Evaluation

Type of Evaluation	Weightage (in %)
Quizzes (2)	40%
End Sem Exam	60%

Textbook: Daniel Reisberg (2019). Cognition: exploring the science of the mind. 7th Edition. W. W. Norton & Company, NY, USA

Brain & Cognition

- integration of the neurosciences and cognitive sciences

Kavita Vemuri

I am given the following words:

- EAT, ME, WANTs and LION

Thinking 1: The lion wants to eat me.

Thinking 2: I want to eat the lion.

- Betsy wanted to bring Jacob a present. She shook her piggy bank. It made no sound. She went to look for her mother. (Charniak, 1972)

What is Cognition?

- *It* encompasses the mental functions by which knowledge is acquired, retained, and used: perception, learning, memory, and thinking.
- cognicioun, “ability to comprehend, mental act or process of knowing”, from Latin cognoscere “to get to know, recognize,” from assimilated form of com “together” + gnoscere “to know” ..(from https://www.etymonline.com/word/cognition).

- Most important is ‘reasoning’

Understanding the definition/word cognition

- The word seems straightforward, yet it is often a cause of debate in the psychological and neuroscience fields, particularly about whether a behaviour of an animal that happens not to be human is truly “cognitive”, in a similar sense to human cognition.
- Does this mean the birds “know” about the displacement of water by sinking objects?

(/www.cell.com/current-biology/fulltext/S0960-9822(09)01455-9).

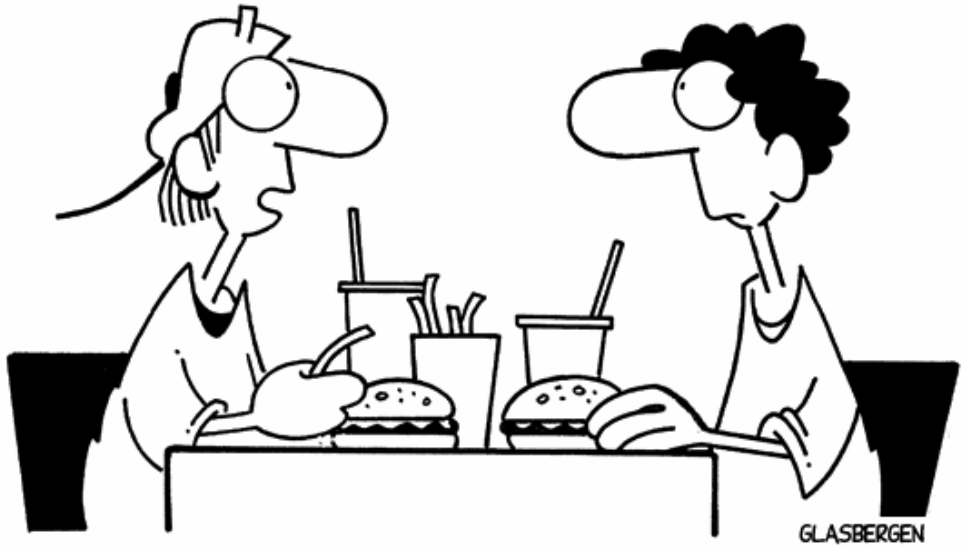
- Researchers have long investigated whether birds possess the mental equivalent of a compass, driven by observation of sun or stars, or a map, driven by geomagnetism.
- That is, mental maps and compass bearings are representations of information that imply specific c properties, the bread-and-butter of cognitive theorizing.

Cognition in non-human animals

- J. David Smith, Ph.D., a comparative psychologist at the University at Buffalo who has conducted extensive studies in animal cognition, says there is growing evidence that animals share functional parallels with human conscious metacognition -- that is, they may share humans' ability to reflect upon, monitor or regulate their states of mind.
- Among these species are dolphins and macaque monkeys (an Old World monkey species).

"It's called 'reading'. It's how people install new software into their brains"

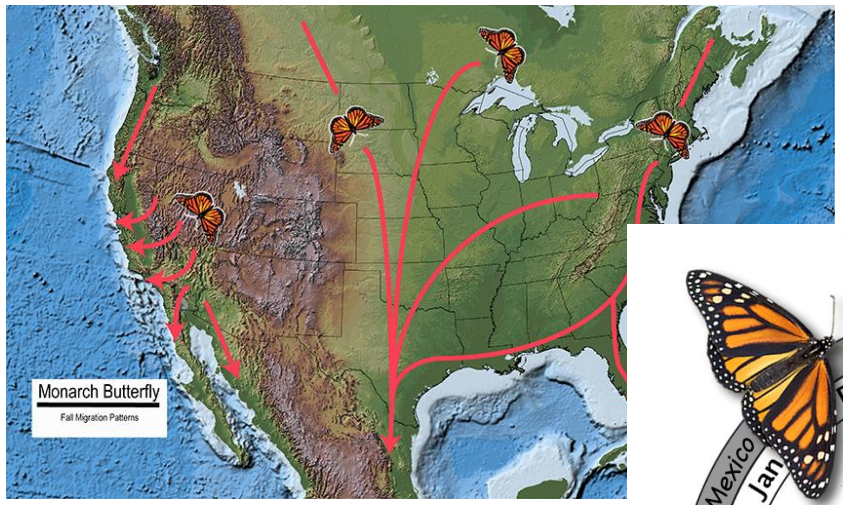
TeachingMadeEasier.com Facebook shares...

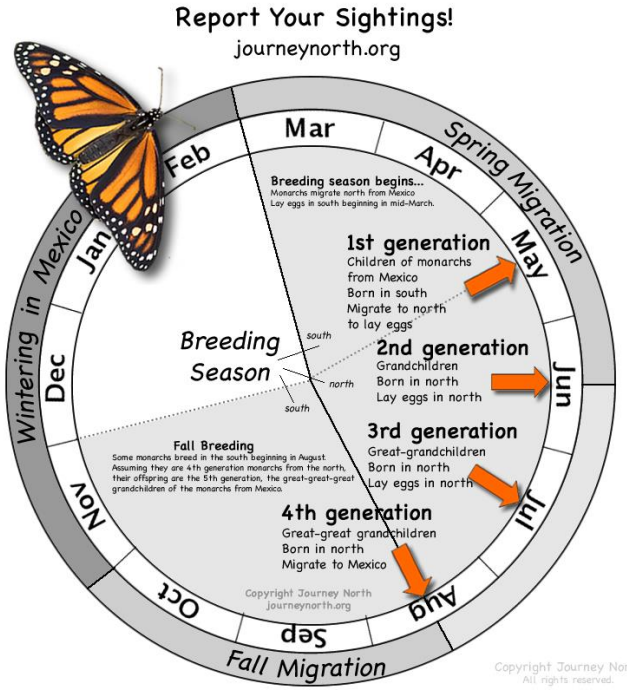


"I forgot to make a back-up copy of my brain, so everything I learned last semester was lost."

Unsolved Mysteries & intriguing research of the brain

Migration of the Monarch butterfly





How did the wasp/bird learn to build?

https://www.youtube.com/watch?v=B9amFX3lVgM

https://journeynorth.org/sites/default/files/2019-01/annual_cycle_wheel.jpg

The case of Anna H

Oliver Sacks

- Dear Dr. Sacks,

My (very unusual) problem, in one sentence, and in non-medical terms, is:

I can't read. I can't read music, or anything else.

In the ophthalmologist's office, I can read the individual letters on the eye

chart down to the last line. But I cannot read words, and music gives

me the same problem. I have struggled with this for years, have been

to the best doctors, and no one has been able to help.

I would be ever so happy and grateful if you could find the time to see me.

Sincerely yours,

Anna H.

The case of Anna H

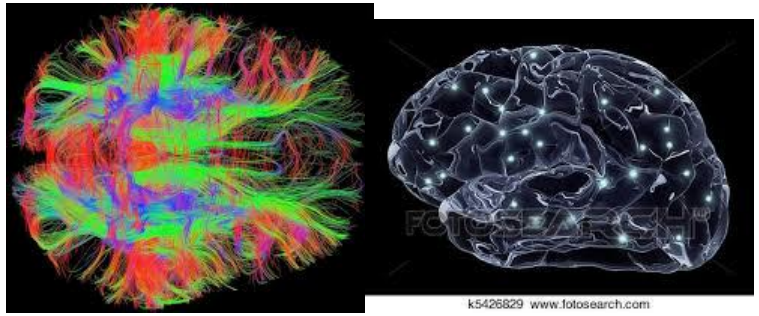
- Given a battery of neuropsychological tests—tests of visual perception, of memory, of verbal fluency, etc.—Mrs. H. did particularly badly in the recognition of drawings: she called a violin a banjo, a glove a statue, a razor a pen, and pliers a banana.
- Shown a photograph of a face, she could perceive that the person was wearing glasses, nothing else
- In contrast to her severe visual problems, her speech comprehension, repetition, and verbal fluency were all normal.
- A PET scan showed lower activity in the posterior Visual cortex (dominantly on the left side)

The case fo Howard Engel

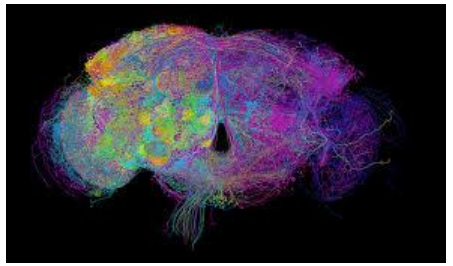
- Howard Engel, a Canadian novelist, who told me that he had a somewhat similar problem following a stroke. “The area affected,” he relates, “was my ability to read. I can write, but I can’t read what I’ve just written. . . . So, I can write, but I can’t rewrite. . . . My vision for the most part is unaffected until I look at a text. Then, whatever I’m looking at turns into unfamiliar blocks of type that could at first glance be taken for Serbo-Croatian. Familiar words, including my own name, are unfamiliar blocks of type and have to be sounded out slowly. Each time a name recurs in an article or review, it hits me as unfamiliar on its last appearance as it does on the first. . . . I have just started [writing] a crime novel in which the hero has similar problems.” Though Engel was a fair sight reader, he told me later, he had no musical alexia

Caenorhabditis elegans

302 neurons and 7,000 connections



86 billion neurons in our brains



Drosophila melanogaster

roughly 135,000 *neurons* in the brain

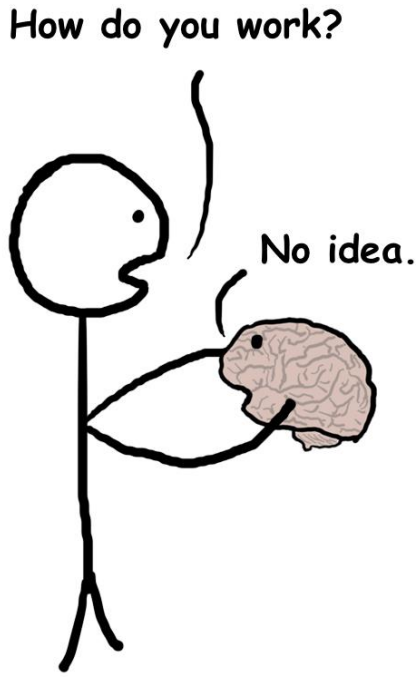
What is not known still?

- **What is the brain made of?**
- **How does the brain change in disease?**
- **How do neurons talk to each other?**
- **How does the brain compute?**
- **What will it mean to understand our brains?**

https://alleninstitute.org/what-we-do/brain-science/news-press/articles/5-unsolved-mysteries-about-brain

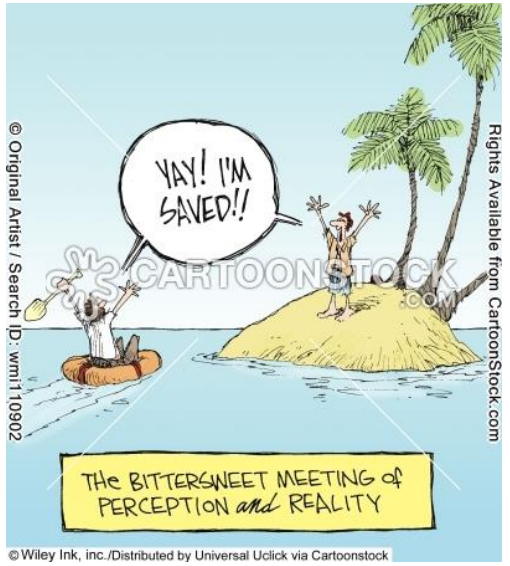
Top unsolved or most researched topics in neuroscience

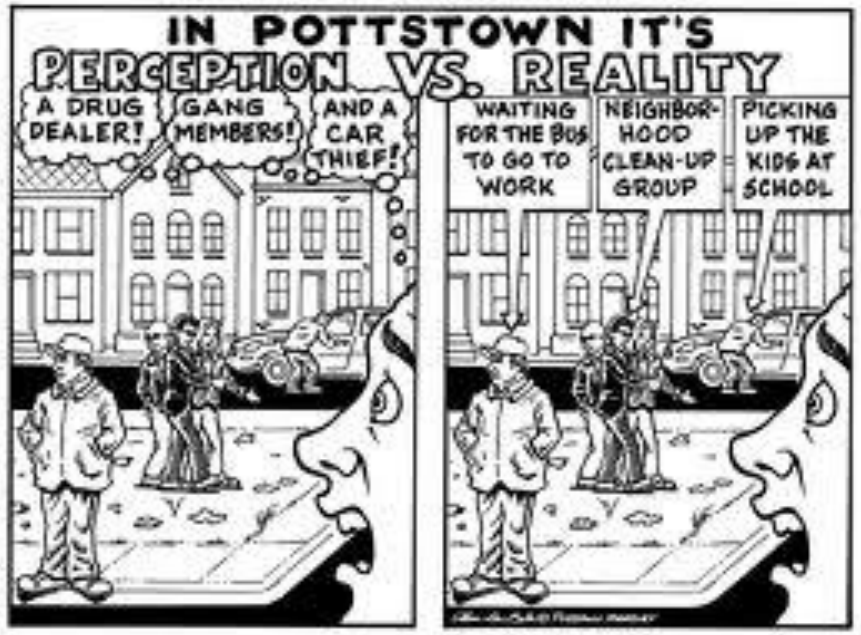
- Perception
- Consciousness
- Learning and memory:
- Neuroplasticity
- Development and evolution:
- Cognition and decisions
- Language
- Diseases

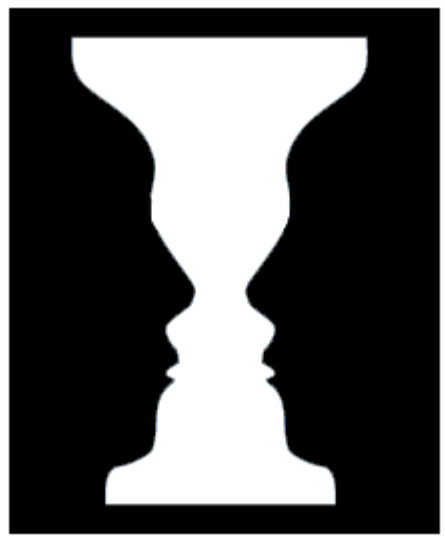


Perception

- Sensory input into coherent (private) percept's.







Consciousness:

Neuronal basis of:

- subjective experience
- Cognition
- Wakefulness
- Alertness
- Arousal
- Attention

How do brains simulate the future?

Essentially, it asks: what is consciousness? Or how do we think?

Is simulation possible without learning & the experience that comes with learning?

Are we conscious of things we have no knowledge off ?

MUST WATCH

- http://www.youtube.com/watch?v=X4A6oHFLWSA

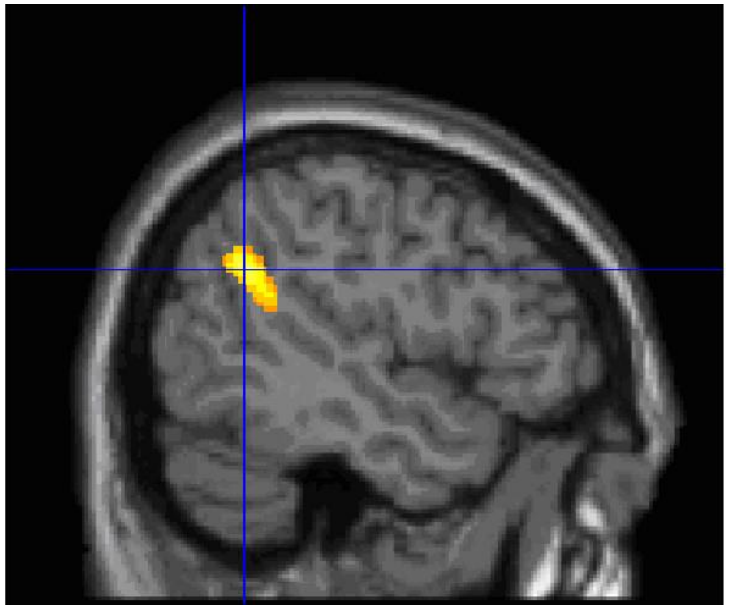
_ the interview with Nobel Laureate in Medicine, Dr Eric Randel.

personal favourites

Dreams

Recalling dreams: The high-recallers and the low-recallers.

- temporo-parietal junction (information-processing hub and attention orienting toward external stimuli) and medial prefrontal cortex



Credit: © Perrine Ruby / Inserm

Visual/mental imagery & vivid projections of images internally!

- The Question is: how is the image formed, stitched and presented.
- Or is visual imagery really visual?

Sleep walking

- Brutal act: Case of Scott Falater – 43 year old who stabbed his wife & ducked her in the pool in 1997. When interrogated, he claimed does not recall the complete act - When he was tried, the prosecution claimed that after the murder had been committed, Falater changed his clothes, put the murder weapon in a Tupperware container, put the container in a trash bag with his boots and socks, stashed the bag in the spare tire well in the trunk of his car, and took and hid all the items that showed that he was the person who killed her.
- On June 18, 1999 a prosecution expert testified that Falater's actions were "too complex" to have been carried out while sleepwalking. Four weeks later, Scott Falater was found guilty of first degree murder and sentenced to life in prison without chance of parole

phantom limbs

- the vivid impression that the limb is not only still present, but in some cases, painful.
- Patient recognizes that the sensations are an illusion(unreal vision) not a delusion (false beliefs).
- Case of elaborate sensory memories

Major debates

Ongoing debates today

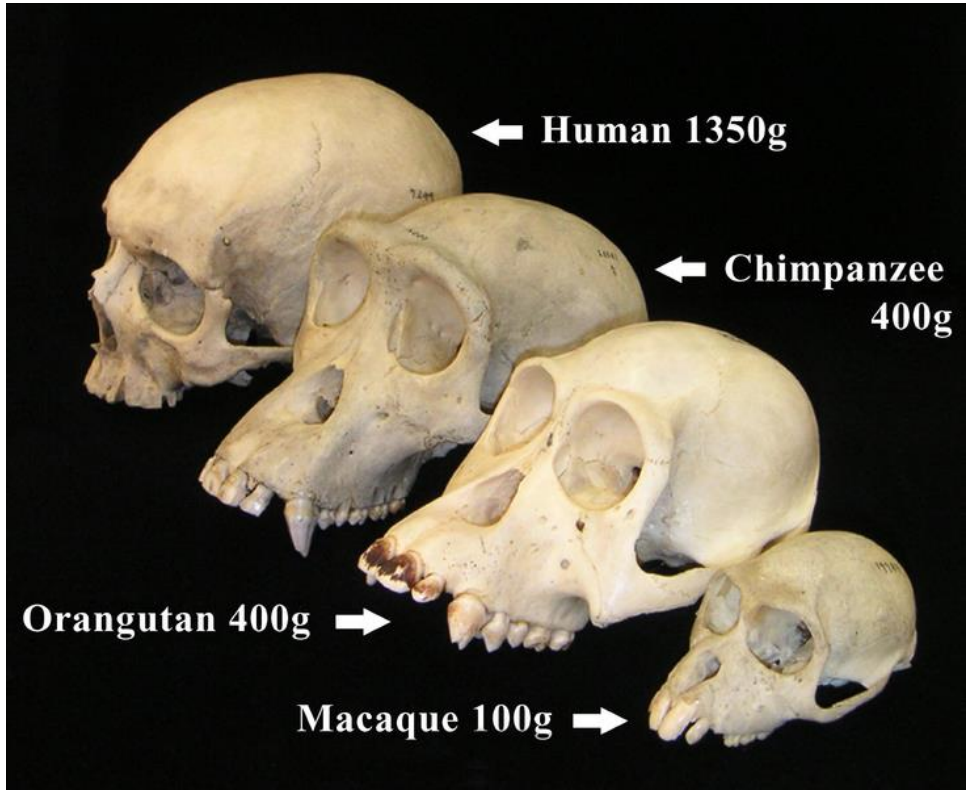
- Local versus widespread functions in the brain
- The neuron doctrine (*Advocates of the neuron doctrine claimed that the nervous system was composed of discrete cellular units. Proponents of the alternative reticular theory, on the other hand, argued that the entire nervous system was a continuous network of cells, without gaps or synapses between the cells*)
- The question of consciousness
- Unconscious inferences in vision
- Capacity limits in the brain
- Short-term and long-term memory: are they separate?
- The biological bases of emotions – to an extent established (the role of hormones & limbic lobe)
- Nature *versus* nurture, genes *versus* environment

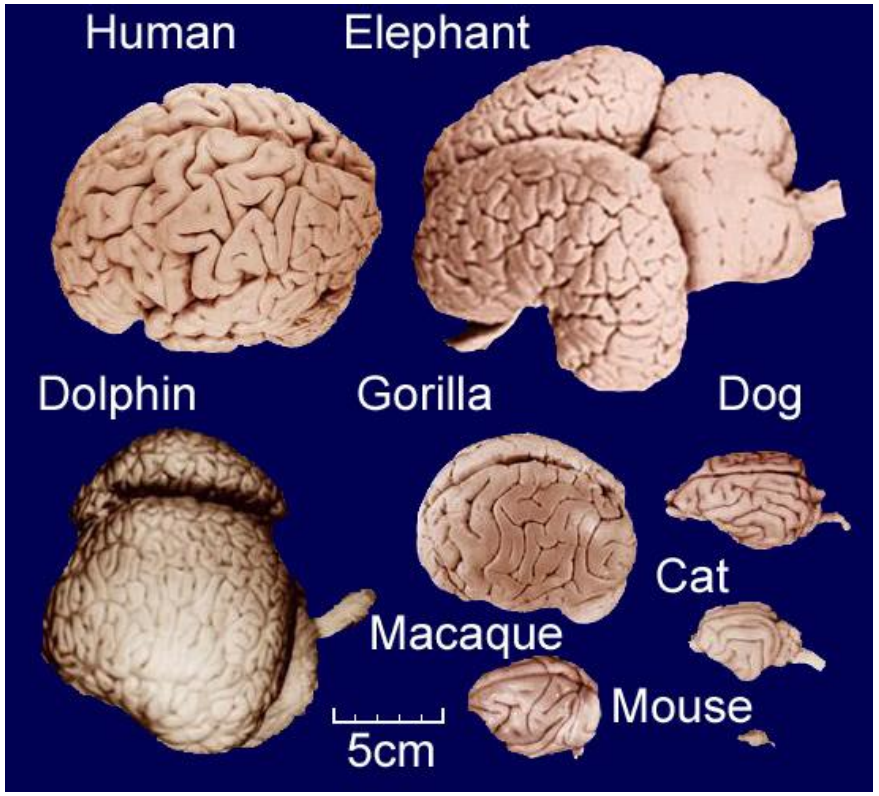
Interesting titbits & myths

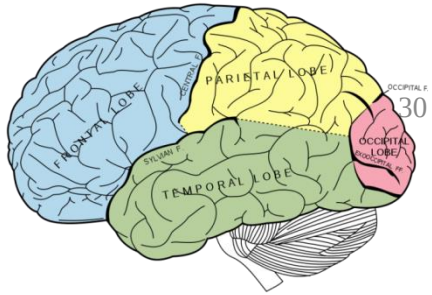
- The fastest (simple) reaction time to a stimulus is about 100 milliseconds, and the time it takes for a sensory stimulus to become conscious is typically a few hundred milliseconds.
- Until Andreas Vesalius, a Belgian physician (1514 – 1564), it was widely believed that women had one less rib than men, based on the Biblical story of Adam and Eve.
- Descartes is often considered to be the originator of modern mind/body philosophy.

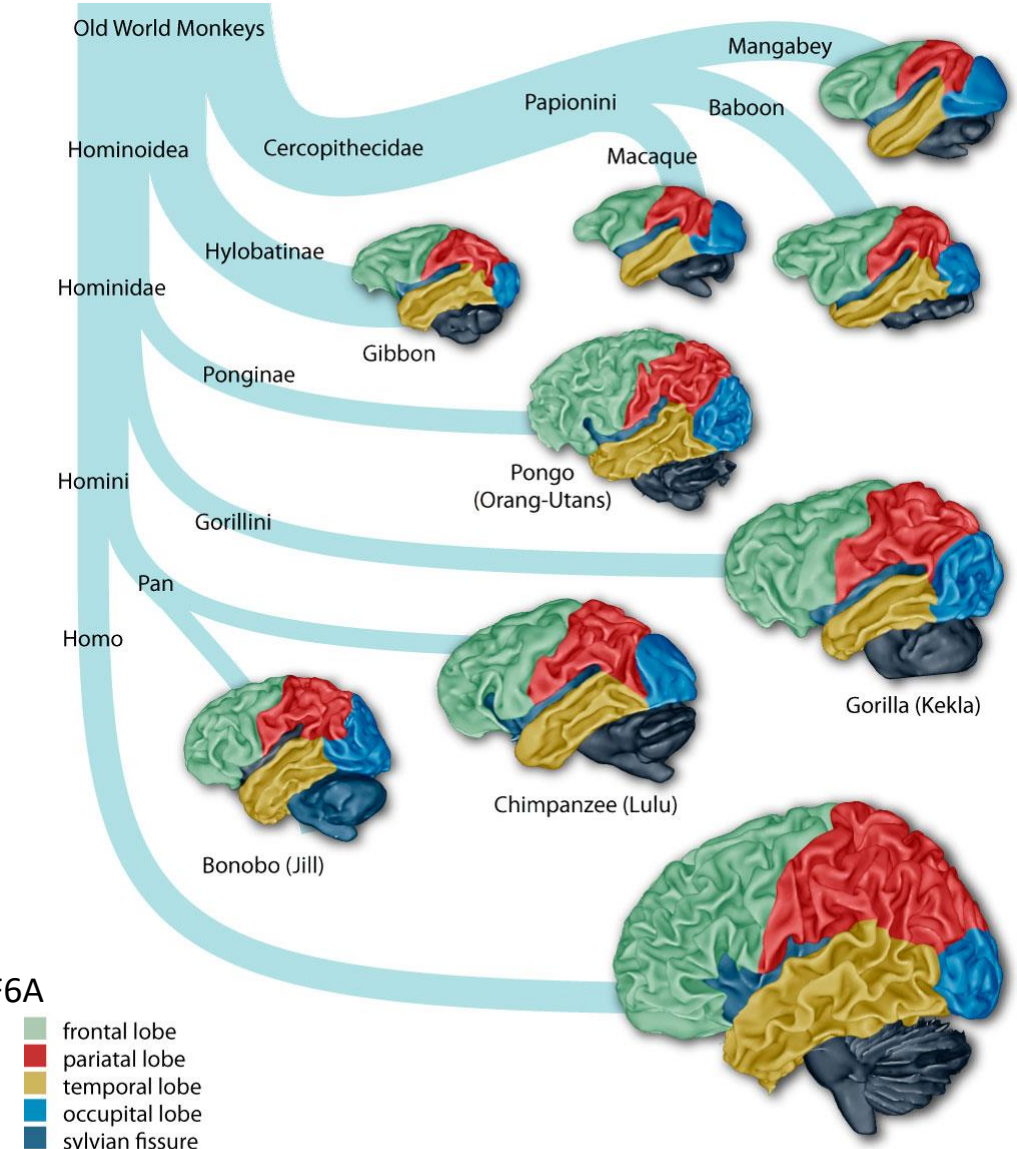
Brain size and evolution

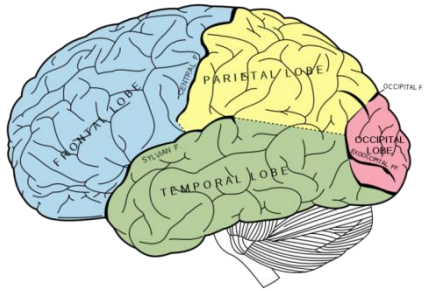
Different brains for different folks!





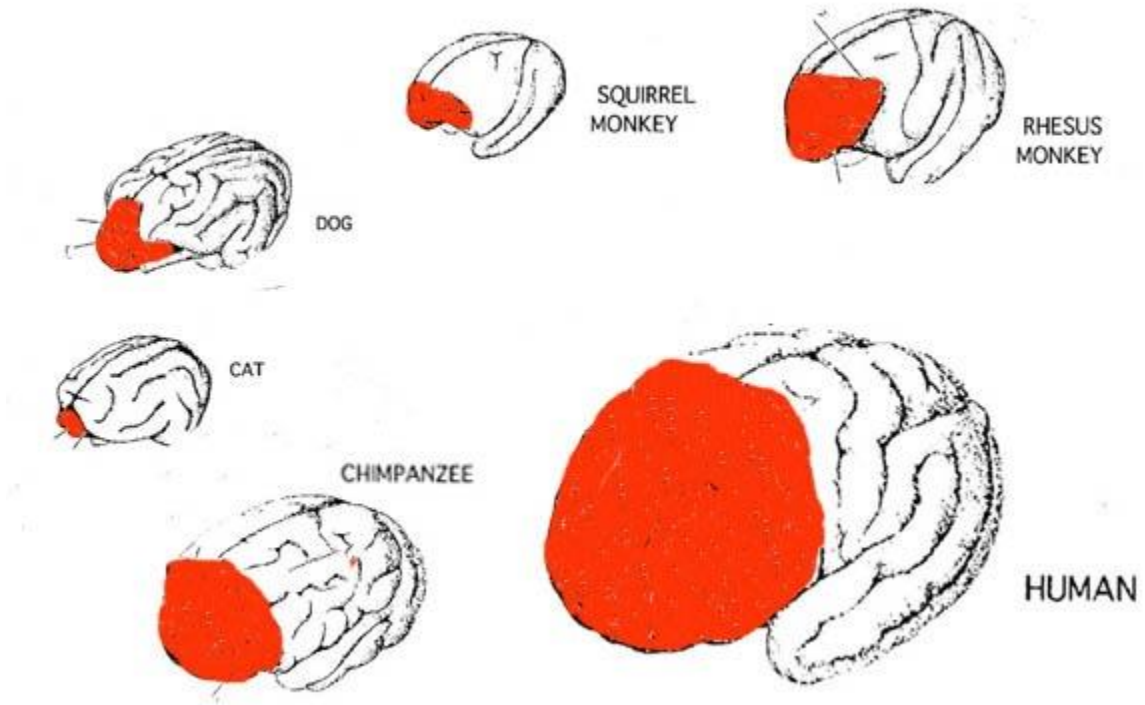


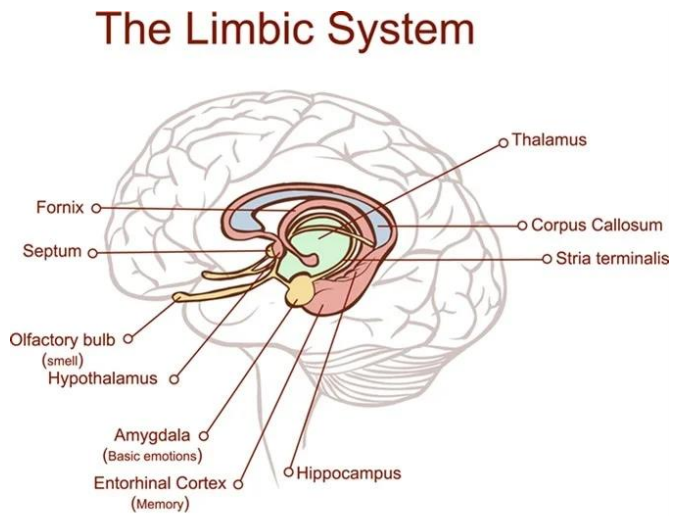


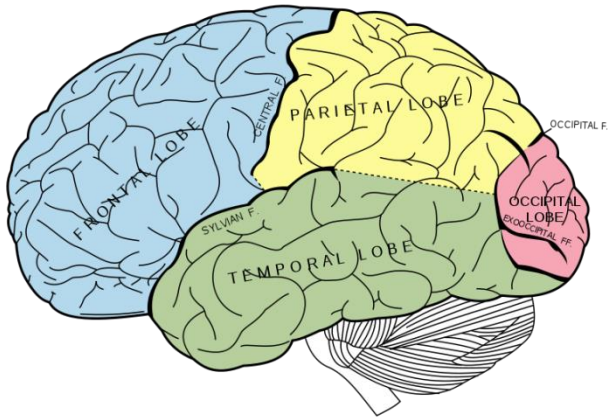


https://www.youtube.com/watch?v=zsXP8qeFF6A

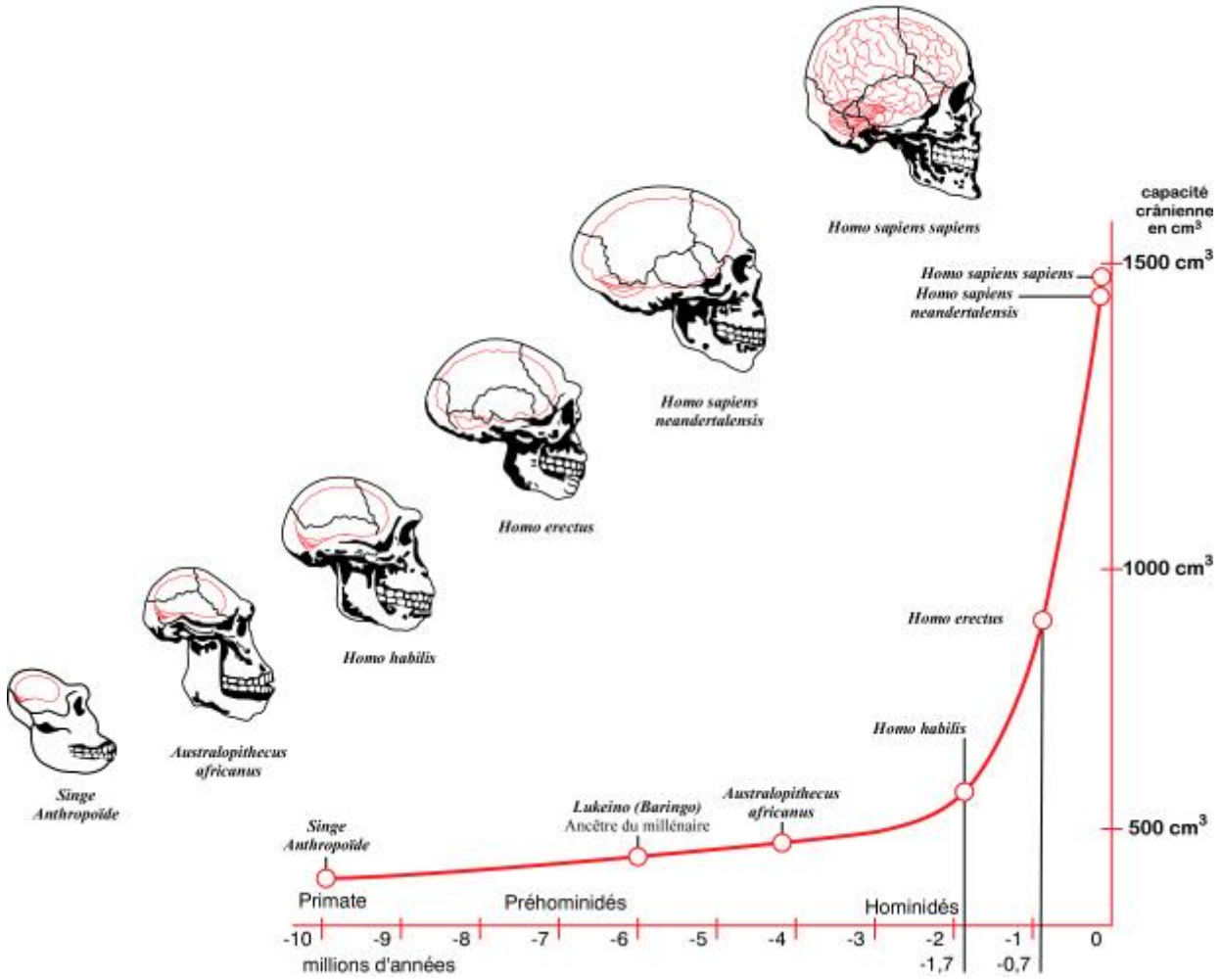
Fig. HE: Visualization of evolution of brains in primates based on the inner surface. The lobes, the sylvian fissure and the hindbrain (brainstem and cerebellum) are colorized for better orientation.







Source:**Evolution of Paleolithic Cosmology and Spiritual Consciousness, and the Temporal and Frontal Lobes, Rhawn Joseph,** Journal of Cosmology, 2011, Vol. 14.



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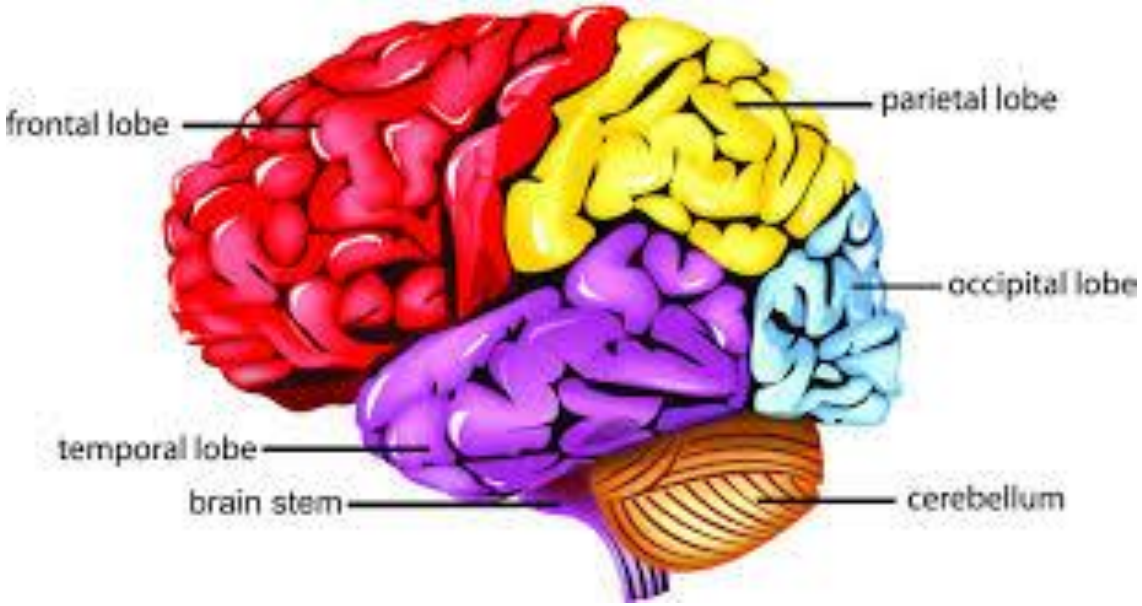
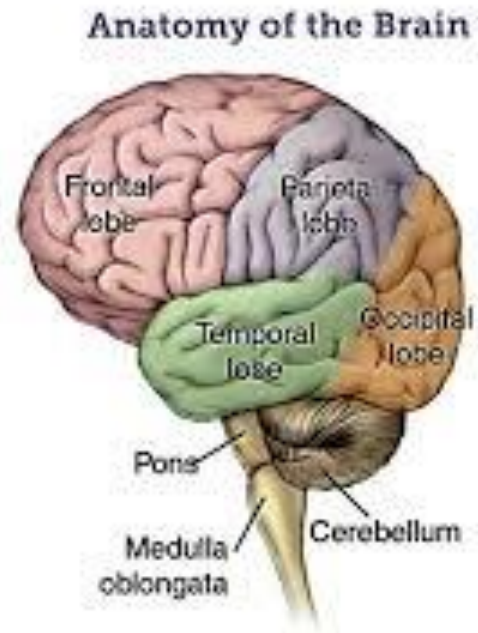

frontal lobe
parietal lobe
occipital lobe
temporal lobe
brain stem
cerebellum

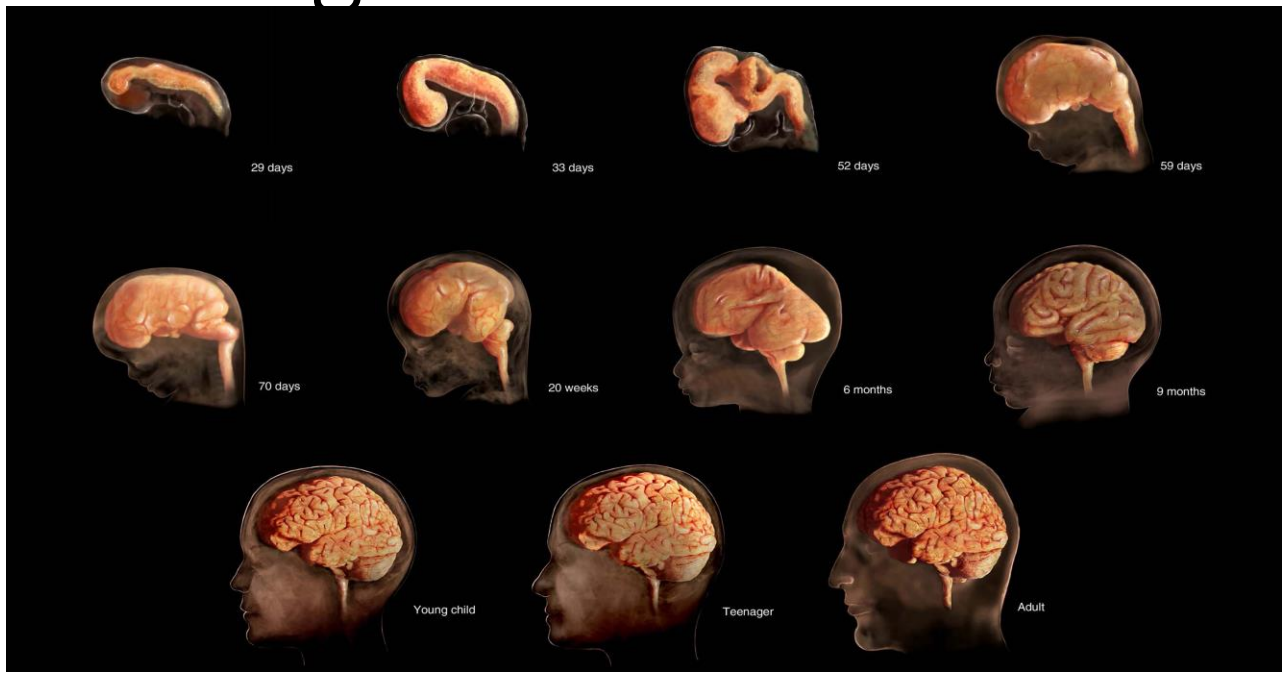

Anatomy of the Brain
Frontal lobe
Parietal lobe
Temporal lobe
Occipital lobe
Pons
Medulla oblongata
Cerebellum

So, what's the difference - cognitively

- Expanded working memory
- Ability to maintain representation of the goal, despite distractions.
- Retrieve representations of events from distant past – episodic memory.
- Prediction of future events
- Conscious awareness of one' s feelings & thoughts.
- Understand 'good' & 'bad' and feeling of shame over violations.
- Seeking new experiences
- Invent relations

Are we coded with these functionalities - neurodevelopment

Brain growth

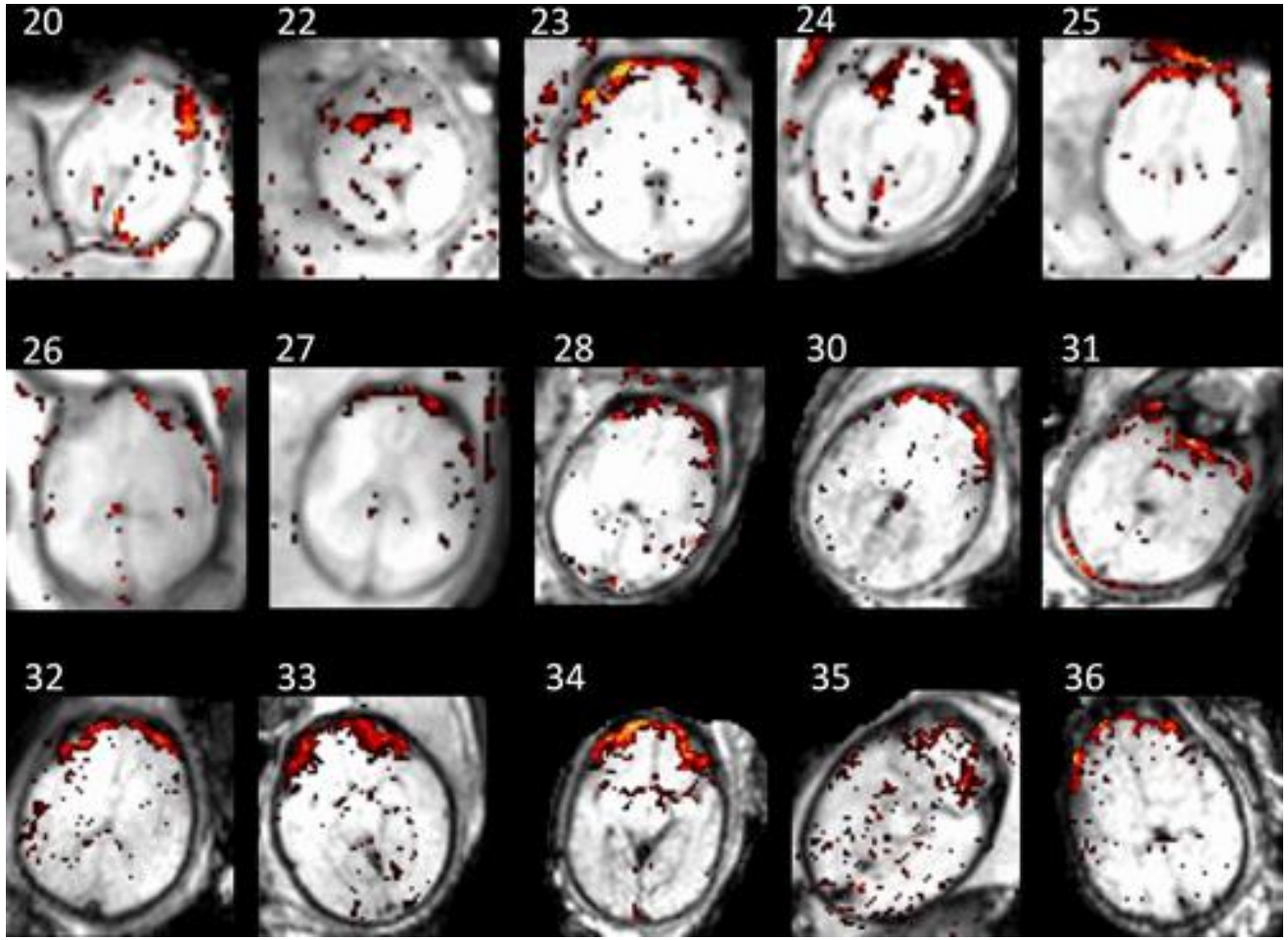


6th–7th week of gestation and matures in a caudal to rostral arc,
thereby forming the medulla,
pons,
and midbrain

7th–9th gestational week the fetus displays spontaneous movements, 1 week later takes its first ‘‘breath,’’ and by the 25th week demonstrates stimulus-induced heart rate accelerations

20th to 27th weeks the fetus responds with arousal and body movements to vibroacoustic and loud sounds delivered to the maternal abdomen.

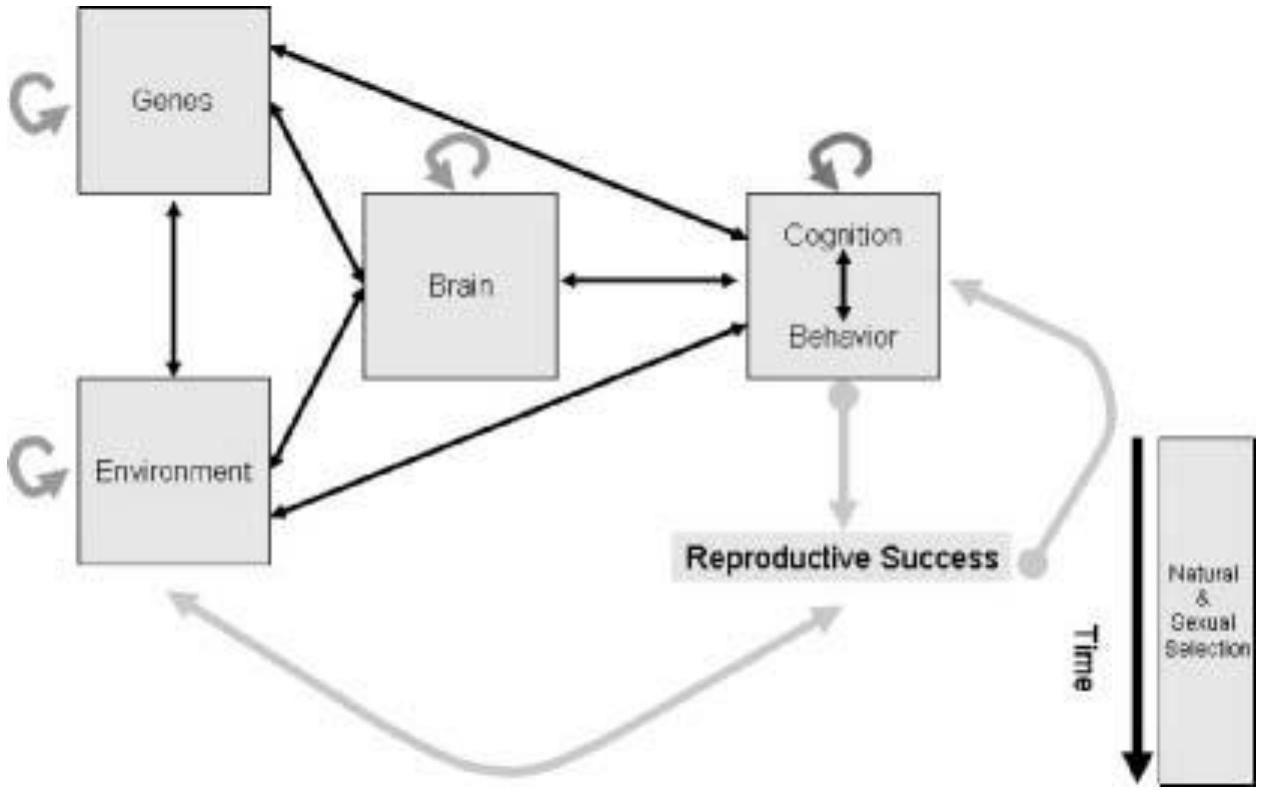
Image: © TheVisualMD/Science Source.



Resting state fMRI of fetusus. In 2012, Veronika Schöpf et al. captured functional images of fetal brains at gestational weeks 20–36 (the numbers in the figure above indicate gestational week). The team was the first to show that resting-state networks can be detected *in utero*

+ve news!!

- Although various limbic nuclei become functionally mature over the course of the first several postnatal months and years, the neocortex and lobes of the brain take well over 7, 10, and even 30 years to fully develop and myelinate



Evolutionary cognitive neuroscience involves complex systems that not only interact with each other but in which each entity also interacts with itself.

Source: evolutionary cognitive neuroscience – edited by Platek et al.,

Nutrition effect

- In a recent review, 19 out of 21 studies reported impaired mental, motor, socio-emotional, or neurophysiologic functioning in infants with iron deficiency anemia compared to infants without iron deficiency anemia.[1].

- In a recent study in China, children born to mothers with iron deficiency anemia in late pregnancy had a significantly lower mental development index score than children of non-iron-deficient mothers at 12, 18, and 24 months of age.[2]

- Similarly, in Nepal, daily iron/folic acid supplementation beginning in early pregnancy resulted in significantly better scores in working memory, inhibitory control, and fine motor functioning in children at 7 to 9 years of age [3]

- [1]Walker et al. 2007. Child development: risk factors for adverse outcomes in developing countries. *The lancet*, *369*(9556), pp.145-157.
- [2] *Chang S, et al.2013. Effect of iron deficiency anemia in pregnancy on child mental development in rural china. Pediatrics.*
- *[3] Christian, P et al., Prenatal micronutrient supplementation and intellectual and motor function in early school-aged children in Nepal. JAMA, 2010. 304(24): p. 2716-23.*