Review of: "The Case for Conscious Experience Being in Individual Neurons"

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Authors of the article Jonathan Edwards and Pavel G Somov already in the abstract write, that "... all the human conscious experiences... are events in individual neurons, not global to the brain". They maintain that "cellular consciousness is the only plausible way to explain ‘our’ experiences within current physics and biology". The authors argue "that events of experience must involve rich integration of information and individual neurons are the only places in brains where integration of information occurs". The authors maintain that "any more global ‘binding’ is neither required nor physically possible". Thay write that " the detailed nature of events of integration of signals in a neuron’s dendrites remains uncertain but recent developments provide some candidates".

The authors in the chapter of the article **'Why Consciousness in Individual Neurons Makes More Sense"** discusses the idea of locating consciousness within individual neurons, emphasizing that dendritic trees of neurons are where signals are integrated". They suggest there "that a single neuron could encompass an entire experience". The paper also touches on quantum concepts, proposing that experiences should be "direct, indivisible quantum event". The "soul" is hypothesized to be a field excitation, comparable to a sound wave, inhabiting dendritic trees. In conclusion, acording to authors of the article the conscious experiences are more logically placed in individual cells than in the entire brain, hinting that we are primarily driven by desire or emotions, and secondarily by reason.

The work is extensive, and the conclusion mentioned above is preceded by considerations contained in the chapter titled: **"Why Looking for Brain-wide Consciousness is a Wild Goose Chase".**In this chapter, the authors present the following arguments: The Neuron Doctrine posits that key brain activities are in individual cells, but 20th-century studies proposed distributed functions. Pribram's theory compared the brain's functions to a hologram, but this is often confused with a unified brain experience, which lacks evidence. Brain's structure doesn't neatly encode images; dendritic trees are where information converges. While some believe signals form a unified electromagnetic field, consciousness likely arises from entities influenced by this field, with neuronal dendrites as probable sensors. The concept of a unified brain consciousness appears flawed; current insights lean towards localized neuronal experiences.

After this brief introduction of the work's significance, I, as a reviewer, present **the following comments:**

I. Since the title of the work includes the term **"conscious experience,"** it is necessary to clarify what we mean by this concept.

Personally, I can comment on the message of the work only after attempting such clarification. Therefore, I suggest understanding the three most important concepts related to consciousness as follows:

Sentience

Sentience is the awareness that external interaction is taking place. It is also the capacity to have subjective experiences and feelings, or more simply, the ability to perceive and experience sensations. This notion is commonly used in discussions about animal rights. In the context of animals, sentience refers to the ability to feel, perceive, or experience subjectively. This includes the capacity to experience positive or negative influences and emotional states, like happiness or suffering.

Self-awareness

I try to approximate what self-awareness by first attempting to answer the question: what does the statement **'I am self-aware'** mean in colloquial understanding.

To respond to this question, we must first define such a mental state as simply and intuitively as possible. So, it seems that to be conscious, one needs to... {understand one's own separateness from other beings (and objects) perceived around oneself and be able to perceive oneself against the background of images of the surrounding world, taking into account one's past existence and anticipating the outline of possible future events}.

To refine this description, it's necessary to introduce the important concept of imagination (mental images, imagery). This initial definition can then be clarified. It's also important to discuss the concept of self-image. Imagining objects previously seen, such as an apple, a tree, a chair, a table, involves recalling an image of these objects from memory. This enables us to see them with our eyes closed, albeit less vividly. We sometimes describe this sensation as 'seeing something with the eyes of the imagination'. The same applies to auditory and tactile perceptions, as well as actions. Movements or complex behaviors can also be imagined.

Thus, we can now say that consciousness consists of the ability of the nervous system to {imagine oneself against the background of the image of the known world or on the backdrop of imagery of the world}. But we need yet to define what self-perception is.

Living beings, especially humans, experience a constant state of self-perception during periods of wakefulness. Beyond the visual and auditory sensations perceived then, animals and humans experience sensations from within their own bodies. These stimuli come from surface sensory receptors, joint sensory receptors, sensations from the respiratory system, the heart, and sometimes other organs.

Self-images also include autobiographical data. Shortly after waking up, there's a moment of quick review of one's biographical path, a mental journey back in time, which gives exactly the feeling that I am 'John Doe'. Intense self-images also include memorized data about social and situational relationships. The ability to recall 'stories about oneself' and various types of 'opinions' about oneself is also important.

Since it can be stated that the sense of consciousness occurs only when awake, when body perception takes place, the image of oneself is a slightly different process than the imagination of an object known from visual perception. The image of oneself is superimposed on the perception of oneself.

Hearing or listening to words in natural language, such as apple, tree, chair, activates the same neuronal structure that was active during the perception of images of these objects. However, the neuronal process occurring after the activation of the word 'I' is much more complicated, and a substantive discussion of it requires considering contemporary neurophysiological theories.

Consciousness

Consciousness is the state of being aware of and able to think and perceive one's surroundings, thoughts, and emotions. It encompasses self-awareness, cognition, and the subjective experience of existence.

Beyond individual awareness, it also implies a collective understanding and interconnectedness among beings. This multifaceted concept has been explored in various disciplines, from neuroscience to philosophy, and remains a central subject of inquiry, bridging the tangible and the intangible, the known and the mysterious.

II. Let's now consider, in the light of the given definitions, how the processes occurring in a single neuron, that is, in a single biological cell, relate to: sentiens, self-awareness, consciousness.

(1) Well, we cannot forget about Stewart Hameroff's and Roger Penrose's 'Orch OR' Theory here. Many authors attempt to illustratively present the message of this theory. I have also made such an attempt [1]. I recommend this article [1]. However, here we need to highlight only a few statements and assumptions of these authors. As is known, they emphasize the presence of a significant amount of microtubules within neurons. They assume that quantum processes occur in these microtubules. These authors assume that in the microtubules of neurons repetitive, cyclic quantum information processing is realized, which consists of increasing the quantum coherence of the tubulin dimers, interrupted by the OR operation, causing the "conscious momen". Stewart Hameroff and Roger Penrose talk about "conscious experiences" in a way similar to the term used by the authors of the reviewed work. For Stewart Hameroff and Roger Penrose, these "conscious experiences" are equivalent to the reception (sensing) of qualia. In this sense, the authors of the reviewed work, Jonathan Edwards and Pavel G Somov, can therefore refer to a fairly important argument that some phenomena that make up the overall phenomenon of consciousness indeed occur at the level of individual cells.

(2). If I try to answer the question - "does the phenomenon of self-awareness (- defined or rather specified above) occur at the level of a single cell (neuron)" - then my answer (belief) is no !!! Arguing as briefly as possible - the well-known mirror test does not apply to a cell ... it concerns the whole person. Many animal species probably develop feelings known as qualia. Nevertheless, it has long been known that only some of them recognize themselves in a mirror. Thus, the need arises to explain what the process of the perception of one's own identity is about; that is, what self-awareness is.

(3). If we now recall what we understand by the word "consciousness" - in the most general sense (see above) - surprisingly, in my opinion, we can still find some validity in considering the relationship between what happens in a single cell and this multifaceted concept, which is explored in various disciplines, from neuroscience to philosophy. Why? In my opinion, it is because we must consider that every biological cell, including a single neuron, contains a cell nucleus, which, as is known, contains DNA determining (able to determine) the entire individual. If it is a human cell, then the DNA contained in the cell nucleus also determines how the brain, in which self-awareness emerges, is to arise during embryogenesis, enabling the human to successfully pass the mirror test.

Thus, although I am not convinced by the authors' belief that "consciousness" arises in dendritic trees, I still believe that the discussion conducted by the authors of the paper is useful and can provide stimulating material for young neuroscientists.

Reference

Różyk-Myrta, A.; Brodziak, A.; Muc-Wierzgoń, M. Neural Circuits, Microtubule Processing, Brain’s Electromagnetic Field—Components of Self-Awareness. Brain Sci. 2021, 11, 984. https://doi.org/10.3390/brainsci11080984