

Thinking about Thought

- Introduction
- Philosophy of Mind
- Cognitive Models
- Machine Intelligence
- Life and Organization
- Ecology
- The Brain
- Dreams and Emotions
- Language
- Modern Physics
- Consciousness

"Somewhere something incredible is waiting to happen" (John Wheeler)

Session Ten: Consciousness for Piero Scaruffi's class “Modern Physics” at UC Berkeley (2014)

Roughly These Chapters of My Book “Nature of Consciousness”:

- 22. The History of Consciousness
- 23. Consciousness: The Factory of Illusions
- 24. The Physics of Consciousness
- 25. The Self and Free Will: Do We Think or Are We Thought?

The Factory Of Illusions

- Mind = cognition + consciousness
- Cognition is ubiquitous in nature
- The mind translates a world of particles and waves into a world of colors, sounds and smells

Terminology

- Every conscious state is mental.
- Is every mental state also conscious?
- What is the mind?
 - The set of all brain processes
 - The set of all conscious processes
 - Something in between
 - The soul

Terminology

- Consciousness (awareness)
- Self (awareness of lasting in space and time)
- Sensations (bodily feelings such as pain, red, warmth)
- Emotions (phenomenal feelings such as anger, happiness, fear, love)
- Cognition (processes that result in reasoning, memory, learning, etc.),
- Perception (the physical process of perceiving the world)
- Thought (what you are doing right now)

Consciousness

- Consciousness is a natural phenomenon.
- If our theory of the universe does not explain consciousness, then maybe we do not have a good theory of the universe.

Consciousness

- ?
 - How does conscious experience arise from the brain's electrochemical activity?
 - Why can't I be aware of my entire being? We only have partial introspection. We have no idea of what many organs are doing in our body.
 - We can only be conscious of one thing at a time. There are many things that we are not conscious of. How do we select which thing we want to be conscious of?
 - Why can I only feel my own consciousness and not other people's consciousness? Why can't I feel other people's feelings? Why can't anybody else feel my feelings?

Consciousness

- ?
 - Why are we conscious?
 - How did consciousness evolve? Did it evolve from non-conscious matter?
 - What is the self? My body changed over the years, and my brain too. Therefore my mind may have changed too. But the self bestows unity.
 - If the “I” exists, does it have free will?

Consciousness

- ?
 - Are other people conscious the same way I am? Are some people more conscious and others less conscious?
 - Are some animals also conscious? Are all animals conscious? Are plants conscious? Can non-living matter also be conscious? Is everything conscious?
 - Can things inside conscious things be conscious? Are planets and galaxies conscious? Are arms and legs conscious?



Octopus on the seabed that had never seen light before (Source: Andy Fisher of UCSC)

National Geographic
2009



Qualias Vs Senses



- Clarence Lewis
 - "Qualia" are subjective, directly perceived and known in an absolute way
 - Matter is "inscrutable"
 - We know what consciousness is because we feel it, but we cannot "sense" it
 - We know what matter is because we sense it, but we cannot "feel" it
 - If i believe my immediate perceptions, there is red. If i try to make sense of my perceptions, i have to work out a theory of nature according to which there is no red

Degrees Of Consciousness



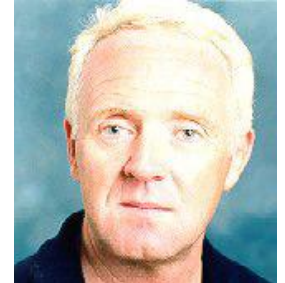
- Degrees of consciousness?
 - The behavior of teenagers depends on parental guidance, role models, peer pressure and marketing campaigns
 - “Rebels” are teens who are more conscious
 - Adults tend to behave according to guidelines
 - “Eccentrics” are adults who are more conscious
 - Consumers tend to like what they have been told to like
 - “Contrarians” are consumers who are more conscious

The Impossibility Of A Science Of Consciousness

- Karl Lashley (1920s): the mind is never conscious (when I think about myself, I am not conscious of what my brain is doing)
- Thomas Nagel (1974): what it is like to be a bat?
- Frank Jackson (1982): the color-blind neuroscientist



The Impossibility Of A Science Of Consciousness



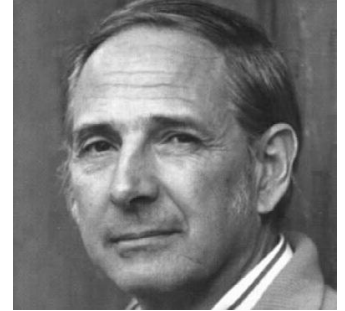
- Colin McGinn (1991)
 - Consciousness does not belong to the "cognitive closure" of our organism
 - Understanding our consciousness is beyond our cognitive capacities
 - "Mind may just not be big enough to understand mind"

The Impossibility Of A Science Of Consciousness



- Objection: “Cognitive closure” changes during the course of a lifetime
- Objection: “Cognitive closure” has evolved over the centuries

The Impossibility Of A Science Of Consciousness



- John Searle (1992)
 - Consciousness is caused by brain processes, but consciousness cannot be reduced to those brain processes because it is a "first person" phenomenon and the brain processes are "third person" phenomena
 - The mind-body problem has never existed: Descartes invented a vocabulary, a terminology, not a real problem.

The Impossibility Of A Science Of Consciousness

- David Deutsch (2011)
 - We are capable of explaining how the world works because the world obeys mathematical laws that our brain can master
 - Therefore we became universal beings, capable of understanding anything that happens in the universe ruled by those laws of nature
 - A higher intelligence (incomprehensible to us) can only exist if the universe is not explicable, i.e. if there exist supernatural beings
 - The cognitive closure of human brains would imply that the ancient superstitions were correct.



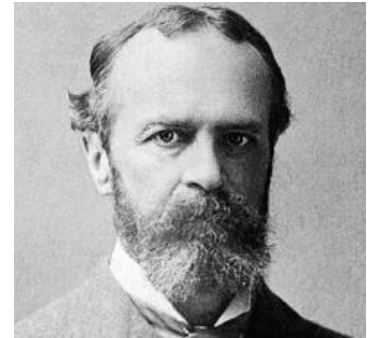
The Impossibility Of A Science Of Consciousness

- David Deutsch (2011)
 - Humans are "universal constructors": humans can transform anything into anything as long as they understand the natural laws that govern the universe
 - If the universe is governed by deterministic rules, then the human brain can eventually (explanation after explanation) get to understand everything
 - There is no limit to human knowledge
 - The universality of the laws of nature coupled with a universal constructor like the human mind yields unlimited knowledge growth.



The Process Of Consciousness

- William James:
 - Consciousness is not an entity, but a function
 - Consciousness is an operation rather than a thing
 - The stream of consciousness



The Process Of Consciousness



- George Herbert Mead (1934)
 - Consciousness is not a separate substance, but the world in its relationship with the organism
 - Consciousness is in the world, outside the organism
 - Objects of the environment are colored, beautiful, etc: that "is" consciousness
 - Objects do not exist per se, they are just the way an organism perceives the environment
 - It is our acting in the environment that determines what we perceive as objects

The Process Of Consciousness



- George Herbert Mead (1934)
 - Different organisms may perceive different objects
 - The environment results from the actions of the organism
 - We are actors as well as observers (of the consequences of our actions)

The Process Of Consciousness



- George Herbert Mead (1934)
 - Any change in the organism results in a change of the environment.
 - Those objects have qualities and values that constitute what we call "consciousness"
 - Consciousness is not a brain process: the switch that turns consciousness on or off is a brain process
 - Consciousness is pervasive but only social species can report on their conscious experiences
 - A self always belongs to a society of selves

The Process Of Consciousness



- Owen Flanagan (1991)
 - Some of the processes of our body are unconscious and some are conscious
 - Consciousness is a set of processes, not an object
 - There is no “Mind’s i” that thinks and is conscious, there are just thoughts that flow
 - Consciousness is not: consciousness flows
 - “The thoughts themselves are the thinkers”. I do not think thoughts, thoughts think me.
 - This conscious activity differs from the neural activity only in kind, but the mind “is” the brain.

The Integration Of Consciousness

- The location of consciousness
 - Space-based binding
 - Time-based binding
 - Theater of Consciousness
 - Dreams

Space-based Binding

- Antonio Damasio
 - The assembly (“binding”) of consciousness requires more than a working memory: a system of “convergence zones”
 - “Movie in the mind” consciousness (how a number of sensory inputs are transformed into the continuous flow of sensations of the mind):
 - Constructed from sensory mappings
 - First order narrative of sensory mappings
 - Unchanged throughout a lifetime
 - Shared by other species
 - Purely non-verbal process



Space-based Binding



- Antonio Damasio
 - "Self" consciousness
 - Topography of the body
 - Topography of the environment
 - Self vs nonself
 - Second-order narrative in which the self is interacting with the non-self

Space-based Binding

- Antonio Damasio
 - "Self" consciousness
 - An "owner" and "observer" of the movie is created
 - The sense of the self is created, while the movie is playing, by the movie itself.
 - The self is continuously reconstructed
 - The thinker is created by thought.
 - The spectator of the movie is part of the movie.
 - The "i" is not telling the story: the "i" is created by stories being told in the brain
 - Body's homeostasis (continuity of the same organism)



Space-based Binding

- Gerald Edelman
 - The brain refers to itself
 - Neurons get organized by experience in maps (categories)



Space-based Binding

- Gerald Edelman
 - Primary consciousness (being aware of the world)
 - Two kinds of nervous system...
 - 1. Memory continuously reorganizes ("recategorizes")
 - 2. Learning as ranking of stimuli ("value-laden" memory, instinctive behavior)
 - "Intelligent" behavior + "instinctive" behavior
 - Primary consciousness arises from "reentrant loops" that interconnect "perceptual categorization" and "value-laden" memory ("instincts")



Space-based Binding

- Gerald Edelman
 - Higher-order consciousness (language and self-awareness)
 - Distinction between the self and the rest of the world
 - Definition of the self: the amygdala, the hippocampus, the hypothalamus
 - Definition of the non-self: the cortex, the thalamus and the cerebellum



Space-based Binding

- Gerald Edelman
 - Higher-order consciousness (language and self-awareness)
 - Concept formation...
 - social interaction...
 - anatomical changes ...
 - phonology...
 - permanent categories/concepts...
 - semantics...
 - syntax
 - Higher-order consciousness is liberation from the present
 - Unique to humans



Space-based Binding

- Adam Zeman (2002)
 - A little more or less of this or that chemical makes a big difference as to how you “feel”.
 - Perception is the brain’s reaction to being bombarded with energy picked up by the body’s sensors.
 - Perception is then processed according to the chemical structure of the brain, which, by definition, depends on the amount and kinds of chemicals in the brain.
 - Different neurotransmitters contribute to different aspects of consciousness
 - Consciousness is the sum of its parts



Space-based Binding

- Adam Zeman (2002)
 - Thalamus is the central site of consciousness.
 - During sleep, the thalamus interacts with the cortex in rhythmic bursts, while inhibiting all sensory inputs
 - When the body is awake, the thalamus works as an intermediary between the periphery and the cortex, shuttling back and forth sensory inputs and commands to move.



Time-based Binding

- Christof Koch (1989)
 - Very large number of neurons oscillate in synchrony
 - Only one pattern is amplified into a dominant 40 hz oscillation



Time-based Binding

- Francis Crick (1990)
 - Synchronized firing in the range of 40 Hertz in the areas connecting the thalamus and the cortex might explain consciousness
 - Consciousness arises from the continuous dialogue between thalamus and cortex
 - Awareness of something requires "attention" (being aware of one object rather than another), and attention requires "binding" (binding together all neurons that represent aspects of the object)
 - During attention, all the neurons that represent features of an object fire together



Time-based Binding

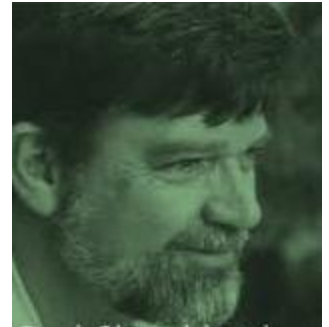


- Charles Gray (1994)
 - The memory of something is generated by a stream of oscillating networks
 - Brain regions send out nervous impulses at the same frequency
 - The perception of an object is created by the superimposed oscillation
 - The brain uses frequency as a means to integrate separate parts of a perception
 - The limited capacity of the brain can handle the overwhelming amount of objects that the world contains

Time-based Binding

- Erich Harth (1993)
 - Positive feedback works at the edge of instability: the signal is amplified by itself, weakening the relationship between input and output
 - A loop of positive feedback spreads through different areas of the brain and provides "selective amplification"
 - The loop basically joins the thalamus and the cortex, so that both send outputs that are inputs to the other
 - When input from the thalamus is stronger, the external world prevails
 - When input from the cortex is dominant, cognition prevails

Time-based Binding



- Paul Churchland (1995)
 - Consciousness must be based on a "recurrent" network
 - The 40 Hz oscillation in the cortex is a convenient candidate for a brain-wide recurrent network
 - That brain-wide recurrent network would be able to unify the distinct senses in one consciousness.
 - Consciousness does not require language, and non-linguistic animals can be conscious too

Time-based Binding

- Rodolfo Llinas (1996)
 - A scanning system that sweeps across all regions of the brain every 1.25 thousandths of a second (40 times a second)
 - Sent out from the thalamus and triggers all the synchronized cells in the cerebral cortex that are recording sensory information
 - The cells then fire a coherent wave of messages back to the thalamus.



Time-based Binding

- Rodolfo Llinas
 - Only cortex cells that are active at that moment respond to the request from the thalamus.
 - Consciousness originates from the constant interaction between the thalamus and the cortex
 - Every function in the body is controlled by a rhythmic system that occurs automatically



Darwinian Consciousness

- Michael Gazzaniga
 - The interpreter
- Robert Ornstein
 - Multimind
- Daniel Dennett/ Susan Blackmore
 - Memes create the mind
- William Calvin
 - Cerebral code
- Susan Greenfield
 - Competition of gestalts

The Social Brain



- Michael Gazzaniga (1985)
 - Independent systems work in parallel
 - Evolutionary additions to the brain
 - Many minds coexist in a confederation
 - A module located in the left hemisphere interprets the actions of the other modules and provides explanations for our behavior
 - Beliefs do not precede behavior, they follow it: behavior determines our beliefs

The Social Brain



- Michael Gazzaniga (1985)
 - It is only by behaving that we conceptualize our selves
 - There are many "i"'s and one "i" that makes sense of what all the other "i"'s are doing
 - The verbal self keeps track of what the person is doing and interprets reality

Mental Darwinism

- Robert Ornstein (1986)
 - A mind is actually many small minds, each operating independently and specialized in one task
 - The body contains many centers of control
 - The lower level ones developed millions of years ago for basic survival activities, and humans share them with other animals
 - The most recent ones (e.g., the cortex) deal with decisions, language, reasoning
 - The brain is not a single whole, it is a confederation of more or less independent brains.

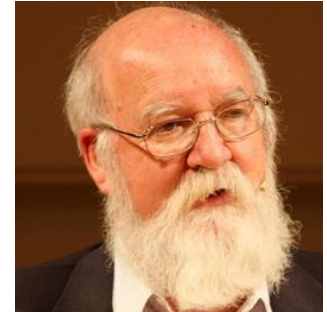


Mental Darwinism



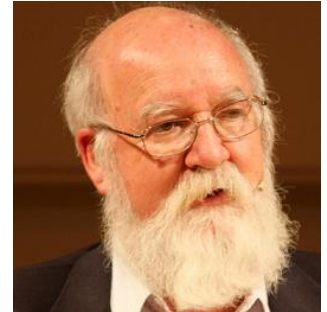
- Robert Ornstein (1986)
 - These "minds" compete for control of the organism.
 - Each one tends to stay in place for as long as possible, with its own memories and goals, until the circumstances favor the takeover of another mind.

Mental Darwinism



- Daniel Dennett (1991)
 - The mind is occupied by several parallel "drafts"
 - A "draft" is a narrative that occurs in the mind, triggered by some interaction with the world
 - At every point in time, there are many drafts
 - One of the drafts is dominant in the brain, and that is what we are conscious of
 - "Consciousness" simply refers to the feeling of the overall brain activity

Mental Darwinism



- Daniel Dennett (1991)
 - There is no place in the brain where consciousness resides
 - Consciousness does not flow at all, there is no single stream of consciousness
 - The continuity of consciousness is an illusion
 - It doesn't even exist all the time: "probing precipitates narratives"
 - The goal of the parallel drafts is to manage "memes"

Mental Darwinism



- Susan Blackmore (1999)
 - The conscious self is but a story built by memes
 - Free will is the consequence of the story (the very complex story due to many many interacting memes) that is playing in the brain
 - Thinking is the process of absorbing, understanding, adapting and broadcasting memes
 - People tell us what to think and we think their thoughts
 - What we think are other people's thoughts

Mental Darwinism

- William Calvin (1991)
 - A Darwinian process in the brain finds the best thought from the many that are continuously produced
 - A cerebral code allows for reproduction and selection of thoughts
 - The analogue of the genetic code



Mental Darwinism

- William Calvin (1991)
 - A cerebral pattern copies itself repeatedly around a region of the brain
 - “Thoughts” compete and evolve subconsciously
 - Only some of them result in action
 - Thoughts are movements that haven't happened yet
 - Thought arises from the copying and competition of cerebral patterns



Mental Darwinism

- William Calvin (1991)
 - Dreaming occurs all the time but we can't see them when we are awake
 - Our actual thought is simply the dominant pattern in the copying competition
 - Circuits in the cerebral cortex act as copying machines
 - Variants compete for cortex space



Mental Darwinism

- Tor Norretranders (1998)
 - The senses process huge amounts of information, but consciousness contains almost no information
 - Large quantities of information are discarded before consciousness occurs.
 - The discarded information, nonetheless, has an influence on our behavior.
 - There is a non-conscious aspect of the human experience that we are not familiar with because we cannot "feel" it.
 - Consciousness presents us with an altered, subjective, tampered with view of reality
 - Our brain knows more than our consciousness does



Mental Darwinism

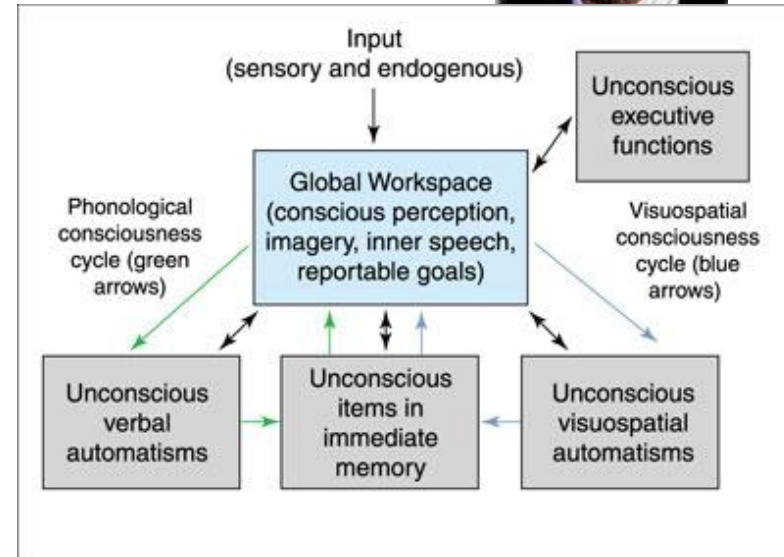


- Tor Norretranders (1998)
 - Conscious (thinking) "i" vs acting (instinctive) "me"
 - The "i" is held responsible for the actions of the "me", although the "i" is often not aware (literally) of what the "me" is doing.

Theatre Of Consciousness



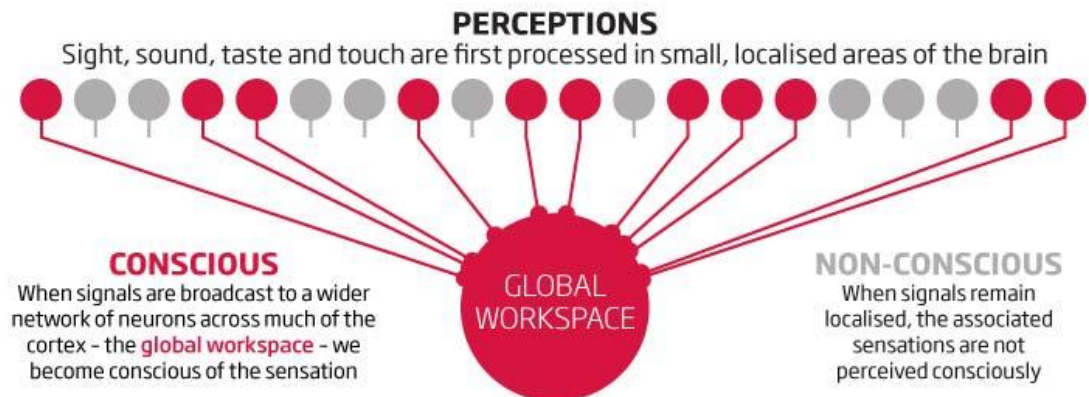
- Bernard Baars (1988)
 - Independent intelligent agents that broadcast messages to each other through a common workspace
 - Conscious experience emerges from cooperation and competition



Broadcasting consciousness

The global workspace theory suggests that consciousness arises from highly coordinated, widespread activity in the brain

©NewScientist



Theater of Consciousness

- Marcel Kinsbourne (1992)
 - Consciousness "is" performance
 - The brain does not generate consciousness: it is conscious
 - Consciousness is not a product of neural activity: it is the neural activity itself
 - The brain does not generate consciousness: it is conscious
 - Any region of the brain can be conscious when its circuits are in the appropriate state.
 - There is no central site for consciousness: any site can host consciousness
 - There can be more than one consciousness.



Theatre Of Consciousness

- Susan Greenfield (1995)
 - Consciousness is the process of propagating a stimulus through a network of connected neurons, the same way one perceives the widening ripples created by an object falling in a pond
 - There is no site of consciousness, but consciousness originates from processes happening locally somewhere sometime
 - Different groups of neurons ("gestalts") take over at different times



Theatre Of Consciousness

- Susan Greenfield (1995)
 - Consciousness is multiple in space but unitary in time
 - The dynamic properties of the brain "emerge" in a "gestalt" fashion from the connectivity of the gestalts
 - An external (sensory) phenomenon or an internal (cognitive) phenomenon causes the formation of a "gestalt" around an epicenter.
 - The gestalt causes the "emergence" of a conscious event.



Theatre Of Consciousness

- Susan Greenfield (1995)
 - The passage from one conscious event to another conscious event, from one gestalt to another gestalt, is due to a ripple effect: the ripples of one gestalt's concentric action may act as an arousal and trigger another gestalt
 - Mental life is a dual process of searching for information and adaptation to information, the former leading to more conscious access, the latter reducing conscious access (things become habitual and automatic)



Theater of Consciousness

- Denise Ingebo-Barth (2000)
 - Consciousness is a stream of discrete conscious events, just like a film is made by a stream of frames
 - An operation of the nervous system results in a "trajectory" of neural events in the brain
 - Whenever that trajectory crosses the thalamus, a conscious event is generated.
 - That trajectory could be coming from the senses (and result in a sensation) or the cortex (and result in a thought) and could be going to the cortex (and result in a memory)

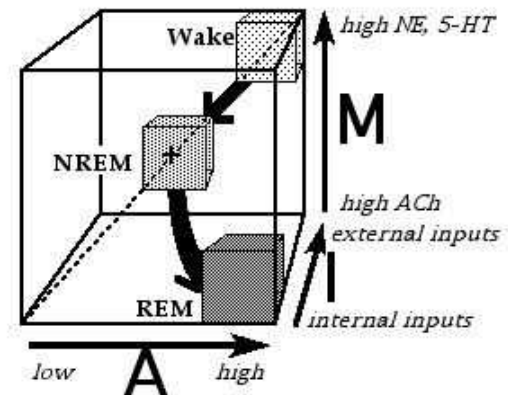
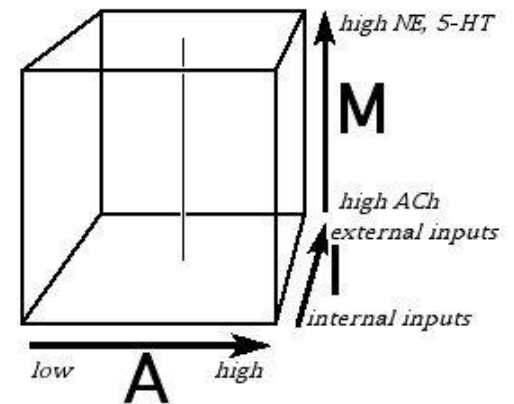


The Dream Of Consciousness

- Consciousness may simply be a manifestation of the same process that creates dreams
- Jonathan Winson:
 - Dreams were helping us survive before mind was invented
 - The mind is an evolution of dreaming
 - First the brain started dreaming, then dreams took over the brain and became the mind
 - The mind is one long, continuous dream of the universe

The Dream Of Consciousness

- Allan Hobson
 - The interplay of two chemical processes is responsible for all of consciousness
 - Both chemical systems are always active
 - Conscious states fluctuate continuously between waking and dreaming



The Self



Self

- Every year 98% of the atoms of your body are replaced



Self



- We inherit bodily traits from our parents: do we also inherit the consciousness of our self from our parents' selves?
- After all, my brain's structure is probably very related to my mother's and/or my father's brain.
- If the self (my feeling of who i am) is due to the processes inside my brain, then my self should be somehow similar to the self of my parents.

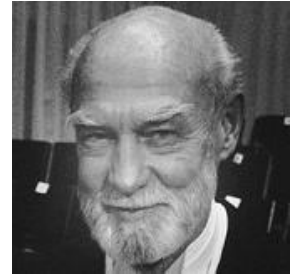
Self

- Lewis Thomas (1974)
 - The self is a myth, because we are part of a bigger self that eventually includes all life
 - The Earth is a giant self.



Self

- Roger Sperry (1976)
 - The self is an “emergent” property of brain processes that, in turn, controls brain processes
 - This emergent property is generated by brain (neural) processes but, once it is born, it is no longer a brain (neural) phenomenon: it belongs to a different category that does not obey to neurobiological laws anymore (“non-reductive physicalism”)



Self

- Derek Parfit (1985)
 - What happens to a person who is destroyed by a scanner in London and rebuilt cell by cell in New York by a replicator that has received infinitely detailed information from the scanner about the state of each single cell, including all of the person's memories?
 - Is the person still the same person?
 - Or did the person die in London?



Self

- Derek Parfit (1985)
 - The self "is" the brain state
 - As the brain state changes all the time, the self cannot be the same, there cannot be a permanent "self"
 - "I" do not exist. What exists is a brain state that right now is "me".
 - The next brain state will also be a self, distinct from the previous one.
 - There is a chain of successive selves, each somehow linked through memory to the previous one.
 - Each self is distinct from the previous ones and future ones.



Self

- Derek Parfit (1985)
 - The "I" is a mere illusion.
 - There is no person that all those selves share.
 - Buddhist-like set of potential consciousnesses



Self

- Michael Gazzaniga (1985)
 - Many minds coexist in a confederation
 - A module located in the left hemisphere interprets the actions of the other modules and provides explanations for our behavior
 - Beliefs do not precede behavior, they follow it: behavior determines our beliefs



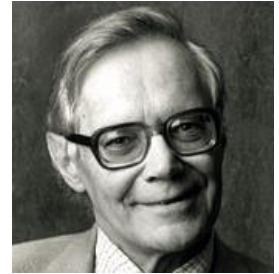
Self



- Robert Ornstein (1986)
 - Different regions of the brain behave independently of consciousness
 - The self shares the brain with other selves
 - Selves take hold of consciousness depending on the needs of the moment
 - Each self tends to run the organism for as long as possible
 - Continuity of the self is an illusion: we are not the same person all the time
 - Different selves within the brain fight for control over the next action.

Self

- Ulrich Neisser (1987)
 - Five kinds of self-knowledge:
 - the ecological self (situated in the environment)
 - the "interpersonal self" (situated in the society of selves)
 - the private self
 - the conceptual self
 - the narrative (or "remembered") self



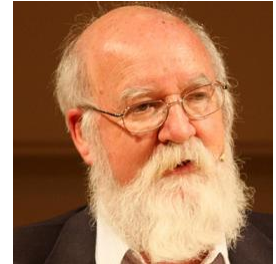
Self



- Richard Lazarus (1991)
 - The differentiation of self and other is a fundamental property of living organisms

Self

- Daniel Dennett (1991)
 - Multiple drafts



Self



- Jerome Bruner (1995)
 - Narratives create the self.
 - We are capable of turning sensory input into a "narrative"
 - There is a biological need to "make sense" of our experience
 - We structure that sense into "narratives"
 - One particular case of narrative is the "autobiography": the story about myself
 - As we organize their actions in stories, we also construct theories of other minds
 - Narratives interpret reality from the vantage point of the self
 - The self is a "perpetually rewritten story"

Self



- John Kotre (1996)
 - When we think of ourselves in the distant past, we are often part of the memory: we can see ourselves in the scene.
 - Thus at some point the remembering self (the self as subject) fashions a remembered self (the self as object).
 - The self is due to an "interpreter": it remembers itself as the center of things and makes sense of everything else
 - This interpreter is both a librarian, who simply archives memories, and a "myth-maker", who creates the myth of the "i".

Self



- John Kotre (1996)
 - Youngest children cannot attribute to others their own qualities (e.g., a four-year old boy cannot grasp the idea that his brother has a brother)
 - Later we develop the concept of the "me": we as we are seen by someone else.
 - The child begins to tell stories that are not just self-centered.
 - By the late teens, the child can reflect on herself and creates a myth of herself
 - The adult simply continues to refine that "myth"
 - The "myth-maker" is as relevant as the "keeper of archives" for the purpose of reconstructing memories

Self



- Richard Carlson (1997)
 - Every act of perception specifies both a perceiving self and a perceived object
 - Seeing something is not only seeing that object: it is also seeing it from a certain perspective: the perspective implies a "seer"
 - The subject is as much part of perception as the object.
 - Co-specification of self and object
 - Consciousness is an ecological necessity, because the self is co-specified by perception, and perception is driven by changes in the world
 - Cognition is grounded in one's point of view, and that point of view is grounded in an environment

Self

- Richard Carlson (1997)
 - The continuity of consciousness is not only real, but it is even an ecological necessity
 - The self is co-specified by perception, and perception is driven by changes in the world, and those changes are continuous
 - Cognition is grounded in one's point of view, and that point of view is grounded in an environment, and this two-fold grounding process is continuous.

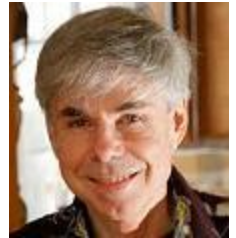


Self



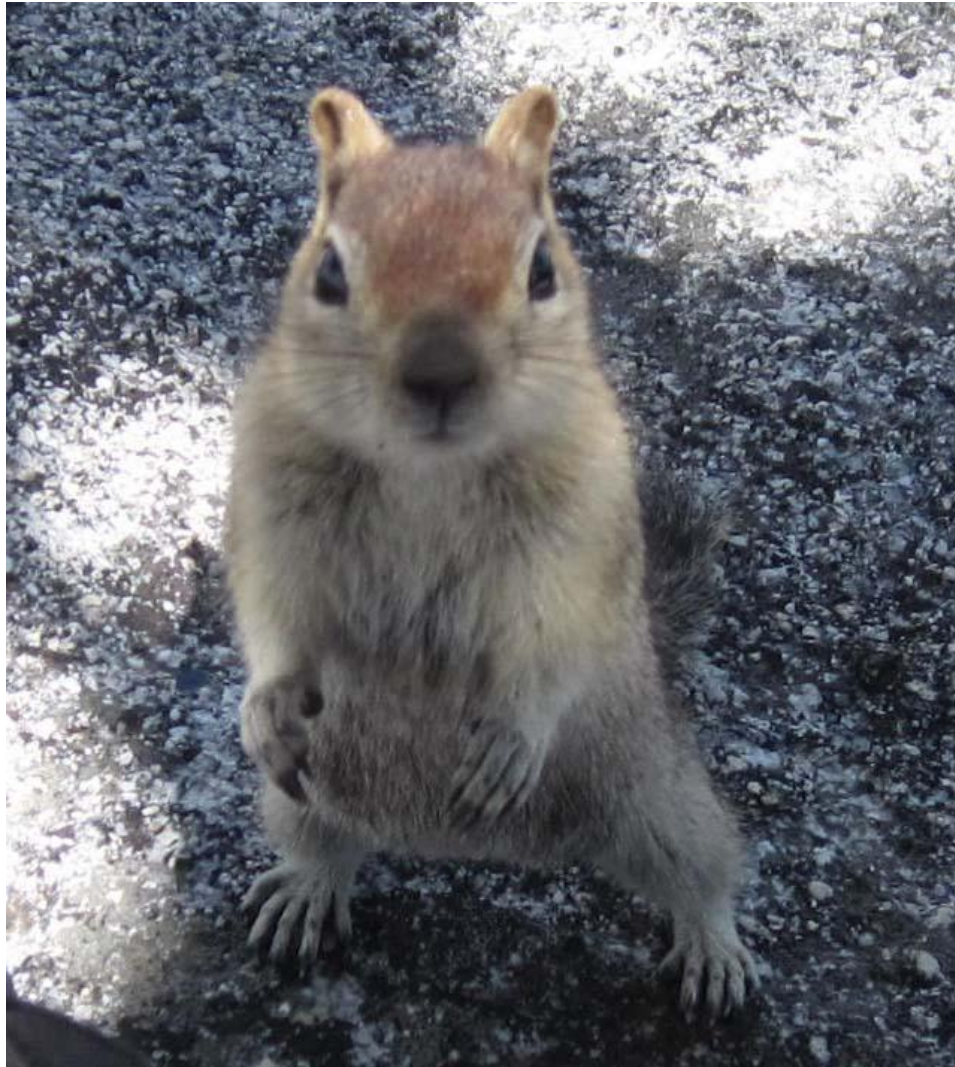
- Eric Olson (1997)
 - Identity comes from biology, not from psychology.
 - Psychological continuity is one thing, and identity is another thing
 - Minds change all the time, and therefore i am no longer the mind that i was a second ago
 - Therefore it is improper to claim that "i" was.
 - "I" can only "be" now.
 - "I am" is correct, whereas "i was" is a contradiction
 - The US physician Lewis Thomas argued that even the most primitive organisms must have a sense of self. It is not about being smart: it is about "being".

Self



- Douglas Hofstadter (2007)
 - The self can exist not only because of an ability but also because of an inability: we are unable to perceive the working of our brain.
 - Our mind cannot peer below the level of symbols.
 - Were we able to perceive the detailed operations of our brain's neurons, we probably wouldn't be "self-aware"
 - Thinking is inherently opaque: when i think of myself, i think of my goals, failures, desires, memories, but i don't think of Neuron 345-769-045 triggering Neuron 745-809-760 triggering Neuron...
 - "Our very nature is such as to prevent us from fully understanding its very nature".

Free Will

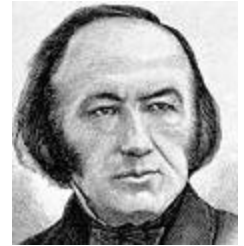


“Do We Think or Are We Thought?” (Faust)

Free Will

- Do we think or are we thought?
 - We are simply machines programmed by the rest of the universe (eg, relativity)
 - Consciousness fabricates reality (eg, quantum theory)
- Can a brain process occur that is not completely caused by other physical processes?
- Does matter have a degree of control over its own motion?

Self



- Claude Bernard (19th c)
 - The self-regulating nature of living organisms creates the illusion of purpose and free will
 - Each living organism is a system built to maintain a constant internal state in the face of changing external conditions
 - Inanimate matter obeys Newton's laws of cause and effect, animate matter tends to maintain its state no matter what external forces are applied
 - A living body seems to "want", "intend", "desire" to maintain its internal state
 - Living bodies appear to act purposefully, but they are simply reacting to the environment.
 - The living organism is "free" in that is not a slave of its environment.

Free Will

- Is quantum randomness the secret of free will?

Free Will



The question is not whether we have free will, but whether the laws of our universe allow for free will

Is the lack of free will in machines a limitation of our creativity, or proof that free will cannot exist in this universe?

Free Will



- The Nonlinear Origins of Free Will
 - No insect nor worm moves in a predictable manner
 - The same person will never tell the same story using the same words
 - If you perform the same action a thousand times, in exactly the same position under the exact same conditions, you will always perform a different sequence of movements.
 - We cannot repeat ourselves because "we" change all the time: we are never the same again.
 - It is impossible to put "you" in the exact same initial conditions because "you" are the one element that is different even if everything else in the universe remains the same

Free Will



- The Nonlinear Origins of Free Will
 - Anything that is alive changes all the time, therefore will never repeat itself.
 - You are unpredictable because your brain is governed by a nonlinear equation.
 - Robots do not exhibit "free will" because they don't change while they exist.
 - Given the same conditions a robot's "mouth" will utter the exact same words to tell a story.

Free Will



- The Nonlinear Origins of Free Will
 - The "i" that is supposed to have free will does not exist: it is something that changes all the time, because at every instant countless cells of the body change including countless cells of the brain.
 - The "I" is precisely the sequence of unpredictable actions generated by a nonlinear system.
 - Free will exists, but the "i" does not exist.

Summary

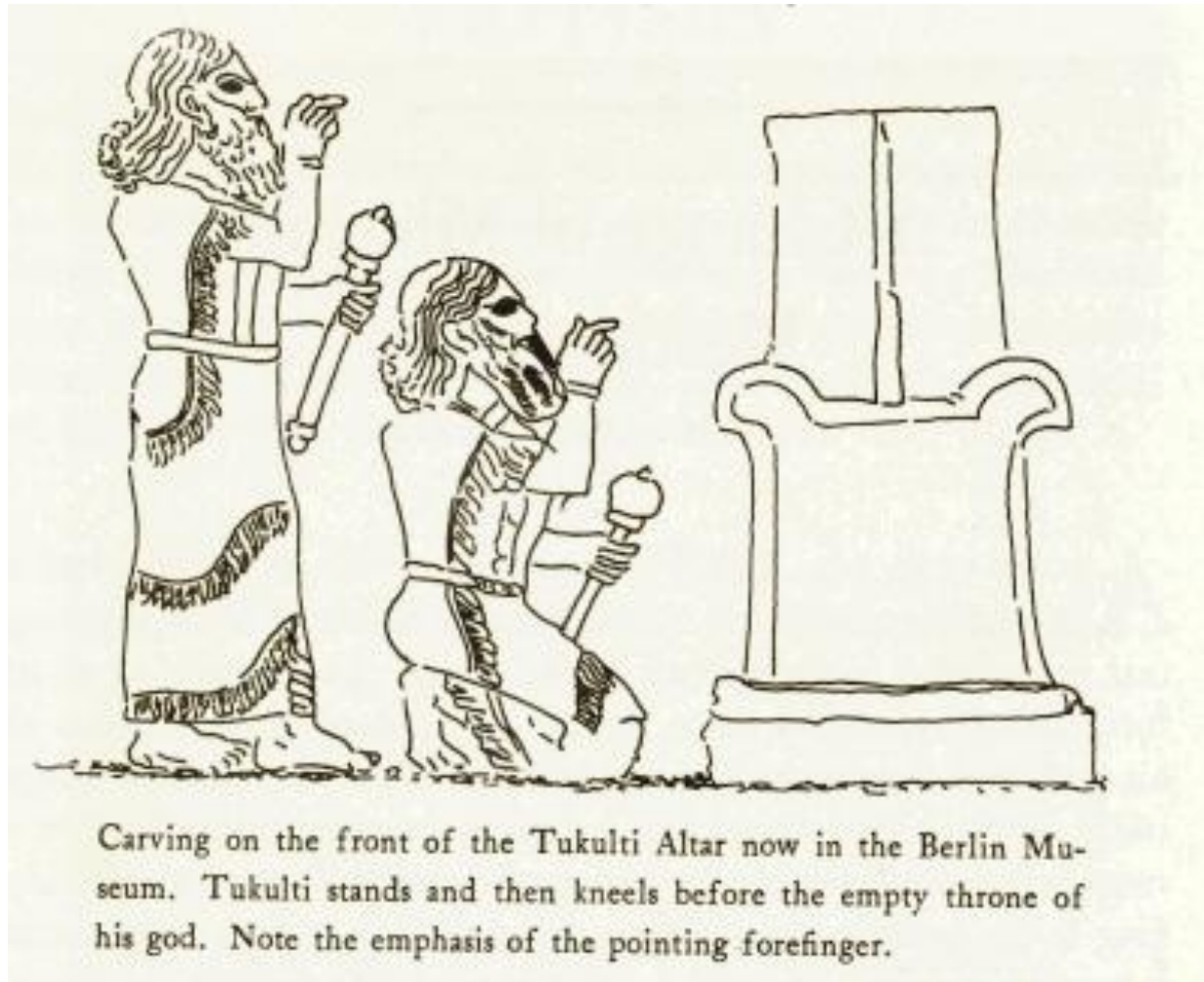
- The Factory Of Illusions
- Qualia
- The Impossibility Of A Science Of Consciousness
- Consciousness is a process, not an object
- The location of consciousness
- Space-based binding
- Time-based binding
- Theater of Consciousness
- Dreams
- Self
- Free will

Break



"If you gaze long into an abyss, the abyss will gaze back into you" (Friedrich Nietzsche)

Origins of Consciousness



Carving on the front of the Tukulti Altar now in the Berlin Museum. Tukulti stands and then kneels before the empty throne of his god. Note the emphasis of the pointing forefinger.

The Origin of Consciousness

1. A by-product of Language
2. A recent invention
3. An Ancient evolutionary invention
4. A by-product of memes

The Origin of Consciousness

1. Language

The Origin of Consciousness

- David Malet Armstrong (1960s)
 - The biological function of consciousness is to “sophisticate” the mental processes so that they yield more interesting action

The Origin of Consciousness

- Karl Popper (1977)
 - Phylogenetically speaking, consciousness emerged with the faculty of language
 - Ontogenetically speaking, it emerges during growth with the faculty of language



The Origin of Consciousness



- Nicholas Humphrey (1983)
 - By exploring their own selves, humans gained the ability to understand other humans
 - By understanding their own minds, they understood the minds of the individuals they shared their life with.
 - The function of consciousness is that of social interaction with other “consciousnesses”
 - Consciousness gives every human a privileged picture of her own self as a model for what it is like to be another human

The Origin of Consciousness



- Euan Macphail (1998)
 - "Association formation" is ubiquitous in vertebrates, but it is only the unconscious form of learning
 - Humans also have a conscious (explicit) system
 - The explicit memory system is about what happens to the self: it requires the existence of the self

The Origin of Consciousness



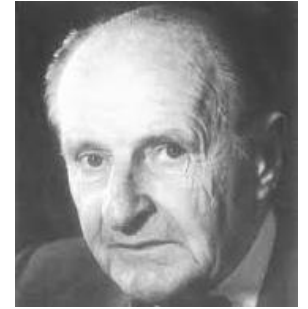
- Euan Macphail (1998)
 - Language, the self and consciousness develop together in the infant, and this development somehow recapitulates the evolution of language in our species
 - We started to think when we acquired the capacity to discriminate self and non-self, and we acquired that capacity when we acquired the linguistic ability
 - The self is a by-product of "aboutness": the association between a subject and a predicate
 - Aboutness comes with language

The Origin of Consciousness

2. A recent invention

The Origin of Consciousness

- Bruno Snell (1946)
 - Consciousness is a recent acquisition



The Origin of Consciousness

- Julian Jaynes' Bicameral Mind (1977)
 - Ancient texts were composed by nonconscious minds
 - Human beings were guided by "hallucinations" (eg, by gods)
 - Hallucinations would form in the right hemisphere of the brain and would be communicated to the left hemisphere of the brain, which would then receive them as commands
 - Language did not serve as conscious thought: it served as communication between the two hemispheres of the brain



The Origin of Consciousness

- Julian Jaynes' Bicameral Mind (1977)
 - The bicameral mind began breaking down under the pressure caused by the complexity of the environment
 - The hallucinated voices no longer provided automatic guidance for survival
 - Consciousness was therefore invented by human beings through a process that entailed the loss of belief in gods



The Origin of Consciousness

- Julian Jaynes' Bicameral Mind (1977)
 - Awareness of an action tends to follow, not precede, the action
 - Awareness of an action bears little or no influence on the outcome
 - Consciousness is an operation rather than a thing
 - Consciousness requires metaphors and analogy



The Origin of Consciousness

- Julian Jaynes' Bicameral Mind (1977)
 - Metaphors and analogies map the functions of the right hemisphere into the left hemisphere and make the bicameral mind obsolete
 - Consciousness expanded by creating more and more metaphors and analogies
 - Ultimately, consciousness is a metaphor-generated model of the world



The Origin of Consciousness



- Steven Mithen's Cognitive Fluidity (1996)
 - Four kinds of intelligence (four “modules” in the brain) evolved independently:
 - Social intelligence: the ability to deal with other humans
 - Natural-history intelligence: the ability to deal with the environment
 - Tool-using intelligence
 - Linguistic intelligence (language, metaphor and analogy)

The Origin of Consciousness

- Steven Mithen's Cognitive Fluidity (1996)
 - The hunters-gatherers of our pre-history were experts in all these domains, but those different kinds of expertise did not mix
 - "Cognitive fluidity" caused the cultural explosion of art, technology, farming, religion, ...

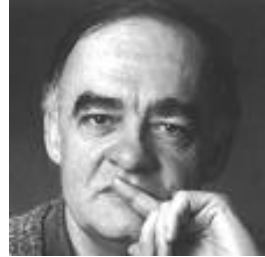


The Origin of Consciousness



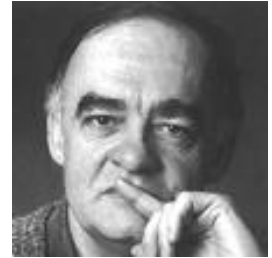
- Steven Mithen's Cognitive Fluidity (1996)
 - What caused cognitive fluidity?
 - Self-awareness may have integrated intelligences that for thousands of years had been kept separate.
 - Mithen's evolutionary theory mirrors Annette Karmiloff-Smith's theory of child development

The Origin of Consciousness



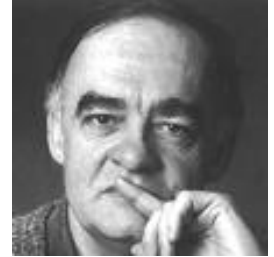
- Merlin Donald (1991)
 - The human mind developed in four stages, which roughly correspond to stages of child development
 - Episodic mind: remembers repeating episodes, learns stimulus-response associations, cannot retrieve memories independent of environmental cues, lives entirely in the present.

The Origin of Consciousness



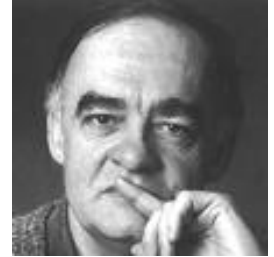
- Merlin Donald (1991)
 - The human mind developed in four stages,
 - Mimetic mind (Homo Erectus): maintains motor-based representations, retrieves memories independent of environmental cues, re-describes experience based on knowledge, communicates intentions/desires, makes tools
 - (Annette Karmiloff-Smith's "representational re-description" in the stages of child development)
 - The mind has a representation of the world and it is capable of continuously adapting it to new knowledge.
 - Generations can pass on cultural artifacts
 - A collective memory arises (a "culture")

The Origin of Consciousness



- Merlin Donald (1991)
 - The human mind developed in four stages,
 - Mythic/narrative mind (Homo Sapiens): speaks, constructs narratives, builds myths
 - Myths represent integrated models of the world by which individuals could generalize and predict
 - "Language is about telling stories in a group"

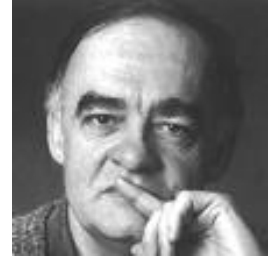
The Origin of Consciousness



- Merlin Donald (1991)
 - The human mind developed in four stages,
 - Theoretical/symbolic mind (50,000 years ago): manipulates symbols
 - Humans began to store memories in the outside world instead of in their own brain (e.g., cave paintings, figurines, calendars, etc).
 - Modern humans, helped by written language, achieved higher, symbolic representational capabilities such as logic

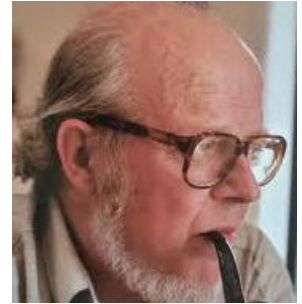
The Origin of Consciousness

- Merlin Donald (1991)
 - The human mind developed in four stages,
 - Jean Piaget and Lev Vygotsky: children follow a similar path to full-fledged thinking, from event to mimetic, from narrative to symbolic



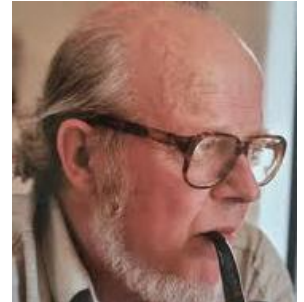
The Origin of Consciousness

- Jacques Cauvin (2000)
 - At some point the “modern” brain of the neolithic individual started forming symbolic systems that we now call “religion” and “politics”
 - That new way of thinking caused a change in behavior, from hunting/gathering to agriculture and cities
 - The transition occurred not because it is more rational and efficient, but simply because their brains started thinking that way



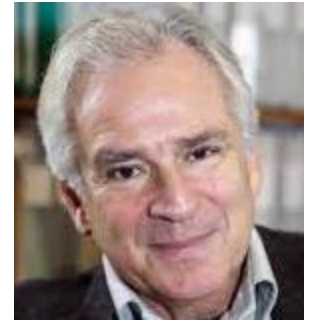
The Origin of Consciousness

- Jacques Cauvin (2000)
 - The new brains convinced themselves that the transition to agriculture was the right thing to do and that such a transition constitutes "progress"
 - First our brains started (accidentally) believing in deities of fertility, rain dances and river spirits; and then we started farming and creating cities.



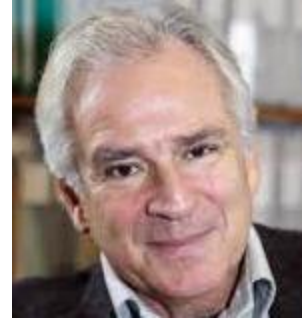
The Origin of Consciousness

- Peter Gardenfors (2003)
 - Perceptions (the interpretation of sensations, which are representations directly related to the world) vs "detached" representations (representations about something that is present here and now)
 - Detached representations allow a being to "become increasingly detached from the immediate vicinity"

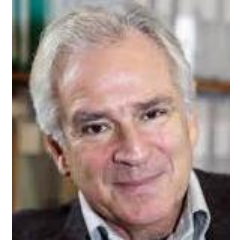


The Origin of Consciousness

- Peter Gardenfors (2003)
 - The self presupposes a you
 - The "I" emerges from a network of inter-related cognitive functions
 - Language came last: human language is very much about the "I" and the "you"
 - Language is an emergent property of cognitive systems (it is a natural evolution of cognitive skills that preexisted it)

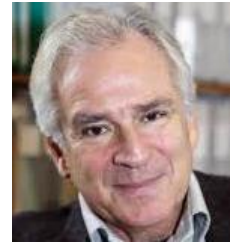


The Origin of Consciousness



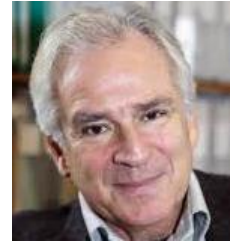
- Peter Gardenfors (2003)
 - The cortex is the place where a representation of the world is created.
 - That allows the brain to use the representation of an object (or a situation) rather than the object (or the situation) itself.
 - It allows to be somewhat "detached" from reality: the brain can work on something that is not an "here and now"
 - The large cortex of the human brain makes the difference with animal behavior: superior ability in representing the world

The Origin of Consciousness



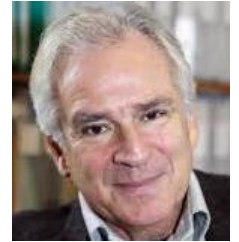
- Peter Gardenfors (2003)
 - First came sensations, then perceptions (the interpretation of those sensations, which are already representations but are directly related to the world) and then "detached" representations (representations about something that is not present here and now).
 - Only mammals and birds have the cortex that allows for detached representations: they can "guess" and "plan"
 - An internal representation "allows our hypotheses to die instead of us".
 - Animals that are capable of internal representation share some behavioral traits: they play and they dream.

The Origin of Consciousness



- Peter Gardenfors
 - An understanding of others people's minds came before an understanding of one's own mind
 - I understand that you exist, act and have motives before i understand that i exist, act and have my own motives.
 - First came the concept of "i and you", then came the concept of "i" (the subject, which presupposes a non-subject)

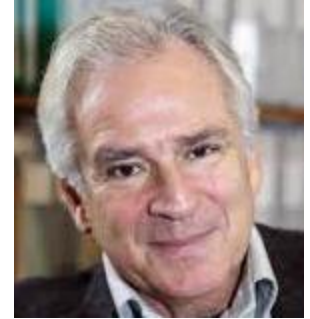
The Origin of Consciousness



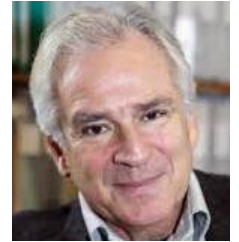
- Peter Gardenfors
 - Animals make tools to be used immediately
 - Humans carry their tools with them, knowing that they may need them again.
 - Animals do communicate, but their communication is about the "here and now",
 - Humans can discuss our memories from the past and dreams for the future.
 - Only humans are self-conscious.

The Origin of Consciousness

- Peter Gardenfors (2003)
 - How self-conscious beings came to be:
 - first sensations,
 - then attention,
 - then emotions,
 - then memory,
 - then internal representations,
 - then planning,
 - then the self,
 - then free will
 - and finally language



The Origin of Consciousness



- Peter Gardenfors
 - Language is the last (not first) stage
 - Humans are the only animals that are truly conscious of themselves and can speak.
 - Animals cannot literally talk. "They have no need to talk since they have nothing to talk about"

The Origin of Consciousness

3. Ancient evolutionary invention

The Origin of Consciousness

- Kenneth Oakley (1940s)
 - Three levels of consciousness, corresponding to the three evolutionary layers of the brain:
 - awareness, controlled by the older part of the brain and related only to conditioning;
 - consciousness, controlled by the cortex and the hippocampus, and related to the internal representation of the world;
 - self-awareness, due to the most recent layer of the brain and related to the internal representation of one's internal representation



The Origin of Consciousness

- Harry Jerison (1973)
 - Mammals evolved about 200 million years ago as the “nocturnal” reptiles
 - Mammals were capable of using sound to create a cognitive map of their environment
 - Then vision too became a major source of information for the mammal brain
 - The brain of mammals was flooded with sensory inputs, and had to develop the ability to recognize an object that could be defined by many different sets of inputs.
 - Consciousness arose as a way to represent the perceptual world



The Origin of Consciousness

- Harry Jerison (1973)
 - The reptilian brain was simply “reacting” to stimuli. The mammalian brain was capable of transforming the stimuli into an “object” existing in time and space, and then “act” accordingly.
 - The nervous system integrates all the sensory data , constructs a model of the world, and then uses that model to “understand” sensory data.
 - As the model gets refined, it also gets easier to recognize sensory data for what they are.
 - A sensory datum is not recognized in isolation, but it is recognized as part of a scene



The Origin of Consciousness

- John Eccles (1950s)
 - Consciousness arose with the advent of the mammalian neocortex, about 200 million years ago

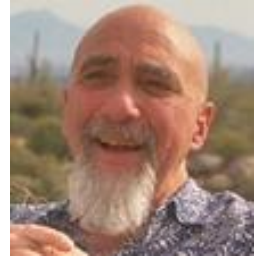


The Origin of Consciousness

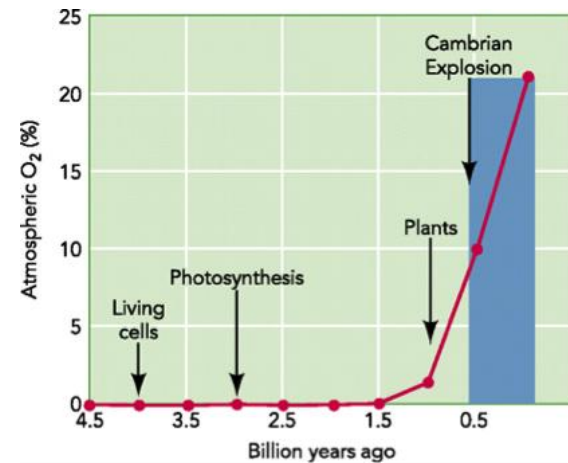
- Lynn Margulis
 - The cytoskeleton was created by symbiotic mergers more than a billion years ago
 - Primitive organisms relied on the cytoskeleton for purposeful behavior
 - The cytoskeleton organizes intelligent behavior in simple organisms.
 - Consciousness was a property of even simple unicellular organisms of several billion years ago



The Origin of Consciousness

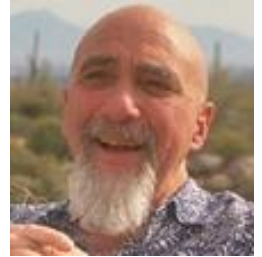


- Stuart Hameroff (1987)
 - The mystery of the Cambrian explosion
 - A new feature greatly enhanced adaptation and mutation
 - Behavior can indirectly alter genetic code by enabling organisms to survive and reproduce where non-intelligent organisms would simply die
 - Consciousness occurred early in the evolutionary path
 - Consciousness altered the course of evolution



The Origin of Consciousness

- Stuart Hameroff
 - The cytoskeleton organizes intelligent behavior in simple organisms
 - Consciousness is created at the level of the cytoskeleton



The Origin of Consciousness



- Stephen Porges (1995)
 - Transition from a state of being acted upon by the world to a state of acting upon the world.
 - Consciousness originated when the brain evolved from the reptilian structure to the mammalian structure
 - The brain of a reptile is not active, but simply reactive.
 - Matter prevails over mind.

The Origin of Consciousness



- Stephen Porges (1995)
 - The brain of a mammal commands adjustments so that body temperature and metabolism are kept stable.
 - The brain of a mammal is capable of acting.
 - Mammals explore their environment looking for what they need.
 - Mind prevails over matter.
 - The reptilian brain is designed to use food. The mammalian brain is designed to look for food.

The Origin of Consciousness



- Stephen Porges (1995)
 - The resulting organization of the brainstem in mammals fostered brain functions of attention, motion, emotion, and communication.
 - The development of the cortex enabled the mammalian brain to communicate emotions
 - Then it was just a matter of time before language and conscious thought emerged.

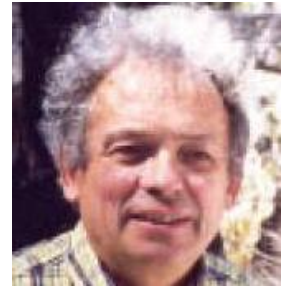
The Origin of Consciousness



- Graham Cairns-Smith (1995)
 - A rudimentary system of feelings was born by accident
 - Evolutionary usefulness evolved more complex feelings
 - The organism was flooded with emotions and a "stream of consciousness" appeared
 - Verbal language allowed to express it in a more sophisticated way than the primitive facial language
 - Thought was born.

The Origin of Consciousness

- Graham Cairns-Smith (1995)
 - With language, thought and deep emotions, the conscious "I" was born
 - Consciousness originated from the evolution of emotions



The Origin of Consciousness

4. A by-product of memes

Daniel Dennett/ Susan Blackmore

The Origin of Consciousness



- *Co-evolution of brains, tools, emotions, language, memes*

Summary

1. A by-product of Language
2. A recent invention
3. An Ancient evolutionary invention
4. A by-product of memes

Quantorelativistic Theories of Consciousness



Relativistic Models Of Consciousness



- James Culbertson (1963)
 - All space-time events are conscious: they are conscious of other space-time events
 - The subjective features of the "psycho-space" of an observer derives from the objective features of the region of space-time that the observer is connected to
 - Our brain create the impression of a time flow , of a time-travel through the region of space-time events connected to the brain
 - Consciousness permeates all of nature
 - Every object has a degree of consciousness.

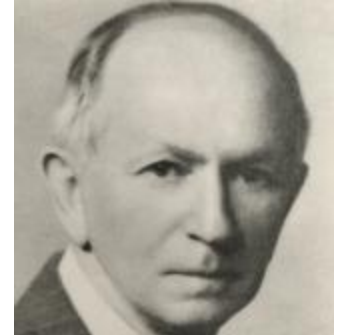
Quantum Models Of Consciousness

*Perhaps the phenomenon of consciousness is something
that cannot be understood in entirely classical terms
(Roger Penrose)*

Quantum Models Of Consciousness

- Consciousness is unlikely to arise from classical properties of matter
- Neurobiological descriptions of the brain are based on Newton's physics
- Uncertainty, non-locality and entanglement seem better candidates to explain consciousness
- In Quantum Physics, matter is ultimately not a solid substance
- The brain "instantiates" not one but two systems: a classical one and a quantum one

Quantum Models Of Consciousness



- Alfred Lotka (1924)
 - The mind controls the brain by modulating the quantum jumps that would otherwise lead to a completely random existence.

Quantum Models Of Consciousness



- David Bohm (1951)
 - The universe is an undivided whole in constant flux
 - The thinker and the thought cannot be separated
 - "subject- verb- object: the key actor is the verb, not the subject, and the verb unites the subject and the object in one, undivided action

Quantum Models Of Consciousness

- David Bohm
 - At the level of the “implicate order” (“higher dimension”) there is no difference between matter and mind
 - That difference arises within the “explicate order” (the conventional space-time of Physics)
 - As we travel inwards, we travel towards that higher dimension, the implicate order, in which mind and matter are the same



Quantum Models Of Consciousness



- David Bohm
 - As we travel outwards, we travel towards the explicate order in which subject and object are separate
 - Every particle has a rudimentary mind-like quality
 - Matter has mental properties, as well as physical properties
 - The two sides cannot be separated because they are entangled in the same quantum field

Quantum Models Of Consciousness

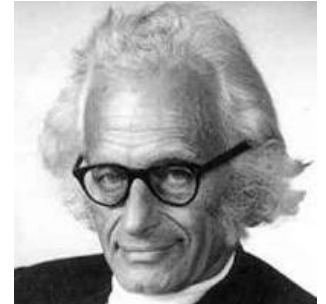
- Bose-Einstein condensation - Fröhlich, 1968
- Synapses - Electron Tunneling - Walker, 1970
- Dendritic Nets - Hologram - Pribram, 1971
- Neural Cell Water - Quantum Field Ordering - Stuart, Takahashi, Umezawa, 1978
- Synapses Microsites - Psychon - Eccles, 1986
- Neural Membrane- Bose-Einstein Condensate - Marshall, 1989
- Perception of Brain States - Lockwood, 1989
- Pre-synaptic Vesicle Release - Quantum Indeterminacy - Beck/Eccles, 1992

Quantum Models Of Consciousness

- Meet the Bosons
 - Bose-Einstein condensates are the most highly ordered structures in nature
 - Pauli's principle: Fermions never occupy the same state at the same time, whereas bosons do
 - The wave functions of two fermions can never completely overlap, whereas the wave functions of two bosons can completely overlap
 - The bosons basically lose their identity and become one
 - Atoms of a BE-condensate behave like one atom

Quantum Models Of Consciousness

- Herbert Froehlich (1968)
 - Bose-Einstein condensation is likely at body temperatures In living matter
 - Biological oscillators amplify signals and encode information
 - Coherent oscillations are crucial to many processes of integration of information in the brain



Quantum Models Of Consciousness



- Evan Walker (1970)
 - Electrons can "tunnel" between adjacent neurons, thereby creating a virtual neural network overlapping the real one
 - This virtual nervous system produces consciousness and directs the behavior of the real nervous system.
 - The brain "instantiates" not one but two systems: a classical one and a quantum one; the second one being responsible for the properties of mental life (such as consciousness) that are not easily reduced to the properties of the classical brain.

Quantum Models Of Consciousness

- Karl Pribram (1971)
 - A hologram is a permanent record of the interference between two waves of coherent light.
 - Each part of the hologram contains the entire image.
 - The storage capacity of holograms is enormous
 - The brain organizes information by interference patterns just like a hologram
 - A sensory perception is transformed into a "brain wave"
 - The interference of a memory wave and a perceptual wave generates a hologram



Quantum Models Of Consciousness

- John Eccles (1986)
 - Synapses in the cortex respond in a probabilistic manner to neural excitation
 - That probability might well be governed by quantum uncertainty given the extremely small size of the synapsis' microscopic organ that emits the neurotransmitter
 - An immaterial mind (in the form of "psychons") controls the quantum "jumps" and turns them into voluntary excitations of the neurons that account for body motion.



Quantum Models Of Consciousness



- Michael Lockwood (1989)
 - Consciousness provides a kind of "window" onto the brain (Bertrand Russell)
 - Special Relativity implies that mental states must be physical states
 - Sensations must be intrinsic attributes of physical states of the brain: in quantum lingo, each observable attribute (e.g., each sensation) corresponds to an observable of the brain
 - Consciousness scans the brain to look for sensations
 - It does not create them: it just seeks them.

Quantum Models Of Consciousness

- Ian Marshall (1989)
 - Consciousness may arise from the "excitation" of a Bose-Einstein condensate
 - The brain contains a Froehlich-style condensate
 - Holistic properties of condensates and those of consciousness
 - Whenever the condensate is excited by an electrical field, conscious experience occurs
 - Wave function tends to collapse towards Bose-Einstein condensates



Quantum Models Of Consciousness



- Ian Marshall (1989)
 - There is a universal tendency towards creating the living and thinking structures that populate our planet
 - Life and consciousness are ultimately due to the mathematical properties of the quantum wave function
 - We "must" exist and think

Quantum Models Of Consciousness



- Danah Zohar (1990)
 - Mind/body duality can be reduced to wave/particle duality and to bosons/fermions duality
 - The wave aspect of nature yields the mental, the particle aspect of nature yields the material
 - Bosons are particles of "relationship"
 - Fermions make up the matter of the universe
 - Bosons are the basis for the conscious life, and fermions for the material life

Quantum Models Of Consciousness

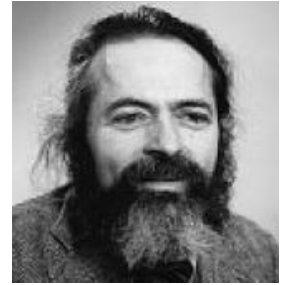
- Danah Zohar (1990)
 - The self changes all the time, but quantum interference makes each new self sprout from the old selves
 - Wave functions of past selves overlap with the wave function of the current self



Quantum Models Of Consciousness

- Neural Proteins - Quantum Superposition- Conrad, 1992
- Hyperspace - Sirag, 1993
- Microtubules - Quantum Coherence - Hameroff, 1994
- Ordered Water - Super-radiance/self-induced Transparency - Jibu/Yasue, 1994
- Calcium Ions - Wave Function Collapse - Stapp, 1994
- Microtubules - Quantum Computation/objective Reduction 'Orch Or' - Penrose/Hameroff, 1995
- Dendritic Nets - Quantum Memory - Yasue, 1995
- Quantum Cognition and Quantum Sensory Data- Globus, 1995
- Neural Membrane Lipids- Quantum Interference - Wallace, 1996
- Gap Junctions - Electron Tunneling - Hameroff, 1998
- Microtubules - Biophoton Emission - Hagan, 1998

Quantum Models Of Consciousness



- Michael Conrad (1992)
 - The molecules inside each cell implement a kind of quantum associative memory
 - Quantum effects at the level of the protein
 - The protein is a biomolecular information processing system

Quantum Models Of Consciousness



- Saul-Paul Sirag (1993)
 - Hyperspace contains many physical dimensions and many “mental” dimensions
 - Time is one of the dimensions that they have in common

Quantum Models Of Consciousness



- Henry Stapp (1993)
 - We only know our observations, ie our perceptions
 - The state of the universe is an objective compendium of subjective knowings
 - Reality is a sequence of discrete events in the brain
 - Each event is an increase of knowledge. That knowledge comes from observing "systems"

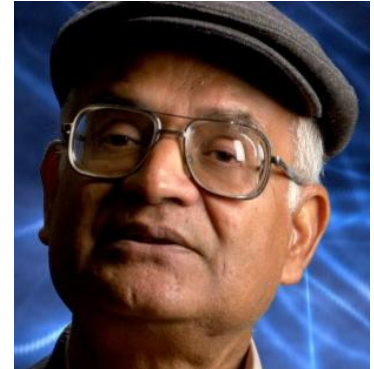
Quantum Models Of Consciousness

- Henry Stapp (1993)
 - Each event is driven by three processes that operate together:
 - "Schroedinger process", a deterministic process
 - "Heisenberg process", a conscious choice that we make
 - "Dirac process", nature's answer to our question
 - Each knower's act of knowledge results in a new state of the universe



Quantum Models Of Consciousness

- Amit Goswami (1993)
 - Consciousness collapses the quantum wave and creates reality
 - Matter is a mental phenomenon
 - Consciousness is the only substance
 - The "oddities" of Quantum Mechanics are in our mind, not in the world
 - There is only one consciousness, only one subject, and not many individual, separate subjects (otherwise different observers could collapse the wave in different ways)
 - There is, ultimately, only one observer
 - Consciousness deliberately determines reality: consciousness "chooses" (not just picks up) the outcome of a measurement



Quantum Models Of Consciousness

- Nick Herbert (1993)
 - Consciousness is a pervasive process in nature.
 - Consciousness is as fundamental a component of the universe as elementary particles and forces
 - The conscious mind can be detected by three features of quantum theory: randomness, the collapse of the wave, and interconnectedness
 - Scientists may be vastly underestimating the quantity of consciousness in the universe.



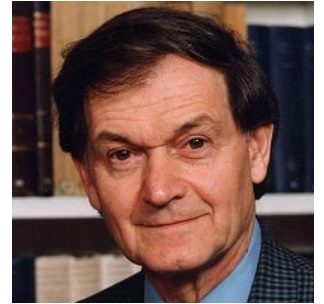
Quantum Models Of Consciousness

- Stuart Hameroff (1994)
 - Microtubules inside the neurons control the function of synapses
 - Consciousness is a manifestation of the quantum cytoskeletal state



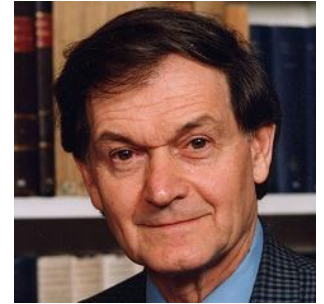
Quantum Models Of Consciousness

- Roger Penrose (1994)
 - Reality emerges from the collapse or reduction of the wave function
 - "Subjective" (observer-driven) reduction is not the only type of collapse
 - Objective reduction is a type of collapse of the wave function that occurs when the universe must choose between incompatible space-time geometries.



Quantum Models Of Consciousness

- Roger Penrose (1994)
 - Each self-collapse in the brain (inside microtubules of the cytoskeleton) corresponds to a discrete conscious event
 - "Protoconscious" information is encoded in spacetime geometry at the fundamental planck scale
 - A self-organizing Planck-scale process (the objective reduction) results in consciousness
 - Consciousness is the bridge between the brain and spacetime geometry



Quantum Models Of Consciousness



- Kuno Yasue (1995)
 - Several layers of the brain can host quantum processes: water mega-molecules in the space between neurons, the membrane of the neuron, microtubules, bioplasma of charged particles, etc
 - The brain is a macroscopic quantum system
 - Consciousness arises from the interaction between the electromagnetic field and molecular fields of water and protein
 - Brain dynamics can be represented by a “brain wave equation” similar to Schroedinger's wave equation.
 - The evolution of the neural wave function is not random, but optimized under a principle of "least neural action".

Quantum Models Of Consciousness

- Fred Alan Wolf (2001)
 - We cannot ever know the exact position of a particle, therefore the particle is a purely mental hypothesis, therefore it exists only because our mind cannot ever know all about it
 - The entire world that we perceive is an illusion, due to the fact that our mind cannot know the world as it really is.
 - If nobody observes it, our world does not exist.
 - Matter is created by mind



Quantum Models Of Consciousness

- Fred Alan Wolf (2001)
 - Mind "invents" a fictitious body and then it starts believing that "it is" the body
 - The observer is not in the brain and it is not in the body
 - The observer, by observing, becomes the body

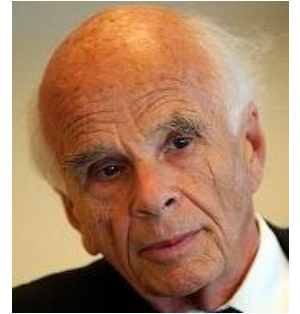


Quantum Models Of Consciousness

- Fred Alan Wolf
 - The “Zeno effect”: the life of a particle depends on how many times we observe it, because each observation changes its state
 - An observer can change the past by fixing the outcome of an observation
 - Every time we “observe”, we force a certain past on the object of our observation
 - Darwinian evolution alone can account for the evolution of life
 - Additional information must be coming from the future
 - Information flows back from the future to the present about which organisms make sense

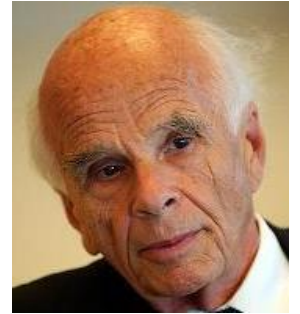


Quantum Models Of Consciousness



- Erwin Laszlo (2004)
 - More than 99% of all physical "matter" consists of a vacuum, and this yields a huge amount of zero-point energy
 - David Bohm's "in-formation" (an active form of information that shapes the informing agent) is the fundamental constituent of the universe expressed through a ubiquitous field that originates from the quantum vacuum
 - All universes originate in the quantum vacuum and evolve thanks to it
 - The vacuum generates a holographic field that encodes everything in spacetime

Quantum Models Of Consciousness



- Erwin Laszlo (2004)
 - Everything in the universe is interconnected thanks to that "Akashic" field
 - Consciousness too is created by the quantum vacuum, and it too permeates the entire universe
 - We are connected in a superconsciousness a` la Bohm's "implicate order", Carl Jung's "collective unconscious" and Teilhard de Chardin's "noosphere"

Panpsychism

- We don't wonder why we are made of electrons: everything is made of electrons, therefore no wonder that my body too is made of electrons
- We wonder why we are conscious because we made the assumption that only some things (us) are conscious
- All we have to do is remove that assumption and we have a simple theory of consciousness.

Panpsychism

- Modern Panpsychism
 - Alfred Whitehead (1920): Every particle in the universe is an event having both an objective aspect of matter and a subjective aspect of experience
 - Niels Bohr (1930s): The quantum wave function of matter represents its mental aspect
 - Thomas Nagel (1979): “Proto-mental properties” must be present in all matter



Panpsychism



- David Chalmers (1996)
 - Consciousness is due to "protoconscious" properties that must be ubiquitous in matter
 - Consciousness is a different set of properties that cannot be explained by the "natural" laws of the physical sciences
 - "Psychophysical" laws, not of the "reductionist" kind that Physics employs, are needed

Panpsychism



- David Chalmers (1996)
 - "Logical" supervenience (loosely, "possibility") is a variant of supervenience: some systems could exist in another world (are "logically" possible), but do not exist in our world (are "naturally" impossible)
 - Natural supervenience occurs when two sets of properties are systematically and precisely correlated in the natural world
 - Logical supervenience implies natural supervenience, but not viceversa.
 - There may be worlds in which two properties are not related the way they are in our world, and therefore two naturally supervenient systems may not be logically supervenient.
 - Most facts supervene logically on the physical facts: if they are identical physical systems, then they are identical, period
 - There are few exceptions and consciousness is one of them
 - Consciousness is not logically supervenient on the physical.

Summary

- The Factory Of Illusions
- The Impossibility Of A Science Of Consciousness
- Consciousness is a process, not an object
- The location of consciousness
- Space-based binding
- Time-based binding
- Theater of Consciousness
- Dreams
- Self
- Free will
- The Origin of Consciousness
- Quantum Models Of Consciousness
- Panpsychism

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Consciousness



"I don't do drugs - I am drugs"
(Salvador Dali)

Consciousness

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