Explanation of Qualia and Self-Awareness Using Elastic Membrane Concept

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Abstract

In this work we show that our self-awareness and perception may be successfully explained using two dimensional holistic structures with closed topology embedded into our brains - elastic membranes. These membranes are able to preserve their structure during conscious processes. Their elastic oscillations may be associated with our perceptions, where the frequency of the oscillations is responsible for the perception of different colors, sounds and other stimuli, while the amplitude of the oscillations is responsible for the feeling of a distance. According to the model the squeezed regions of a membrane correspond to the brain zones involved into awareness and attention. The model may be useful for prediction, explanation and interpretation of various conscious phenomena.

Keywords: Perception, Orch OR, Holographic Principle, Neural Network Paradigm

Introduction

The hard problem of consciousness is the problem of explaining how and why we have qualia or phenomenal experiences - how sensations acquire characteristics such as colors and tastes (Hamad, 1995). David Chalmers (1995), who introduced the term, contrasts this with the "easy problems" of explaining the ability to discriminate, integrate information, report mental states, focus attention, etc. Easy problems are easy because all that is required for their solution is to specify a mechanism that can perform the function. That is, their proposed solutions, regardless of how complex or poorly understood they may be, can be entirely consistent with the modern materialistic conception of natural phenomena. Chalmers claims that the problem of experience is distinct from this set, and he argues that the problem of experience will "persist even when the performance of all the relevant functions is explained" (Chalmers, 1995, 1996).

Erwin Schrödinger had this counter-materialist take (1992): "The sensation of color cannot be accounted for by the physicist's objective picture of light-waves. Could the physiologist account for it, if he had fuller knowledge than he has of the processes in the retina and the nervous processes set up by them in the optical nerve bundles and in the brain? I do not think so."

Nagel argues in his paper “What Is it Like to Be a Bat?” (1974) that consciousness has an essentially subjective character, a what-it-is-like aspect. He states that "an organism has conscious mental states if and only if there is something that it is like to be that organism — something it is like for the organism."(Nagel, 1974) Nagel also suggests that the subjective aspect of the mind may not ever be sufficiently accounted for by the objective methods of reductionist science. He claims that "[i]f we acknowledge that a physical theory of mind must account for the subjective character of experience, we must admit that no presently available conception gives us a clue how this could be done." (Nagel, 1974) Furthermore, he states that "it seems unlikely that any physical theory of mind can be contemplated until more thought has been given to the general problem of subjective and objective."(Nagel, 1974)

It is obvious that drastic modifications in our ways of thinking are needed to solve the hard problem of consciousness. And these ways of thinking will require new non-reductionist scientific methods. In this work a new solution to the hard problem of consciousness is proposed. The solution is based on the concept of elastic membrane introduced recently by the author (Egoyan, 2009, 2011).

Elastic Membrane Concept

Our perception of the entire world has a multidimensional character: we use notions of points, lines, surfaces and volumes when describing our visual experiences. Points can be associated with elementary particles, while other three notions cannot be explained in terms of elementary particles. Indeed, we don’t know any persistent macroscopic holistic material structures which can be associated with these geometrical notions. Another interesting fact is that we have no geometrical theories explaining the embeddance procedure or how lines are embedded into surfaces and how surfaces are embedded into spaces.

The physics of living organisms is much more complicated than that of the inanimate matter and there may be physical objects and structures in the human brain which require special conditions to exist and cannot be observed in the inanimate world. Modern experimental methods don’t allow us to perform effective nonintrusive research of brain processes. At the same time we must take into account that these structures are parts of our brains and affect the whole process of observation. Obviously, we need a new conceptual approach in order to separate the information provided by the external stimuli from the information coming from various brain structures. This is very important because such structures may be responsible for qualia and self-awareness (Egoyan, 2005).

A possible candidate for the new conceptual basis is the elastic membrane concept introduced recently by the author (Egoyan, 2009, 2011, 2012, 2013). The theory is based on a new geometry which postulates that instead of being composed of points, spaces and surfaces are composed of dualistic objects - “point-connections”: connections connect the points of the surface and create a metric - the distance between two points is the minimal number of connections

needed to connect these points. One-dimensional connections are closed lines; n-dimensional connections are compositions of (n-1) dimensional connections (Egoyan, 2011). The theory is based on the idea introduced firstly in the smooth infinitesimal analysis according to which lines are composed of infinitesimally small linear segments (Bell, 1998). All the connections with the same number of dimensions are identical and form isotropic and homogeneous spaces (See Fig. 1).

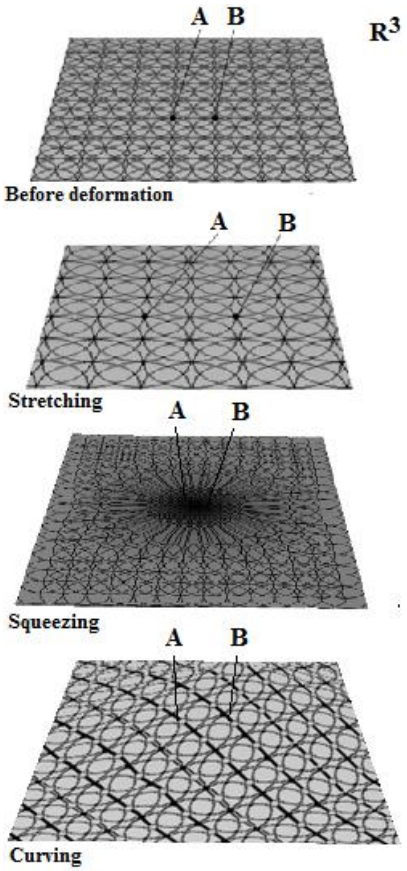

Figure 1: Elastic transformations of a two-dimensional elastic membrane.

Obviously, we can assign two different metrics to the points of the embedded manifold – internal and external: first measured from the position of the internal observer of the manifold and the second from the position of the external observer. Infinitesimal segments which form connections of the embedded manifold may be stretched or squeezed along the infinitesimal segments of the connections of the higher dimensional space. This means that the embedded manifold can change its external metric without changing the internal one. In other words, the embedded surface can change its form without changing the internal metric. It may be stretched, squeezed or curved without changing its internal metric. In other words, such geometry is an elastic one. It is just like inflating a balloon with a pattern on it: during the inflation process everything grows bigger and bigger, but when the air is out everything is restored.

This geometry has an intuitive and simple physical interpretation: manifolds may be associated with elastic membranes. The elastic membranes look different for internal and external observers: for the internal observers they are space-times we are used to, while from the point of view of the external observers they are material objects - surfaces with homogeneous material properties. For example, living organisms play the role of internal observers of the Universe, and at the same time they serve as external observers for two-dimensional (2D) membranes embedded into our Universe (Egoyan, 2012).

When interacting with elementary particles and other membranes, a membrane will transform their energy into its elastic energy (a new form of energy): the energy of stretching of the infinitesimal segments.

Transformations of stretching, squeezing and curving of a fragment of an elastic membrane are shown in Fig. 1.

How Do We Have Qualia?

The model is very useful for describing nervous-system-like branchy structures. From Fig. 2 you can see how a one-dimensional surface with closed topology is stretched to take the form of a branchy figure. Thickness of the surface depends on the coefficient of stretching: the squeezed regions are thicker than the stretched ones. The squeezed regions of the surface will correspond to the neuron's dendrites; regions corresponding to more active dendrites will be thicker.

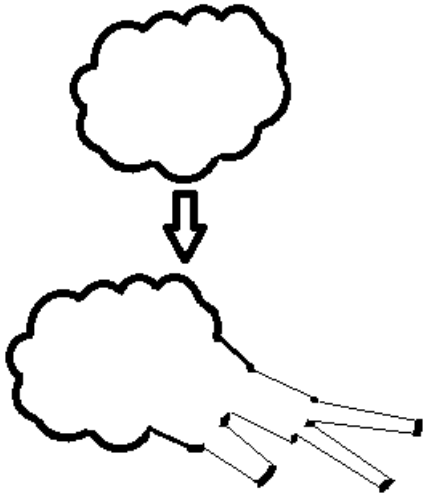

Figure 2: Transformation of a one-dimensional elastic membrane into a branchy figure.

The new multidimensional physics may be useful for explaining our perception. It is supposed that our perception may be considered as the result of elastic oscillations of 2D elastic membranes with closed topology embedded in our brains. Only one elastic membrane responsible for its perceptions will correspond to the selected organism, but

there may be other membranes, even at the living cell level. We can observe our 2D self-membranes through our perceptions, which are encoded in elastic oscillations of the elastic membrane (Egoyan, 2013). There are two types of elastic deformation of the elastic membrane: longitudinal when the direction of elastic deformation is tangent to the surface of the membrane and transverse when deformation happens perpendicularly to the membrane's surface. The first changes density of the membrane and the second causes oscillations of the membrane. Transverse deformations are responsible for our visual, audio and other perceptions while longitudinal deformations change sensitivity of the elastic membrane.

According to the proposed model elastic membranes occupy energetically favorable positions around microtubules involved in Orch OR (Hameroff & Penrose, 1996; Penrose, 1989). During gamma synchronization an elastic membrane starts stretching and propagating along the direction of attentive focus. Stretched regions have lower density and are less sensitive. When Orch OR happens the membrane occupies energetically steady positions around Orch OR region and starts squeezing in order to keep the position of steady equilibrium. The squeezed regions of the membrane have greater density and are more sensitive. This explains why during conscious attention our perception in the direction of the attentive focus becomes more vivid, while in other directions our perception has a damping character (Egoyan, 2013).

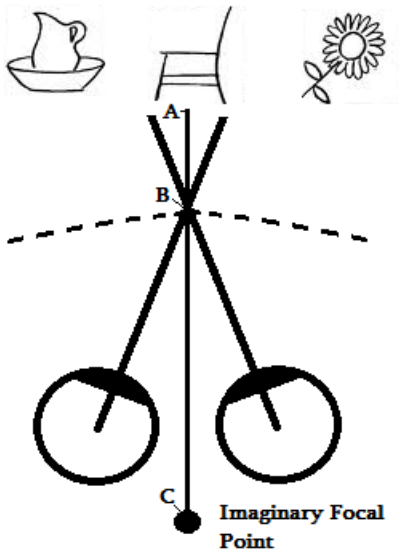

Figure 3: The scheme of stereoscopic vision.

The model explains some features of our perception which cannot be explained using other models:

1.The two dimensional character of our perceptive experience.

2.The feeling of self-awareness as being one whole.

3.The active character of our perception: we aren't zombies because in our brains physics of perception is separated from the information processing physics. But at the same time both mechanisms are tightly connected and complement each other.

4.The feeling of three-dimensionality when observing the world with two eyes. The frequency of elastic oscillations is responsible for the perception of colors, while the amplitude of oscillations is responsible for the feeling of a distance (the amplitude increases when the distance increases). The elastic membrane may undergo more complicated nested oscillations with a fractal structure enabling to encode two distances simultaneously: first between the imaginary focal point of the observer and the surface where the directions of the eyes intersect - CB and the distance between this surface and the observed objects - BA (See Fig. 3). According to the theory the feeling of three-dimensionality is caused by the dynamic superposition of vibrations corresponding to these two distances (See Fig. 4) (Egoyan, 2015).

Figure 4: Nested oscillations.

Why Do We Have Qualia?

In robotics, engineers have created machines with multiple points of articulation. Some robots have an array of sensors that can gather information about the environment, allowing the robot to maneuver through a simple obstacle course. Honda's ASIMO robot can climb stairs and run. From manufacturing to military applications, robots are making a big impact.

Though computers and robots are more advanced than ever, they're still just tools. They can be useful, particularly for tasks that would either be dangerous to humans or would take too long to complete without computer assistance. But robots and computers are unaware of their own existence and can only perform tasks for which they were programmed.

Let's consider a simple analogy of a human mind - a computer. The picture that you see on a computer monitor is made up by the computer to represent the states inside it. Just like the brain, inside the computer, everything is coded in electrical spikes.

Yet you see pictures and text on the computer's monitor. This is to help you interface with the computer, just as qualia help you to interface with your brain which is connected by your senses to your world.

Modern computers and humanoid robots can interact with the real world, they can collect visual, audio and other signals, they even can perform precise and complex operations that humans cannot. But a computer itself hasn't feelings and emotions and, therefore, it hasn't qualia (Harnad, 1995). We see that qualia can be divided into two

subtypes: perceptive - visual, audio, tactile and other perceptions and sensitive - the reaction of the elastic membrane on the generated perceptions. If the former has just informative character the latter is more complicated. These qualia have valence: there is a fundamental bipolar dimension about some of our conscious states: the continuum from pleasurable to unpleasurable. Classic example: emotions, feelings („emotional valence“). It's possible to create programs that mimic thought. These programs might give a machine the ability to recognize and respond to patterns. But ultimately, a machine isn't aware of itself. It is simply responding to commands.

The main tendency of human activity is to improve our lives by achieving persistent pleasant emotions and feelings and avoiding unpleasant ones. In most cases our brains can predict the result of our actions. The prediction is based on the previous experience. But in some cases we aren't sure about the character of expected phenomenal experience. For example, this happens when we change our job, or we taste new dishes, or we communicate with unfamiliar people. In such situations we will need extra information to understand whether the situation is pleasant or not. This is qualia which will help us to do that.

According to the elastic membrane model of human perception an elastic membrane will squeeze along the directions with pleasant elastic oscillations and stretch along the directions with unpleasant ones (See Fig. 5). Elastic membranes serve like shields preserving coherent quantum states. More dense regions will preserve pleasant perceptions. The regions with minimal density will assist to destroy unpleasant elastic oscillations.

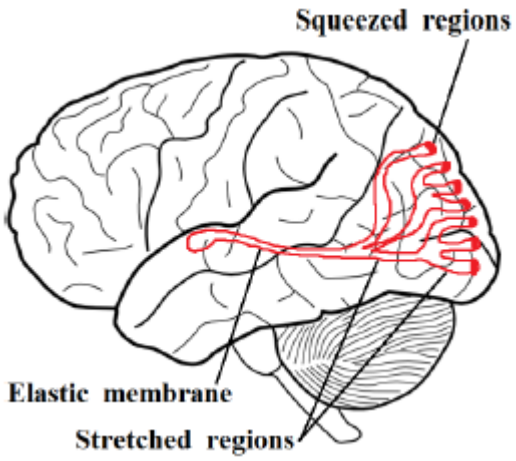

Figure 5: The elastic membrane embedded into the human brain.

Our brains are able to detect elastic transformations of the elastic membrane and, therefore, they can understand the character of perceptions (pleasant or unpleasant) and store the results in the memory (See Fig. 6). The model explains why people have different emotions and feelings when having almost the same perceptual experiences. For example, some people enjoy dishes that other people don't like. The character of our emotions and feelings depends on the parameters of the elastic membrane, its structure and other yet unknown physical factors.

In summary, qualia are simply how we experience our world when we are conscious. We are not conscious of the electrical spikes that are buzzing in our brain, but we are conscious of the qualia which represent these spikes. The experience of colors represents the electric spikes conveyed from our color sensitive cells in our eyes, and that of sound from sound sensitive cells in our ears and so on for all the other senses.

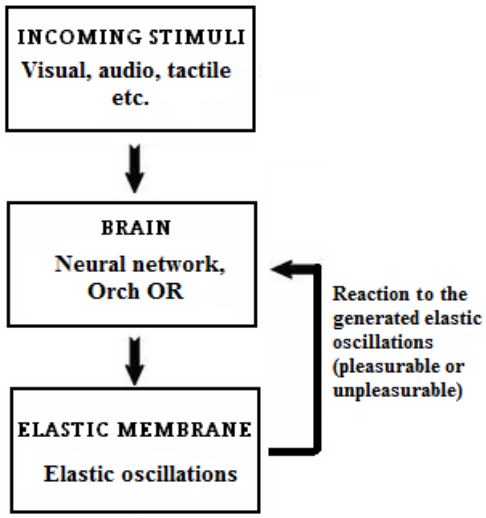

Figure 6: The model of the process of conscious perception.

There are a few reasons why we have qualia:

1. Elastic membranes responsible for qualia interact with our brains and provide them with information about the character of incoming stimuli (pleasant or unpleasant). We need this information when we have new unfamiliar experiences.

2. Elastic membranes occupy energetically favorable positions around microtubules involved in Orch OR and play the role of shields preserving quantum coherent states. Orch OR creates the basis for qualia and self-awareness through space-time geometry and elastic membranes undergo elastic deformations in this gravitational field.

3. Elastic membranes try to preserve pleasant perceptions and destroy unpleasant ones. This fact reflects the global tendency of the human mind to enjoy pleasant feelings and emotions and avoid unpleasant ones.

4. Having the feeling of being a whole thing. The elastic membranes are holistic objects which preserve their structure during the process of perception so that they a priori have this feature.

The model predicts existence of two-dimensional material structures embedded into our brains. These may be complexes of elementary particles or even new yet unknown

physical objects with persistent physical properties which don't change during perceptual processes.

Discussion

The elastic membrane concept gives us the possibility to create phenomenological models of conscious processes. It is very important how this approach agrees with other scientific theories and which experimental methods may be used to detect them.

Compatibility with Other Scientific Theories

The model is in agreement with the mainstream science theories of consciousness: neural network paradigm and Orch OR theory. Elastic membranes occupy energetically favorable positions around neurons involved into the process of perception. The membrane squeezes around neurons so that its elastic vibrations depend mainly on the condition of the neurons. As a result the whole picture produced by the elastic vibrations of the membrane reflects the collective state of a certain group of neurons. This model unifies both approaches to consciousness: the 'standard model' stating that consciousness emerges from complex computation among brain neurons and a theory called 'Orchestrated objective reduction' ('Orch OR'), which suggests that consciousness arises from quantum vibrations in protein polymers called microtubules inside the brain's neurons (Hameroff, 2007).

Applications of the Model

The method allows us to describe conscious phenomena using the language of elastic membranes. Elastic membranes are macroscopic objects, which are useful for explaining holistic features of our perception and prediction of underlying physical phenomena. We can create phenomenological models of conscious processes using such transformations of elastic membranes geometry as squeezing, stretching and curving. On the basis of modern physics we can predict physical mechanisms corresponding to the created phenomenological models.

The method can be successfully combined with other methods of scientific research:

1. Experimental research: the new approach may help us define more preferable directions for experimental research and predict possible outcomes of the experiment.

2. Psychological testing: also called psychological assessment, is the basis for psychologists′ better understanding a person and his behavior. Psychological tests are more effective when performed in parallel with experimental measurement of an individual's physiological parameters, such as blood pressure, temperature and others. This data will provide us with information how emotions and attitude affect perceptual abilities of the person and will help separate holistic properties from the computationally derived features.

3. Theoretical models: the proposed model can help us predict new physical effects and structures. For example, the theory supports the idea of the collective character of gravity and predicts the possibility of instantaneous correlations of space-time curvature at a distance. The latter in its turn gives a scientific basis to the "extended mind concept" which proposes that some objects in the external environment are utilized by the mind in such a way that the objects can be seen as extensions of the mind itself (Clark & Chalmers, 1998). The gravitational corrections of space-time curvature themselves are supposed to be connected with the tendency of living organisms to decrease entropy.

4. Computer modeling: a complex computer model provides a new tool to solve the mystery of how interconnected neurons work together with elastic membranes to produce brain waves. We need a computer model because it will help us relate the activity of individual neurons and elastic membranes with the resulting conscious processes.

Methods of Experimental Verification

According to the theory, elastic membranes are responsible not only for our perceptions but for our reaction to that perceptions as well. So we can expect that the interaction between elastic membranes and brain neurons is strong enough to be detected by modern experimental methods. The main difficulty here is that the measurements should be performed inside a conscious brain which is impossible using existing experimental techniques. At the same time nothing prevents us from exploring elastic membranes indirectly, checking how their existence is supported by a huge amount of data which can be obtained using nonintrusive experimental methods and computer modeling calculations based on the proved theoretical models.

Philosophical Meaning of the New Approach

Philosophically the theory represents a multidimensional version of panpsychism. The proposed model separates perception from information processing mechanisms, dividing material objects into two groups: with passive consciousness and active consciousness. This division happens on the basis of multidimensional approach: objects without elastic membranes are considered as having passive consciousness while the objects with embedded two-dimensional elastic - as being actively conscious. Inanimate objects are considered as conscious because they are more than simple combinations of elementary particles: all particles are entangled with each other through the phenomenon of instantaneous correlations of gravitational curvature at a distance due to which each particle is able to participate in the distant conscious processes.

Conclusion

Obviously, understanding of human consciousness, perception and qualia requires absolutely new methods and scientific approaches. This is because in contrast with ordinary research when we observe other objects from outside and are in the role of external observers, during conscious processes, in addition to signals from the external

world, we can explore our senses, feelings and emotions. Separation of perception from information processing mechanisms and introduction of new material macroscopic objects - elastic membranes make it possible to explain perception, self-awareness and other conscious processes using the language of elastic membranes and their transformations like stretching, squeezing, expansion, contraction, curving and bending.

The theory solves the problem of existence - how a physical object may be aware of its own existence: the elastic membrane is aware of its own existence when it is in a state of steady equilibrium and its regions squeezed around the positions of steady equilibrium can produce elastic vibrations responsible for perception.

The model is in good agreement with modern physical theories including the string theory which is multidimensional in its nature and the holographic principle stating that information about a three-dimensional volume may be encoded in the two-dimensional surface surrounding this volume.

Together with other experimental and theoretical methods of scientific research powered by computer modeling techniques the new theory may bring us new interesting results explaining the nature of perception and consciousness.

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