to test the truth of the proposition that **if** a card shows an **even number** on one side, then its opposite side is **red**?



Confirmation bias

- People seek information to CONFIRM their beliefs and intuitions – the work of S1
- They do not automatically look for negative information
- People perform better on the WST in concrete, socially relevant tasks (and worse in abstract ones)
- S1 causes us to uncritically accept suggestions, and exaggerates the likelihood of extreme and improbable events
- WYSIATI: what you see is what there is -> S1 facilitates achieving coherence; too much information can slow down decisions (S2 would have to get active); examples: same story with two differing endings and both listener groups claim the endings logically follow the content => S1 is trying to make sense of the information there is + doubt and ambiguity are being suppressed!