

EVOLUTIONARY ORIGIN OF CONSCIOUSNESS AND QUALIA

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(Abstract)

On the basis of a triune brain model relating human behavior to three basic evolutionary formations of the brain: reflexive (reptilian), emotive (mammalian) and rational (human), an evolutionary origin of consciousness and qualia eliciting consciousness is sought in two groups of neurons, sameness neurons and newness neurons, discovered in frog's visual system, classifying external objects into what is known (familiar) and unknown (unfamiliar). For human, enhanced consciousness of a patient was observed during aura when the threat of unknown was converted to an affective feeling of familiarity. Considering similar experiences by scientists a proposal is here made to classify the qualia by the evolutionary significance of elicited responses.

(Keywords)

evolution, brain, consciousness, qualia

1. Triune brain model

When the world ceases to be the stage for personal hopes and desires, where we, as free beings, behold it in wonder to question and to contemplate there we enter the realm of science and art.

A. Einstein (1879-1955)

In his book *Triune Brain in Evolution* MacLean [1] compared the brains of existing vertebrate animals possessing central nervous system, including human, with their fossil records. It was shown that the human brain had evolved and expanded to its present form and size while retaining three basic evolutionary formations reflecting their ancestral relationship to reptile, early mammal, and recent mammals. From their known functions the three formations are called reflexive brain, emotive brain, and rational brain, each having its own sense of time (instantaneous, short-term and long-term), its own memory (inherited, innate and acquired), its own inference (sensorial, perceptual and conceptual), its own language (signal, sign and symbol) and consciousness (preconscious, subconscious and conscious).

2. Evolutionary origin of memory, self-consciousness and free will

In 1957 Lettvin et al. [2] discovered two major populations of neurons called sameness neurons and newness neurons [3] in frog's visual system classifying retinal images of external objects into what is known and unknown. The newness neurons are excited to bring the animal into attentive state in search for unknown stimuli. The known objects are further divided by higher-level neurons into two

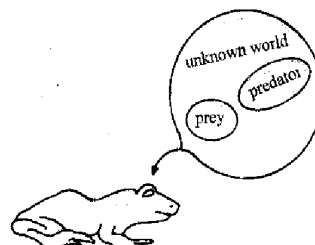


Figure 1. Frog's visual system classifying retinal images of external objects into what is known and unknown. The known object is further divided into what is biologically favorable (prey) and unfavorable (predator).

groups, quickly moving small objects (preys) and slowly approaching large dim objects (predators). It is conceivable that a 'dream' [4] of an amphibian frog of going on land activated animal's subsequent struggle onto land. In order for such a Lamarckian dream to be realized, it was first necessary for animal's fore limbs to fall within its field of vision and elicit self-consciousness. The visual image must then be stored as a long-term memory for a considerable time for a creative synthesis of the image of the upper limbs with the image of the animal on land propelling its own motor behavior. Next, there must occur the partial release of motor activity from genetically determined reflexive movement to voluntary movement. In human, spinal reflexes and other evolutionarily older neural nexus still control the autonomic activity of internal organs, but somatic musculature, hands and speech organs in particular, fall under voluntary control mechanism. By means of such voluntary movement we can explore the external world by free will. The human use of symbols (languages) in the rational brain, which is not under genetic control, affords unlimited boundaries to create conceptual space transforming physical reality into transphysical one (art and virtual reality).

3. Quest for beauty in science and art

In his *Truth and Beauty: aesthetics and motivation in science* Chandrasekhar [4] asks: How does it happen that beauty in creative works in exact sciences become recognizable even before they are understood in detail and before they can be rationally demonstrated? In what does this power of illumination consist? Pauli attributes this power to the preexistence in the human mind of certain primeval images—the archeotypes of Kepler. Jung regards that primary images are emergent from what he calls the collective unconsciousness built up from all memories and patterns of behavior that

have grown up over the entire history of evolution of mankind. Chandrasekhar quotes Plato from Heisenberg's writing: The soul is awestricken at the sight of the beautiful, for it feels that something is evoked in it that was not imparted from outside by the senses, but always be laid down there in the deeply unconscious region. According to Kepler, beauty is harmony. For Heisenberg, beauty is the conformity of parts to one another and to the whole. For Poincaré beauty is simplicity and vastness. For Bacon strangeness, surprise and wonder are essential elements of beauty. In a word, beauty resolves conceptual conflict (in the rational brain) of the dual existence of reality: essential and phenomenal [6].

4. Classification of qualia eliciting behavioral responses

In Plato's writing qualia was implied as something elicited in deeply unconscious region (of reflexive and emotive brain which cannot express themselves in language) at the sight of (by the sensory information from) what is real, true and beautiful (biologically favorable). Though Buddhist middle way philosophy [6] defines qualia as "thatness (likeliness)" and emphasizes the inseparability of observer (subject), observing (cognitive process) and observed (object), Chalmers [7] defined qualia simply as a qualitative feel of experience following Aristotelian definition of qualia as a momentary faint feeling of awareness. In this section proposal is made to classify qualia by its biological value (evolutionary significance and survival value) of elicited behavioral responses, reflexive and emotive [8].

In Fig.2, the equator of the sphere, extending MacLean's scheme for analyzing emotions [1], divides the behavioral responses elicited by a qualia into what is biologically favorable (upper hemisphere) and unfavorable (lower hemisphere), while four lines of longitude separate four kinds of survival value: self-and species-preserving, exploring and aesthetic. A qualia eliciting reflexive or emotive reactions falling on the equator has little biological value and enters into consciousness only

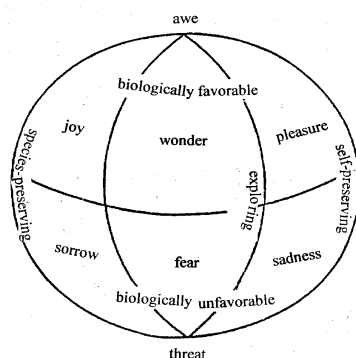


Figure 2. Classification of qualia by its reflexive and emotive responses. The equator divides responses into what is biologically favorable (upper hemisphere) and unfavorable (lower hemisphere) [8].

transiently after which it is forgotten unless, during the period of short-term memory, information is given some biological significance or associated with information with higher biological value. Eureka pleasure associated with a sudden leap of innovative scientific/artistic ideas is likely to arise when the threat of unknown is removed and converted to an affective feeling of familiarity or déjà-vu (already seen) feeling with awe.

5. Quantum and qualia

The human brain has evolved, expanded and bifurcated into left (dominant) and right (non-dominant) hemispheres to resolve evolutionary conflicts between expanding cortex (rational brain) and limited capacity of the brain skull [9]. It has been found experimentally [1,10] that the unilateral stimulation of right hemisphere of emotive brain during aura elicits patient's enhanced feeling of familiarity (sameness) similar to eureka feeling. Depending on the situation the feeling of familiarity was replaced by the feeling of strangeness (newness), and vice versa. It is likely that the left hemisphere is devoted to the detection of difference in similarity (newness) and the right hemisphere to the detection of similarity in difference (sameness): There seems to be a complementary functional division between left- and right-hemispheres such as: verbal/pictorial, digital/analog, temporal/spatial, sequential/parallel, analytic/synthetic, differential/integral, deductive/inductive, quantitative/qualitative and quantum/qualia.

In conclusion it is hoped that the chemical neuro-transmitter substances involved in eliciting different behavioral responses (Fig.2) by hormonal mechanisms will eventually be identified. The accuracy and stability of long-term memories conducting our routinized daily behavior which depend on the specificity of those neuro-transmitters would therefore be confirmed.

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Appendix: some vaguely defined words in the text

aesthetic = concerned with beauty or the appreciation of beauty.

beauty = a combination of qualities such as shape, color, sound, etc., that pleases the aesthetic senses.

consciousness = awareness of one's surroundings (outer world) and identity (inner world).

eureka = excessive expression, such as cry, of the announcement: "I have found it!" attributed to Archimedes.

familiarity = being well known, informed or experienced.

newness = being inexperienced, experienced now for the first time.

sameness = being previously known, informed or experienced and continued.

qualia = something in the outer (physical) world as well as in the inner world (neural organization) that elicits consciousness.

ing. So we must give them some feelings and qualia such as we human beings experience even though it cannot be rationally established in the way that is possible by interhuman communication (10). I am presenting a biological basis for an evolutionary origin of consciousness. It derives from a hypothesis of mind-brain interaction that has already been published (10, 11) and that is based on the special anatomical and functional properties of the mammalian cerebral cortex. The microproperties of neural communication in the cerebral cortex (Fig. I personally find it hard to disentangle evolutionary advantage of consciousness from the ones linked to other cognitive abilities especially the social ones such as for example cooperative hunting, Machiavellian intelligence or advanced communication. I think a big part of the issue in this question is in the exact definition of consciousness. This Leads to complex dynamics of evolution of consciousness and languages. Its mathematical modeling predicts evolution of cultures. We discuss existing evidence and future research directions.