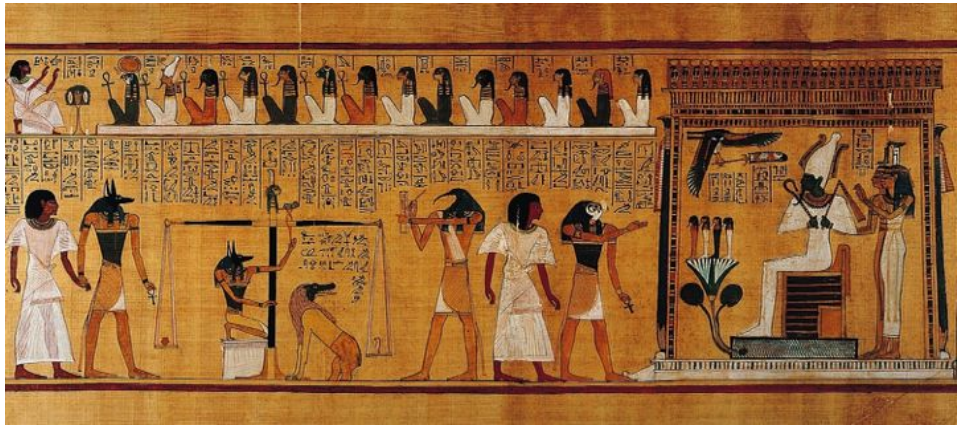
# Brain and Mind

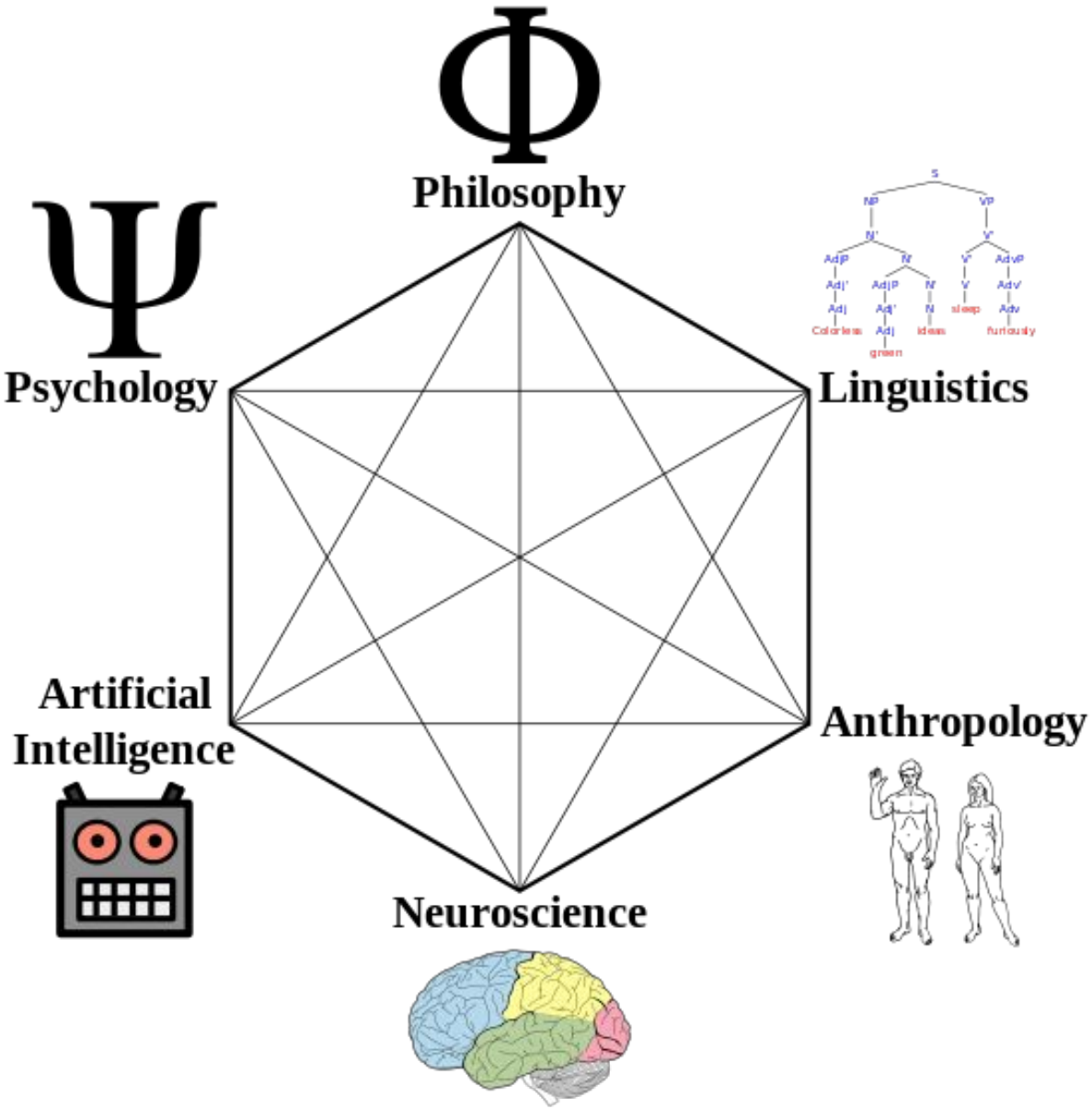
## Neuroscience Search for Meaning





Tatiana Chernigovskaya

St. Petersburg State University

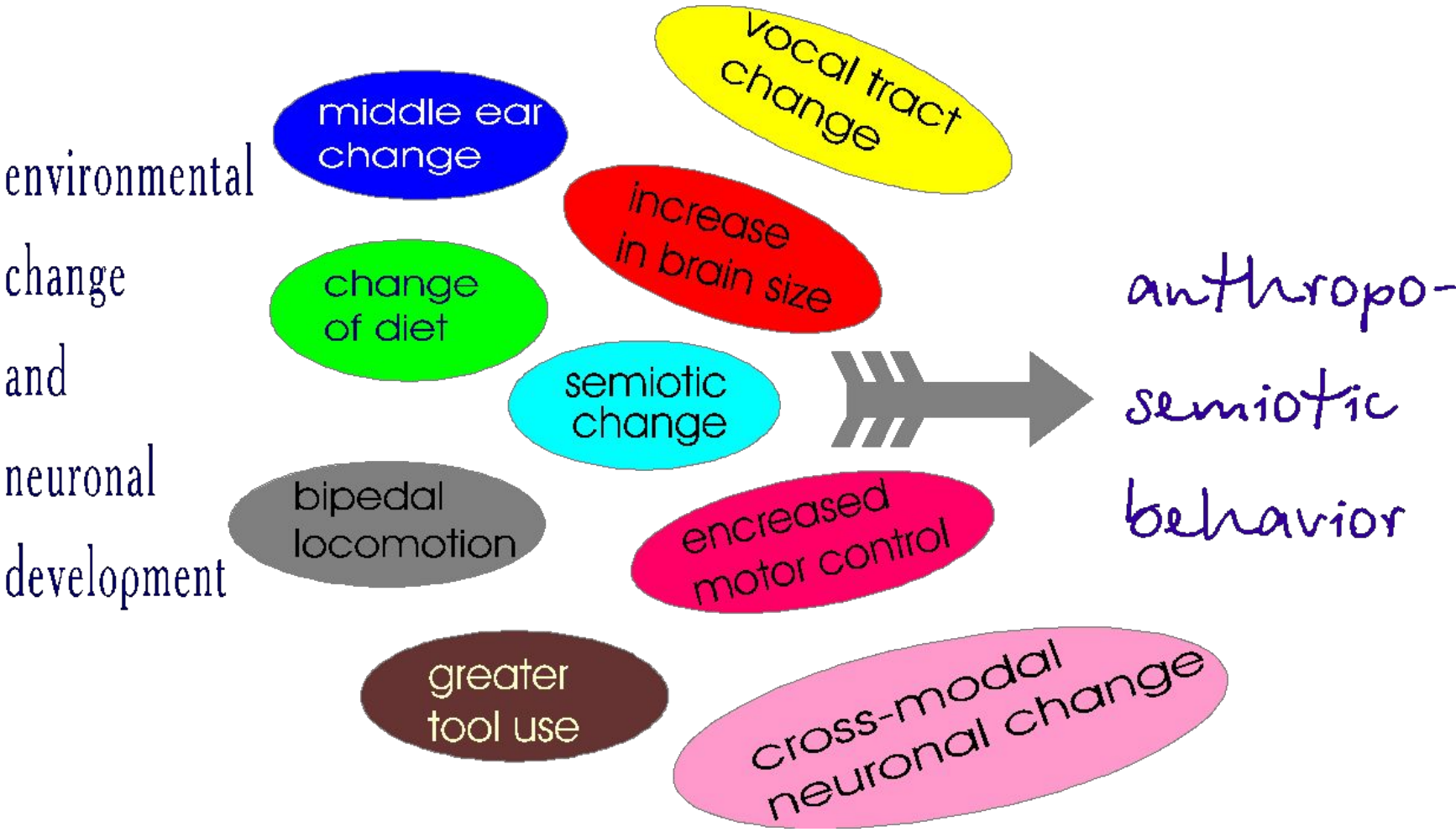

Φ
Philosophy
Ψ
Psychology
Linguistics
Artificial Intelligence
Anthropology
Neuroscience

# Francis Bacon (1561 – 1626)

The logic now in use serves rather to fix and give stability to the errors which have their foundation in commonly received notions than to help the search for truth. So it does more harm than good.

In ‘Wonderful Life,’ Stephen Jay Gould celebrated what he saw as the unlikelihood of our existence. He ventured that if a slithering creature called *Pikaia gracilens* had not survived the Cambrian extinction, about half a billion years ago, the entire phylum Chordata, which includes us vertebrates, might never have existed. For Gould, the fact that any of our ancestral species might easily not survive should fill us with a new kind of amazement

# channeling evolution in the hominid direction

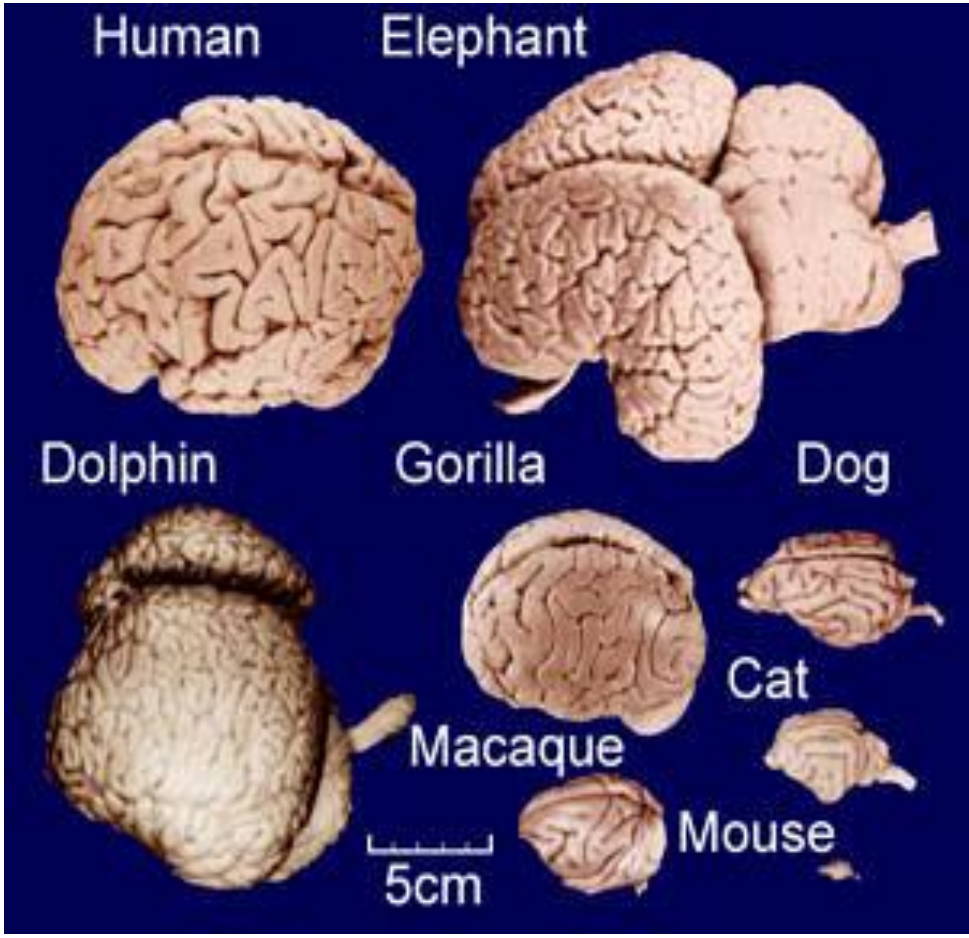


*François Truffaut*'s 1970 film

L'Enfant Sauvage

adapted from the late 18th century writings of *Dr. Jean Itard*

# Not only large frontal lobes, but larger amount of neurons



# Brain: Human vs Other Mammals

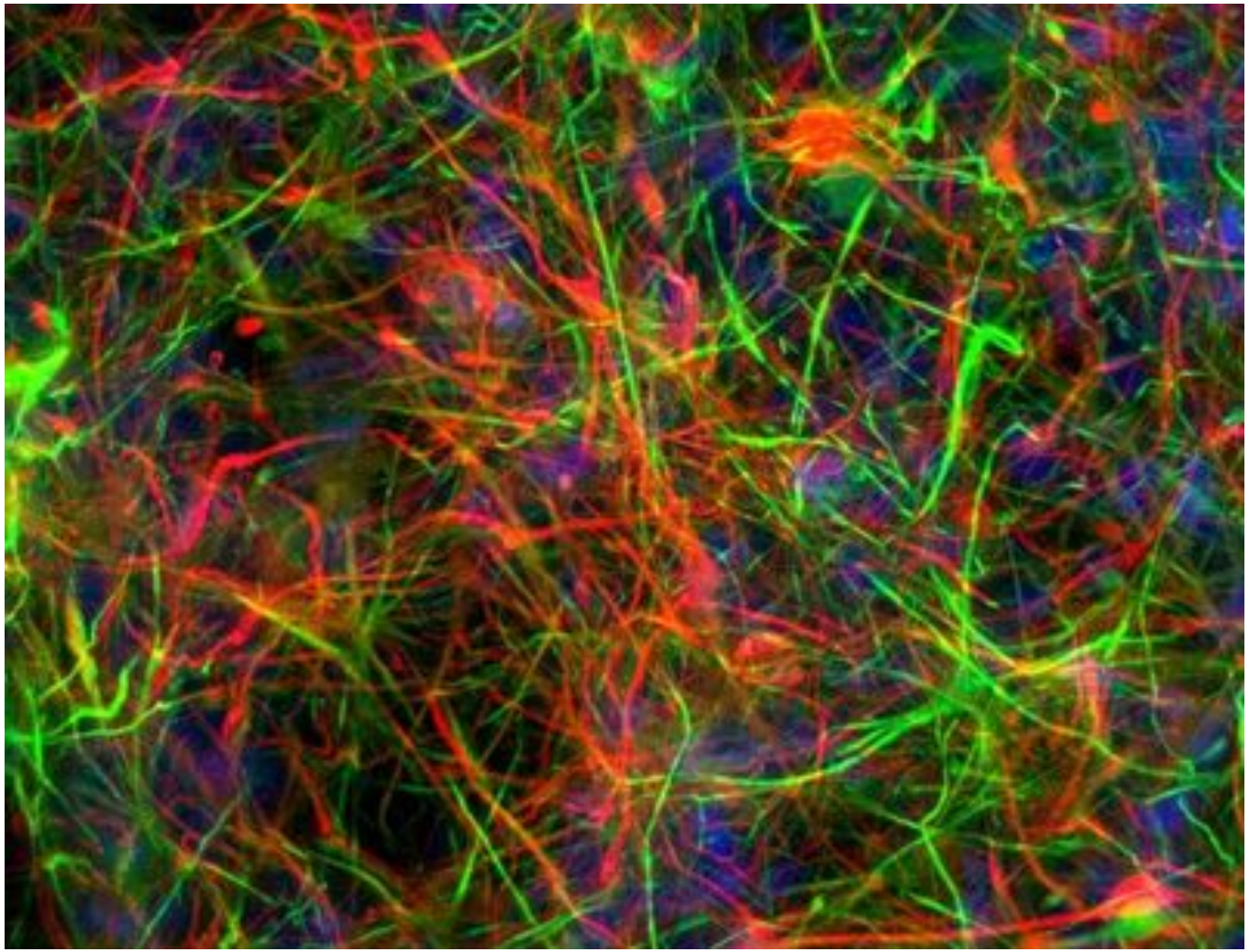
- encephalisation quotient
- thickness of neocortex
- size of the frontal lobes
- energetic cost per gram

# Род *Homo*


Политипический вид
*Homo erectus* sensu lato

# Neurons and glia

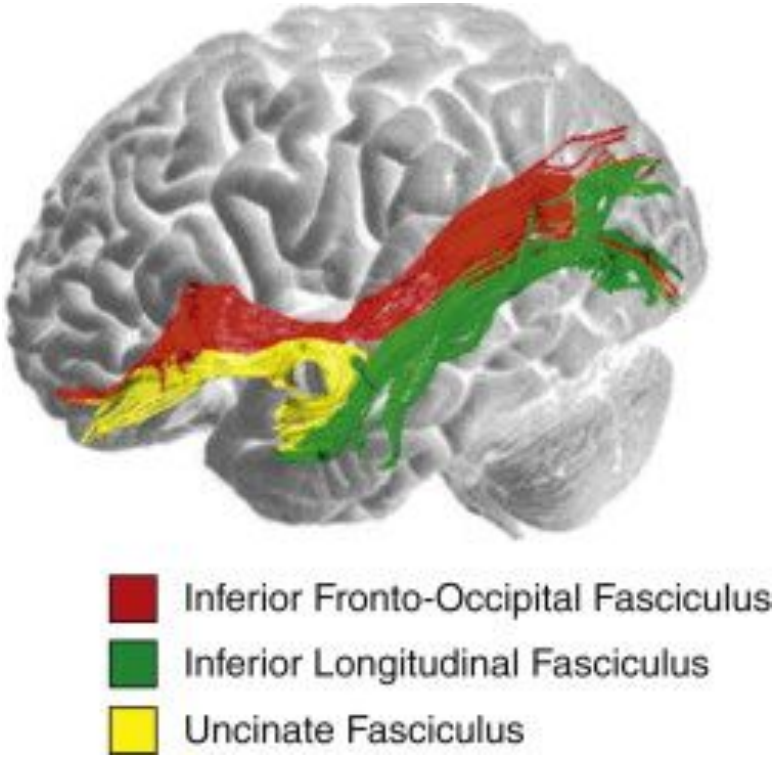
# $10^{15}$ quadrillion synaptic connections



# The Symbolic Species: Looking into the Future

- From *here and now* to *there and then*
- Homo Loquens – more than words
- Language – more than communication

# Meaning is more important than structure!




Anterior and lateral temporal lobe are interconnected with the inferior frontal lobe via the hook-shaped uncinate fasciculus

**ventral language stream (semantics of language)**

Human mind is not a Turing machine, and its principles are not based on stimulus-reaction scheme.

Rather it extracts faces and objects, revealing specific and unusual features, it is not linear and stable.

The brain is not just processing information - rather it creates meanings.

Christof Koch - president and chief scientific officer of the Allen Institute.

Finding out what the detailed differences are between the mouse and human brain will help us understand what makes us unique among species

For many decades science perceives brain and mind as a ‘bio-automatic tool’, however very complex, that gets information from the world, processes it and gives reactions.

What we still do is continue collecting facts ‘from the bottom’ (the more atomic – the better) in hope that the final construction will evolve by itself from a set of neurons, their ensembles, functional zones and finally from neuronets.

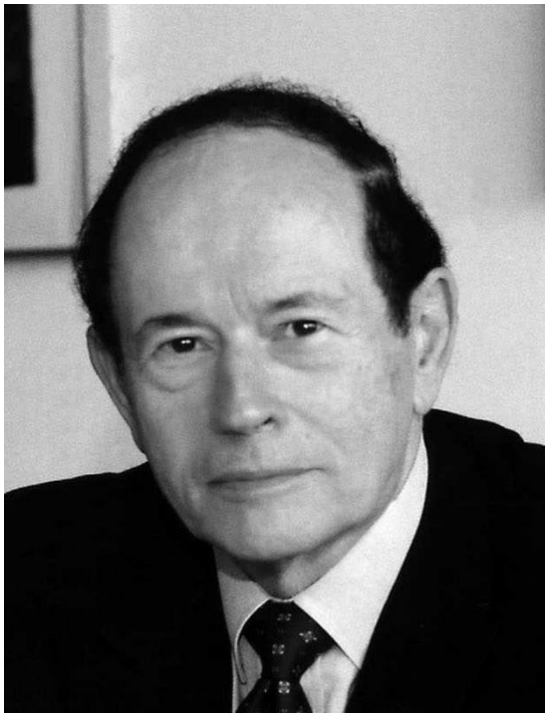
Ethic rules prohibit hard experiments with human brain. Therefore we agree to take the data from simpler systems of other animals, increase in volumes, even include some additional designs, and get a result that can be transposed to human mind characteristics.

It’s an erroneous and a misleading view

Human ability to create totally new worlds using only strength of mind and thought - this is what differs us from our planetary neighbors, and not just additional billions of neurons. Hypernets and cognitoms – the peaks of evolution - can not be studied by multiplication of technical characteristics of units and rules of other species.

Human mind is that of a human

# Gerald Edelman. Theory of Neuronal Group Selection (TNGS)



The neurons in the brain wire themselves up in complex and idiosyncratic patterns during growth and then experience: no two people are wired the same way. The neurons do come to compose a number of structures, however. They form groups which tend to fire together, and for Edelman these groups are the basic operating units of the brain.

# Gerald Edelman: Theory of Neuronal Group Selection

Opposes to the idea that the brain is a computer.

He insists on great importance to higher-order processes - concepts are maps of maps, and arise from the brain's re-categorizing its own activity. Concepts by themselves only constitute primary (first-order) consciousness: human consciousness also features secondary consciousness (concepts about concepts), language, and a concept of the self, all built on the foundation of first-order concepts.

Language
is a communication
instrument,
but still more it is
a Tool for Thinking

# Human Symbolic languages…

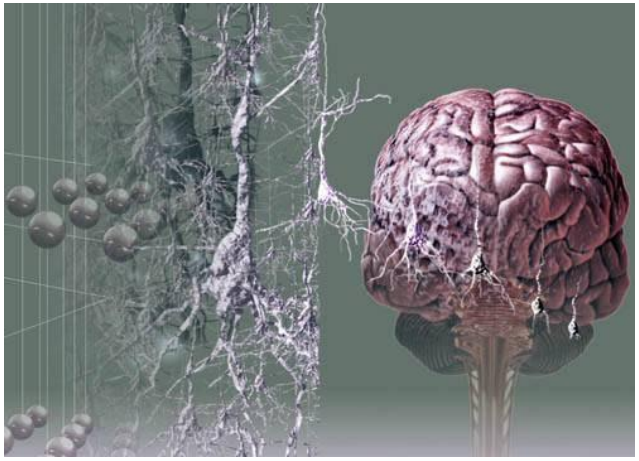
- Verbal  Language
- Mathematics
- Music
- Visual  (and Body) Languages…

# Language Organisation in the Brain

*Domain-specific vs. domain-general processing*

*Modularity vs. Connectivity*

*Cognitive and Linguistic abilities: independent or reciprocal evolution*

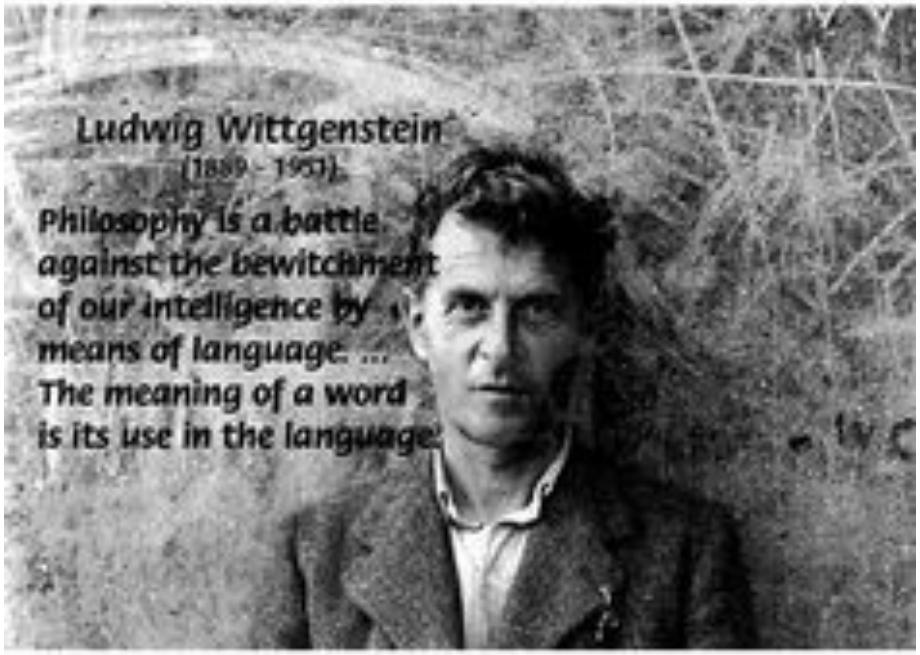


All verbal languages have some mutual Specific features:

phonology, recursion in syntax, universal features – probably innate, context dependence! Changing meaning following the background of the writer/speaker and the reader/listener. On-line! Every time! No stable fixed meaning of items – just clouds=semantic clusters of some prototypes or concepts (some- most general – inborn J. Fodor's), and even their borders are not stable and rather subjective.

It's a very complex code!

# Ludwig Wittgenstein




…introduces a metaphor of a carpet: every reader draws out his own thread out of it – fundamental observer dependence! If you have no concept, you have no understanding of what you register!

To deal with other minds we should have the shared context, definitely based on compatible embodied cognition. To minimize ambiguity and non-transparency causing communicational collapse one should think of bridging the potential gap between humans and other minds – animate or artificial

To deal with other humans we should have mutual cultural background

## Classical science – is a 3rd person science

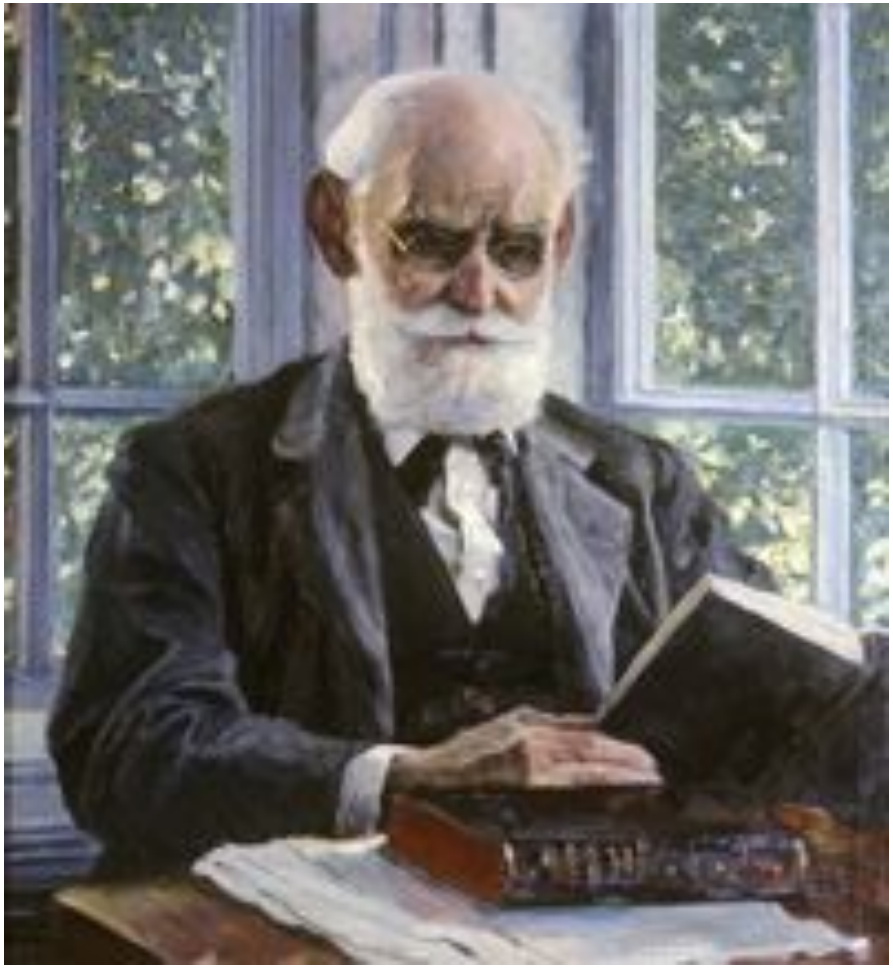
A 3rd person investigator – as if the world does not include him. A paradox: The brain is in the world; however, the world is in the brain. A striking discrepancy between 1st and 3rd person experience. Can QUALIA be transferred to others? To AI?

What for do we need *correlates* of consciousness (if not for clinics)? Correlation is not a causation!

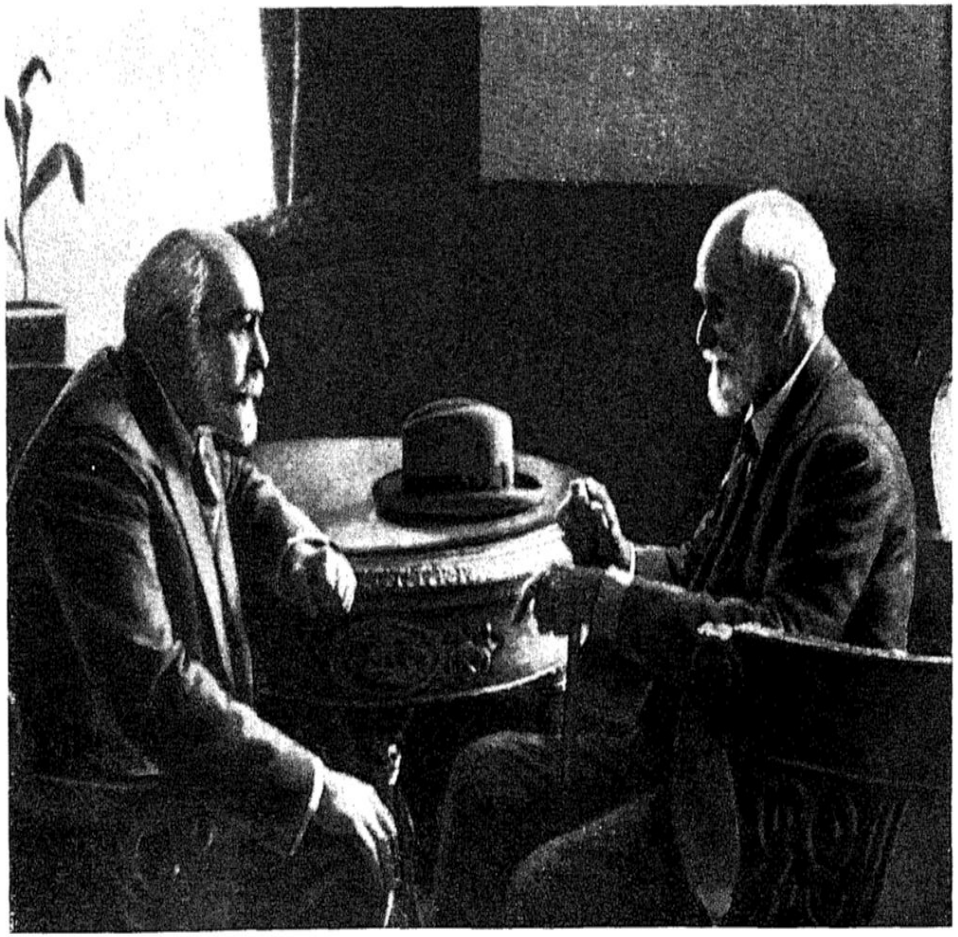
What are the necessary and sufficient requirements to have consciousness? Do we need a brain for that? Embodied cognition!

# *I. Sechenov*

# *I. Pavlov*

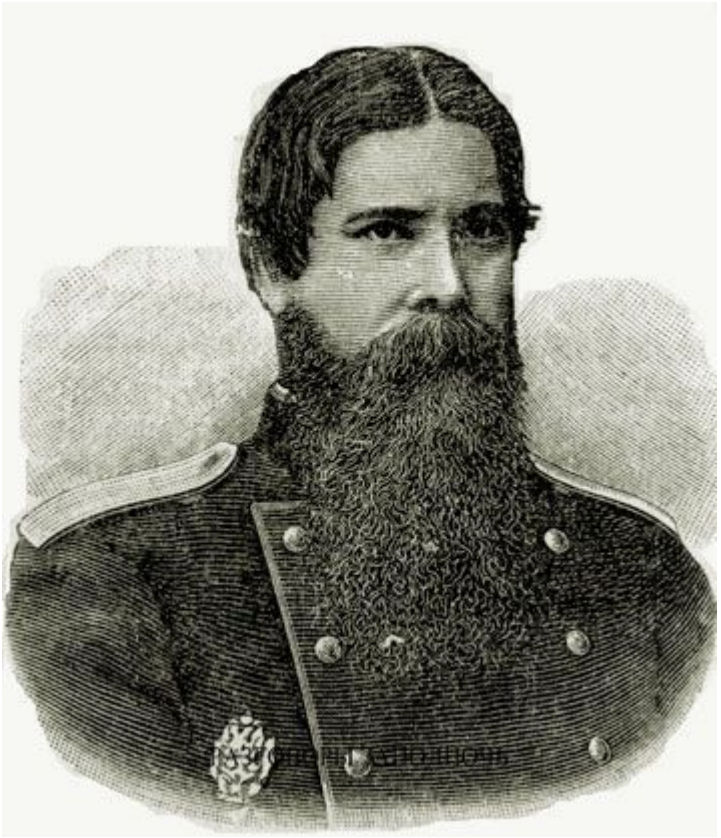


# L. Orbeli & I. Pavlov (1935)



И. П. Павлов и Л. А. Орбели во время XV Международного конгресса физиологов (1935 г.).

# Vladimir Bekhterev



- In 1888 Bechterev gave an assembly talk "Consciousness and its limits" at Kazan University in which he developed the conception of unconscious three years before Z. Freud

# *Alexey Ukhtomsky (1875-1942)*

There is no object without a subject and there is no subject without an object. We are not the viewers, we are the participants of the being. Our behavior is work... Our nature is being made.

# Niels Bohr - Nobel Prize in Physics (1922)

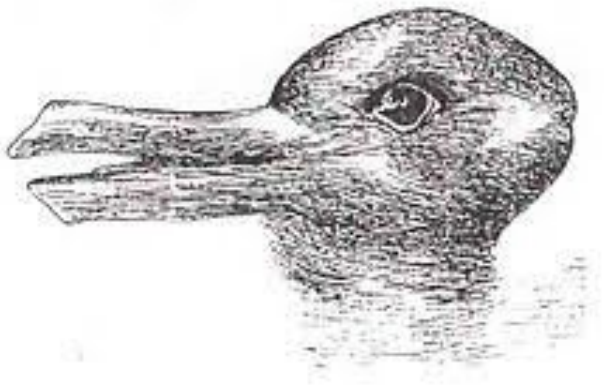
- Quantum physics accepts that an observer IS a part of the scientific paradigm
- The data are not theory free and thus depend on our mind!

Brain and mind should be studied by interconnections of natural sciences, arts and humanities. Cognitive sciences will never experience paradigmatic increase without looking at the problem from a different perspective - in the context of the products of the human genius.

# Mind and Consciousness:

# Can we catch it?

# Can we catch concepts?



Information from the external world is always ambiguous. How do people manage to overcome this uncertainty and process the changing world considering that not only its inherit characteristics change, but also the state of the person perceiving that information?

Linear approach to such complex phenomena is irrelevant. Paradigmatic shift is inescapable

# What is TIME?

A dimension?

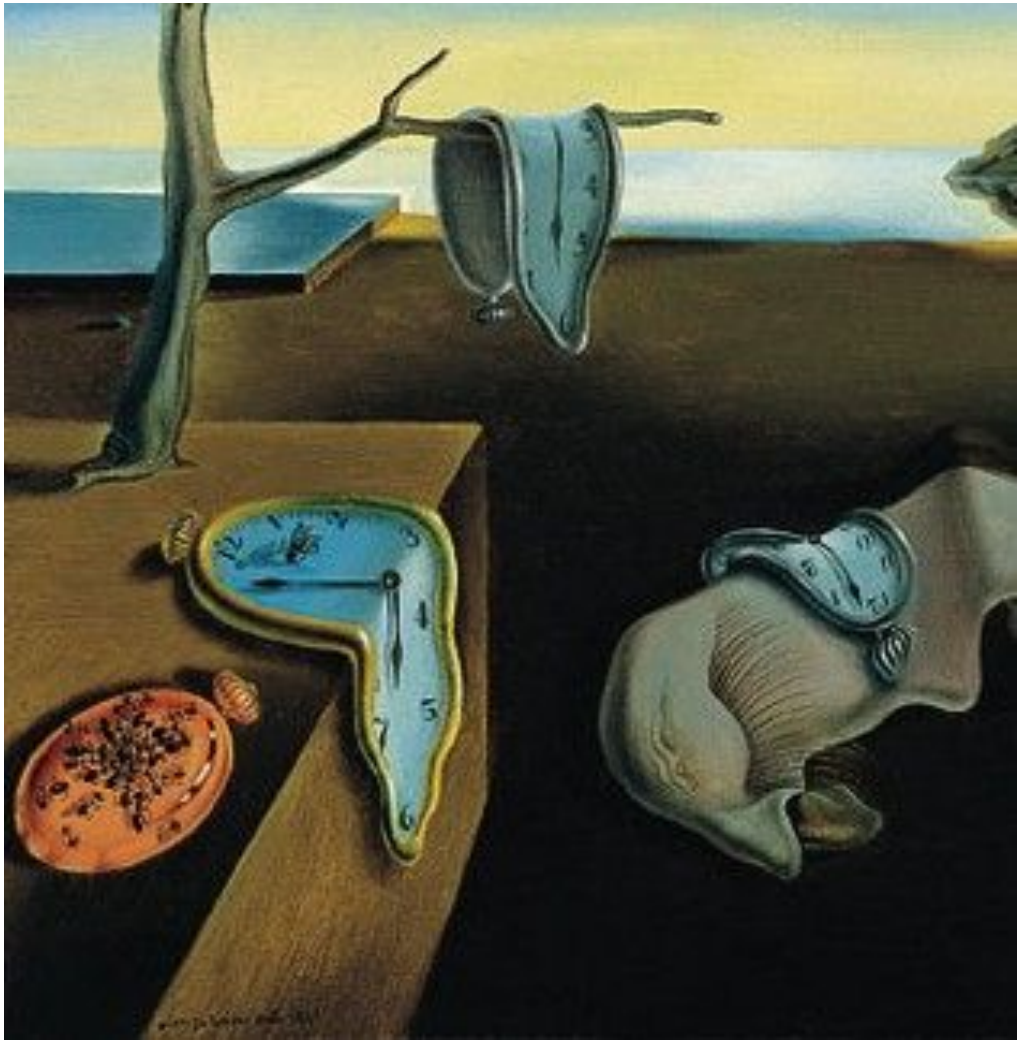
A physical event?

A brain function?

# St. Augustine on The Nature of Time

Sandro Botticelli

The past cannot exist because it has come and gone. The future cannot exist because it has yet to arrive. The present has no extension and cannot be measured. It what sense then is time real? Time is real in at least one way – in our minds. The future exists insofar as we anticipate it. The past exists insofar as it is remembered. As far as the present is concerned, it is but a fleeting moment and is always passing. Consequently, it can be said that we are always living in the present.



# Ivan Sechenov

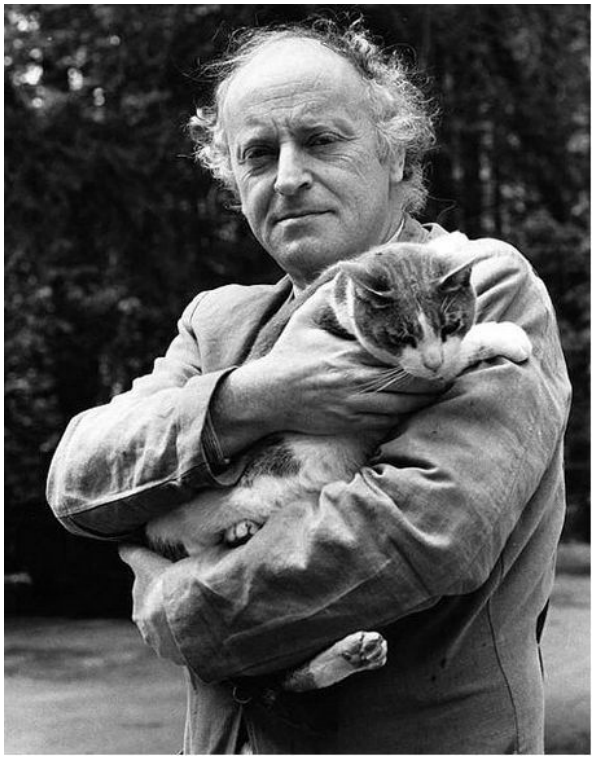
- From a procedural perspective there is not a slightest difference between a real event and its consequences

and a recollection about it

# WHAT is POETRY?

It’s not just words…

# Josef Brodsky (1940-1996)



….poetry is not a form of entertainment, and in a certain sense not even a form of art, but our anthropological, genetic goal, our linguistic, evolutionary beacon. …It is also a highly economical form of mental acceleration…As a tool of cognition, poetry beats any existing form of analysis. In other words, what a poem, or more accurately the language itself, tells you is "be like me."

# WHAT is MUSIC?

It’s not just a sound…

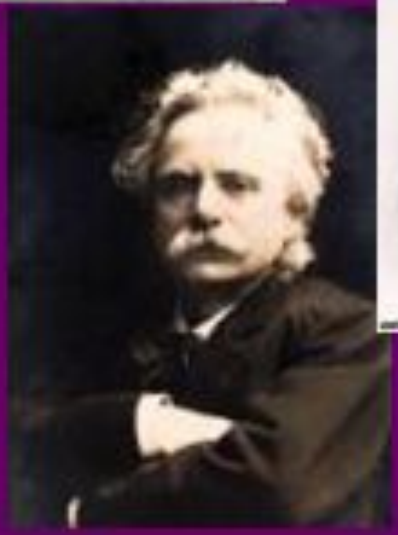
Like mathematics and poetry

it makes us humans










You can borrow tools from arts to study brain mechanisms…

# Alfred Schnittke

To develop a pearl in a sea s you need something irrelevant, alien – a grain of sand. The same is in arts: truly great is born out of rules…

Now I know that ‘errors’ or using rules on the verge of risk is just the zone where life-giving elements of art evolve

Neurocsience shows us important things for understanding human creativeness…

# “Anticorrelated” networks – a balance in specific temporal circuit of dynamic brain activity

The default mode network (DMN) is an internally directed system that correlates with consciousness of self (autobiographical memory, imagination, and self-referencing)

The dorsal attention network (DAT) is an externally directed system that correlates with consciousness of the environment (goal-driven attention and top-down guided voluntary control)

# Network 1 The Imagination Network (DMN)

IS INVOLVED IN CONSTRUCTING DYNAMIC MENTAL SIMULATIONS BASED ON PERSONAL PAST EXPERIENCES SUCH AS USED DURING REMEMBERING, THINKING ABOUT THE FUTURE, AND GENERALLY WHEN IMAGINING ALTERNATIVE PERSPECTIVES AND SCENARIOS TO THE PRESENT. IT INVOLVES AREAS DEEP INSIDE THE PREFRONTAL CORTEX AND TEMPORAL LOBE (MEDIAL REGIONS), ALONG WITH VARIOUS OUTER AND INNER REGIONS OF THE PARIETAL CORTEX.

# Network 2 The Executive Attention Network

IS RECRUITED WHEN A TASK REQUIRES THAT THE SPOTLIGHT OF ATTENTION IS FOCUSED LIKE A LASER BEAM. THIS NEURAL ARCHITECTURE INVOLVES EFFICIENT AND RELIABLE COMMUNICATION BETWEEN LATERAL (OUTER) REGIONS OF THE PREFRONTAL CORTEX AND AREAS TOWARD THE BACK (POSTERIOR) OF THE PARIETAL LOBE.

## Network 3: The Salience Network

Constantly monitors both external events and the internal stream of consciousness. This network consists of the dorsal anterior cingulate cortices [dACC] and anterior insular [AI] and is important for dynamic switching between networks.

Improvisation is associated with decreased activity in the dorsal lateral prefrontal cortex (DLPFC), a region involved with executive functions, such as planning and inhibition

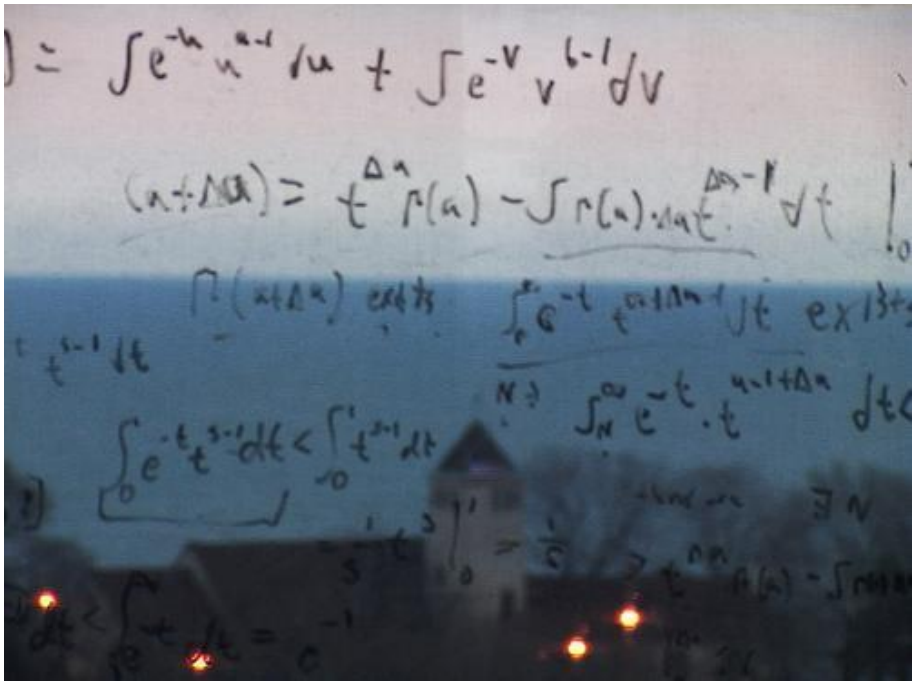
When cognitive control is low, regions of the brain comprising the default mode network (DMN) — which is involved in unconscious forms of information processing — become active. This network, which includes the MPFC, contributes to spontaneous thought generation and plays an important role in creative behavior.

To form the creative behavior -

ALLOW YOUR MIND TO ROAM FREE

Diminish the role of *EXECUTIVE ATTENTION NETWORK* TO ACTIVATE IMAGINATION AND SALIENCE NETWORKS – *FLOW STATE*

Brain scans of mathematicians have found that beauty isn't limited to music and art — an equation can be beautiful, too, given the right set of yes.  QuinnDombrowski, CC BY-SA 2.0

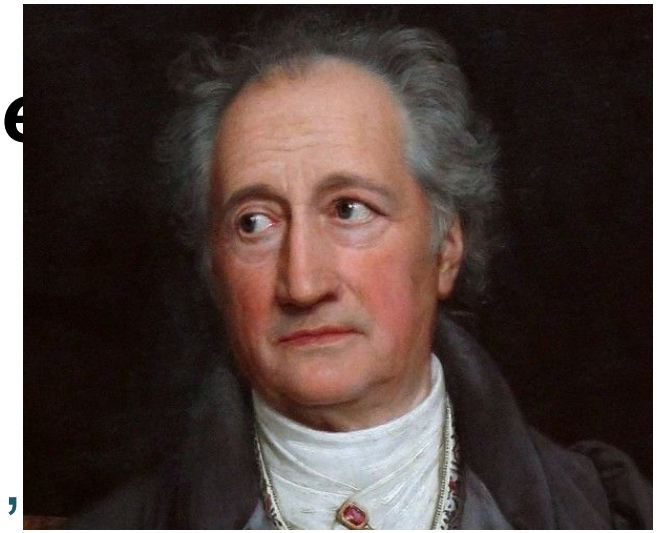


# To sum up…

Cognitive Science will not make important steps without a paradigmatic breakthrough. We should add a different perspective and use the data from higher manifestations of human genius.

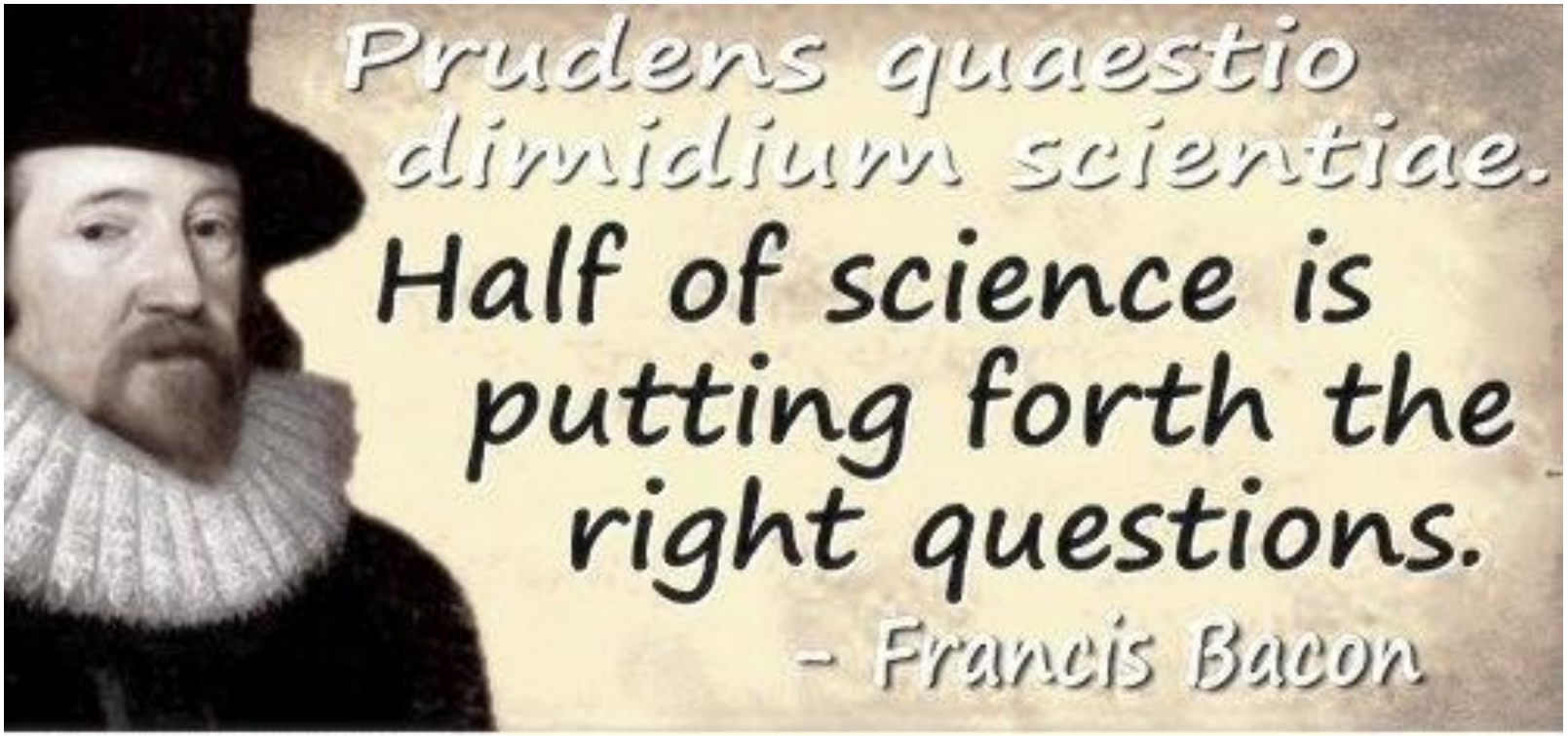
It's a hard path: we should not only habitually register EEG, EP, fMRT etc., we should study letters, drafts and diaries of outstanding scholars and artists to peep into their mind processing

# *Johann Wolfgang von Goethe*



Das preisen die Schüler aller Orten,
Sind aber keine Weber geworden.
Wer will was lebendig's erkennen und beschreiben,
Sucht erst den Geist heraus zu treiben,
Dann hat er die Theile in seiner Hand,
Fehlt leider! nur das geistige Band.
Encheires in naturae nennt's die Chimie,
Spottet ihrer selbst und weiß nicht wie.

# Truth is the daughter of time, not of authority



# *Vielen Dank!*