

Article

Does an Ionic or Biophoton Plasma Transduce Neural Activity into Subjective Conscious Awareness?

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Abstract

The relation between action potentials and conscious awareness presents a conceptual difficulty: *When*, during the generation and transmission of action potentials, does a neuron generate its “bit” of awareness? We postulate that the movement of charged ions through the neuronal membrane generates not only action potentials and thereby an “ephaptic” ionic flux represented by the EEG, but also a biophoton plasma (Larmor radiation) as an analog representation that “simplifies” the “digital” action potentials. *What* is the observer of this activity? We conjecture that light-sensitive chromophores in the multiple associative neuronal systems, including premotor, respond to the biophoton radiation, and thus, “observe”, each other reciprocally and thereby jointly generate conscious awareness. *Where* do we experience conscious awareness? We cannot account for it by our known 4-D universe, because it is not height, width, depth or time, nor any combination of these. Consequently, we conjecture that conscious awareness resides in a different dimension, one in which we are embedded.

Keywords: Biophoton, neural activity, EEG, integration, binding, subjective, conscious awareness, 4-D universe, dimension.

Swiftly the brain becomes an enchanted loom where millions of flashing shuttles weave a dissolving pattern, always a meaningful pattern though never an abiding one; a shifting harmony of sub-patterns.’ Charles Sherrington: Man on His Nature (1941)

Introduction

In considering how a neuron, which is but a “bag of chemicals” generates a bit of subjective conscious awareness, we agree with Chalmers (1995) that it is the “hard question”. But the answer does not appear to be in “quantum oscillations in tubulin/microtubules” (Hameroff, 2020) or “collapse of the wavefunction” (Penrose, 1989), as those are but a postulated site and process in the brain, without specification of how the quality of subjective conscious awareness is generated. We have attempted to address the hard question in this essay by conjecturing on the process by which neuronal activity in the form of action potentials can be converted into subjective conscious awareness...what the mediator might be, and what “observes” the mediator, the observer being subjective conscious awareness and where it is located. We make these

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conjectures, some based on neuroscience, some necessarily fanciful, in the spirit of challenge to disprove them, which could at least narrow the possibilities. Thus, we invite the reader to refute, rather than simply dismiss, any or all of the following set of inductive conjectures from the level of action potentials to the generation of subjective conscious awareness.

When in relation to neuronal firing does conscious awareness occur?

There is general agreement among neuroscientists that conscious awareness depends on (is generated by) brain activity in the form of neuronal action potentials. There are an estimated 100 billion neurons in the human brain, cortical pyramidal neurons each receiving thousands of inputs (Fairen, 2007; Herculano-Houzel, 2009). If we accept that neuronal activity in the brain, in the form of action potentials, generates conscious awareness, this raises a difficult question. That is, each action potential involves a process that takes time as it progresses out along the axon from the axon hillock of the cell body to the synaptic terminals. Thus, *when...at which point ...in the course of the traveling wave action potential does the activity of the neuron give rise to the conscious awareness?...at the initiation of the action potential...in the course of it...at its termination at the synapse...at the post-synaptic neurotransmitter receptor sites, etc.?*

Is conscious awareness digital or analog?

Action potentials are a digital process. The astronomic complexity of action potential activity in the brain is somehow distilled into simplicity, which is essential to enable split-second decision making, and easy enough for a baby to use. We propose that there is a process that could simplify this complexity yet be true to it -- a valid representation or “echo” of action potentials that is a temporally smooth, continuous analog representation of the neuronal action potentials. We suggest the following metaphor to introduce our conjecture that an analog “biophoton plasma” that is generated by movement (acceleration) of the “ionic plasma”, in which the neurons of the brain are embedded, comprises the mediator between action potentials and conscious awareness.

Analogy: perturbation of water in an aquarium is a transduction -- an “echo” --representation, of fish movement

As an analogy, in an aquarium tank, the wave pattern on the surface of the water, and the turbulence pattern below the surface, are representations of the swimming activity of the fish. The surface waves and turbulence pattern are a lawful (i.e., following physical laws), representation that is derived from, and caused by, the movement of the fish. The surface wave and the deep turbulence pattern, while complex and virtually impossible to compute given the movement of the fish, is nonetheless a physically lawful simplification of the movement of the fish.

Neuronal action potentials perturb the surrounding “ionic plasma”

Analogous to the process by which the movements of the fish perturb the water in which they are embedded, the action potentials of the neurons perturb an “ionic plasma” of the brain in which the neurons are embedded. In fact, the graded and action potentials are generated by the movement of sodium, potassium, chloride and calcium ions perpendicularly through opened channels in the neuronal cell membranes. The movement of those ions (charged particles) into and out of the neuronal membrane perturb a “plasma” of the same types of ions that pervade the surrounding medium.

Analog “simplification” of digital action potentials

The “digital” and graded action potentials produce an “analog” perturbation of the surrounding ionic plasma. Thus, our brain simultaneously performs digital and analog processing. By digital processing, we mean action potentials, which are all-or-none and whose firing frequency patterns have specific codes, e.g., faster firing in response to increased stimulus intensity. The action potentials release neurotransmitters at the synapses that form the complex neuronal circuitry. In this way, the brain is like a computer. However, different from the computer, this activity in the brain also generates the movement of ions in and around the post-synaptic neurons, depolarizing or hyperpolarizing them. The change in polarization increases or decreases the neuronal thresholds, thereby generating post-synaptic graded and action potentials. The resulting induced movement of the surrounding ionic plasma is thus a continuous, *analog* representation that encodes and simplifies the digital action potential activity.

Thus, while there is a similarity between a brain and a computer, there is a crucial difference. The similarity is that both depend on circuitry – a “wiring diagram” -- which integrates the activity in diverse components of the system and has “memory”. The crucial difference is that in the brain, there is a process that is generated by the activity of the circuitry, but that is completely different from the circuitry – i.e., the ionic or biophoton plasma. The closest analogy would be as if the heat generated by the circuit activity in the computer would influence the function of the circuitry in a coherent, functional pattern. We have proposed that in the case of the brain, it is specifically such “heat” in the form of the ionic flux-induced biophoton plasma that is the direct mediator of conscious awareness.

The EEG and MEG are an analog representation of graded and action potentials

These analog potentials are well-known and commonly represented and recorded as the electroencephalogram (EEG); the movement of the charged particles is also well known as the basis for the magneto-encephalogram (MEG). This process has not, to our knowledge, been considered as a direct representation (like the movement of the water in an aquarium) of the conscious awareness-generating mechanism, the ionic plasma signal. If it were possible to generate a 3-dimensional map of the relative EEG signal strength throughout the brain volume through time, it would be analogous to the turbulence of the water in the aquarium. To the extent

that it would generate a corresponding biophoton plasma, we postulate that this plasma would be the direct mediator of conscious awareness.

Electrostatic force is a special case of the more general, electromagnetic force

When charged particles move physically (e.g., accelerate into and out of the neuronal cell membrane) within a field of other charged particles, there is a physically lawful change in the (electro)-static charge within the field; this is what is recorded as the EEG and MEG. The net effect of this process is to produce a fluctuating electrostatic field. Electrostatic charges create an actual “force field”, as when an electrostatically charged balloon (e.g., resulting from rubbing the balloon on a wool sweater) sticks to the wall. Electrostatic force is a special case and property of the more general *electromagnetic* field. The electromagnetic field in the brain generates a biophoton plasma.

Are biophotons the quantum “currency” of conscious awareness?

In the example of the electrostatic charge on the balloon, upon discharge (e.g., by grounding), a visible spark can be generated by the resulting emitted photons, as exaggerated in the case of lightning. The acceleration of charged particles generates photons, a process termed Larmor radiation (Singer, 2012). Hence, in the ionic plasma, the movement (acceleration) of the charged ions in the plasma in response to neuronal activity in the form of graded and action potentials will lead to electromagnetic radiation, which is in the form of biophotons (Bokkon, 2009). Biophotons are endogenously produced photons, which are the “quantum force-carrier particles” of the electromagnetic field.

Can biophotons modulate neuronal activity via an “ephaptic” process?

According to Rahnema et al (2011), “...spike-related electrical signals along classical axonal-dendritic pathways of neurons can be converted into biophoton signals by various bioluminescent reactions.” Neuronal activity in hippocampal slices has been shown to emit biophotons (Isojima et al, 1995; Sun et al, 2010). The intensity of the biophoton emission was reported to correlate with the electroencephalographic activity measured on the cortical surface in rat brain (Kobayashi et al, 1999). At least three studies, one in rats (Lisk, 1964) and one in ducks (Benoit, 1961) reported that light *per se* directed into the brain via glass optical fibers can stimulate neuronal (neuroendocrine) function. In a third related study, Menaker and Keatts (1968) demonstrated that sparrows blinded by bilateral enucleation showed recrudescence of the testes under prolonged lighting conditions, a further indication that neurons in the brain can respond directly to light.

The moving force field, which generates the biophoton “plasma”, can actually modulate the action potential activity of the neurons of the brain. The ability of activity in one neuron to affect the activity of adjacent neurons in the absence of their synaptic connection has been termed “ephaptic coupling,” for which various mechanisms have been proposed (e.g., Scott, 2002; Chiang et al, 2019). The ephaptic ionic plasma generated by the action potentials could generate

the biophoton plasma that could relay an energetic “echo” of the action potential to surrounding neurons and thereby modulate their activity. Could this biophoton plasma be Sherrington’s poetic “flashing shuttles”, the “transducer” of our neurons’ action potentials into simplified, coherent, conscious awareness?

What is the “observer” for conscious awareness?

How is the biophoton plasma “observed”? One possibility, although unlikely and difficult to imagine, is that the biophoton plasma is “conscious of itself”. In quantum physics, particles such as the photon are in a “superposition” of multiple probabilistic states until the event of a “wave-function collapse”. At the moment of the collapse, all probabilistic states of the wave function “collapse” into one “real” state. In the brain, light sensitive chromophores in cortical neurons may act as quantum “wave collapsers”. At the moment the light energy of the biophoton is absorbed by a light sensitive chromophore in a neuron, a quantum of light energy is “realized”, i.e., a “quantum bit” of information becomes observable, i.e., in that view, would hypothetically become “conscious of itself”. While we leave that conjecture open to consideration, it is more likely that the biophoton plasma is the energy *source* of conscious awareness, and conscious awareness requires an observer, i.e., neuronal *response to*, the biophoton plasma. Such observation process would require integration among neural systems across time.

Integration among different systems requires a “collapse” of time

The process of integration requires the elapse of time, i.e., (in this case synaptic) latency, for the stimulus to generate a response in the observer(s). The observers are likely to be the multiple sensory association systems, e.g., visual, tactile, proprioceptive, premotor. For example, the visual and the tactile association system neurons could respond to — that is, “observe”— each other reciprocally and the proprioceptive could observe the visual and tactile jointly, while the visual and tactile could both observe the proprioceptive. We conjecture that conscious awareness involves a series of observers of observers, by which self-awareness, the essence of conscious awareness, is generated. Intimately connected with this mutual observer process would necessarily be the pre-motor system of the cortex, which distills and simplifies the brain activity into the relatively simple motor output of the brain, i.e., “behavior”. That is, at any moment, the astronomically complex synaptic computation by the brain becomes channeled – distilled -- to a comparatively simpler output, i.e., muscle contraction. Because the specific muscle contraction (i.e., behavior) is generated in the premotor system, that system would seem to be the “final common output” of the brain’s computation (just prior to the actual motor command). The possible role of the premotor system in conscious awareness raises the intriguing question of whether “free will” occurs at the level of the premotor system. The issue of free will requires a separate treatise.

How do neural events that occur at different times get integrated into singular entities?

How do we combine neural events that occur at different times into an entity rather than disparate elements – the question of “binding”? For example, information about a real, versus a ceramic, pineapple, involving vision, odor, taste, touch and pressure, travels into our brain via different neural pathways, arriving to the integrating mechanisms at different latencies. How do we link (“bind”) them all into a single coherent entity? There is extensive evidence of activity cycles in the brain as represented by the different frequencies of the EEG (e.g., 4-7 cycles per second: “theta” rhythm; 10-12 cycles per second: “alpha” rhythm). The activity cycles generate a condition in which we do not sense or respond to stimuli uniformly in time, but rather in phasic relation to the activity cycles – at certain phases we are more sensitive and responsive than at other phases (Komisaruk, 1977 review). Optimal reaction times and motor actions occur at specific phases of the activity cycle, different for alpha and theta rhythms.

For example, visual sensitivity to a light flash is greatest at a particular phase of the EEG alpha rhythm (Harter & White 1967), and reaction time to a light flash is fastest at a specific phase of the EEG alpha rhythm (Lindsley, 1961). Rats press a lever for a food pellet at a specific phase of the EEG theta rhythm, rather than randomly in time (Komisaruk & Semba, 1981). The “desynchrony” of the EEG during arousal occurs when the activity cycles of the neurons in a relatively large brain volume, in which the neurons were firing relatively in phase with each other, break up into many smaller subunits in which the activity cycles of different groups of neurons are out of phase with each other. The EEG, measuring the gross algebraic sum of the activity of the large brain volume, appears as large amplitude slow waves when the activity cycles of the neurons are relatively in phase with each other (synchronized) and appears as low amplitude fast waves when the neurons are relatively out of phase with each other (desynchronized) (Lindsley, 1961). This normal breaking up of the EEG patterns into different activity cycle phases (i.e., desynchrony) during “arousal”, thus increases the likelihood that some subunit of neurons will be at their optimally responsive activity cycle phase at any given moment.

By contrast, a pathological condition is seizure activity, which is *hyper*-synchrony, and which results in relatively long intervals of lack of responsiveness, because great populations of neurons are active, then inactive, in synchrony. Therefore, each wave cycle of responsiveness of a neuronal population (e.g., 10 times per second for alpha waves, 7 times per second for theta waves) comprises an “entity” or “unit”, receiving relevant inputs from different sources and integrating them as a single entity, then on to the next cycle at the next moment. Thus, each wave of the EEG represents a single excitability cycle of some subpopulation of neurons, and is a “quantum” of cognition such that whatever is responded to within that quantum of time (e.g., represented by one EEG wave, which at the 10Hz rate of the alpha rhythm would be 100ms) is interpreted as part of the same entity. This implies that the brain performs its functions quantized in time, cycle by cycle, throughout its multiple systems. While the overall effect appears to be continuous in time, various different neural systems function cyclically, phasically different from each other, providing an overall temporal smoothing. This process may be the process by which the brain solves the problem of “collapsing time” and thereby constituting conceptual entities, e.g., distinguishing an actual pineapple from a ceramic pineapple.

Where does conscious awareness occur...in a separate dimension?

Where is the observer of the biophoton plasma? If the biophoton radiation generated by the ionic plasma is the mediator – the energy currency -- of conscious awareness, where is the observer that renders the biophotons into conscious awareness? It seems evident that conscious awareness cannot be accounted for by our known 4D universe, because it is neither height, nor width, nor depth nor time, nor any combination of these. Consequently, we conjecture that conscious awareness resides in a different dimension, one in which we are embedded. This additional dimension would impart a unique quality to the biophoton plasma...an emergent property: conscious awareness. We cannot “see” this additional dimension because we are *in* it. We suggest that the following metaphors, regarding qualitative change related to number of dimensions, may help to elucidate this conjecture.

Metaphor #1: Our brain has the ability to construct the perception of a different dimension: 2-D into 3-D

It is remarkable that our brain can take two different visual images, one from each eye, and combine them into a single entity that has a property that we do not perceive as two disparate images, but rather as a single image that is uniquely different from the image in each eye. By doing so, it generates the perception of a new dimension. Each eye alone obtains a 2-dimensional image. Although in a 2-dimensional photo we can impute depth, it is actually only the *impression* of depth based on our prior experience; it is not actual depth perception. When we look with both eyes, each eye provides a different image, but the two different images are fused by our brain into a single image. And that image incorporates the additional dimension of depth. While there exists a variety of neuron types in our visual system that respond to different disparities of input from both eyes, it requires the complex computation by the brain to create one entity out of two disparate entities thereby invoking a unique, three-dimensional entity out of the 2 two-dimensional entities (Parker, 2007). We probably teach ourselves the “visual concept” of 3-dimensionality starting in infancy by relating what we see with two eyes to our manipulation of 3-dimensional objects.

Metaphor #2: Our ability to perceive light depends on the dimension from which it is viewed

If one looks straight on at a laser beam, the light is evident. However, if the laser beam is passing through obstacle-free space (e.g., no dust particles), it is invisible if viewed from the side, i.e., a different dimension – *invisible* from the “length” or “height” dimension, whereas visible from the “depth” (i.e., “head-on”) dimension. Thus, events can occur in a dimension invisible to us, depending on our perspective.

Metaphor #3: Are we 3-D “Flatlanders”?

Imagine holding and rotating a wire cube while using a flashlight to create a shadow of the movement on a sheet of paper. Then imagine a 2-dimensional “Flatlander” (a concept originated

by E.A. Abbott in 1884 in his novella, “Flatland”), drawn on the paper trying to comprehend how the complex changing form of the shadow is generated (to the Flatlander, just a line that changes size as the wire cube is rotated). By viewing from our third dimension, the answer is easy for us, but incomprehensible to the Flatlander. He cannot solve the problem of the shadow of the wire cube on his plane surface because he sees only a single line that changes size along his horizon. If he looks at the shadow from a different position in his flatland, he still sees, again, only a straight line...no depth.

- However, a Flatlander mathematician might be able to postulate imaginary dimensions (like imaginary numbers) and make calculations using them...even create mathematical formulas of imaginary elements that would depict, to the Flatlander, bizarre constructs known to us as volume. But that could not create a picture of a cube or what a cube would feel like for the Flatlander. (But a clever Flatlander might be able to develop a concept of “area” by considering what would exist between herself and the originally observed line by moving away from the line; volume would require conceptualizing an additional dimension).

Metaphor #4: We experience seeing, but we cannot see, our eyes seeing

If we disregard mirrors and knowledge about the neurophysiology of vision, when we experience seeing, we do not see our eyes doing the work of seeing—we just *experience* sight.

As described in metaphor #1, our brain is capable of combining two different 2-D images into a single image by invoking a new, third, dimension. We cannot see the laser beam from a different, “wrong” (non-head-on) dimension, the Flatlanders cannot see a cube from their 2-D universe, we cannot see consciousness from our 4-D universe. Thus, just as in metaphor #4, in which we experience sight but we cannot see our eyes seeing, perhaps we cannot “see” a different dimension – in which conscious awareness resides -- from our vantage point because we are *in* it...experiencing it.

How might we conceptualize a different (higher) dimension?

We can readily understand a phenomenon in a lower dimension from the perspective of a higher dimension but, less readily, a higher dimension from the perspective of a lower dimension. (We can experience 3-D from our 2-D experience from individual eyes, but this is because we have independent experience with 3-D objects). Thus, if we project a flashlight through a wire cube and rotate the cube, we understand that the changing shape of the 2-D projected shadow is cast by the rotating 3-D wire cube. However, the Flatlanders could not understand a 3-D wire cube based on the shadow that it would cast onto their 2-D world.

Perhaps we can overcome the Flatlanders’ limitation by visualizing an additional dimension by the following metaphor: Imagine if two or more equal-size glasses full of water could be merged into a single entity that would still be contained in the volume of one of the glasses. This is the same idea as the mathematical higher-dimension “Tesseract” cube-within-a-cube*. By analogy

with combining the two disparate images from each eye to create a unitary image by which we perceive actual depth, some process in the postulated different dimension combines disparate neuronal events into a unitary unique entity – conscious awareness. Perhaps conscious awareness is the experienced quality that exists in one of the physicists’ proposed 11 dimensions. It resides within, but is not one of, the four dimensions (3-D plus time) of the universe as we know it.

Is a higher dimension required to integrate disparate neuronal activity into an entity?

One form of conscious awareness is our bodily awareness in the form of sensory homunculi of multiple sensory qualities of touch, pressure, heat, proprioception, visceral sensation, etc. Figure 1 depicts this type of integration distilled into a single, simplified unitary entity.

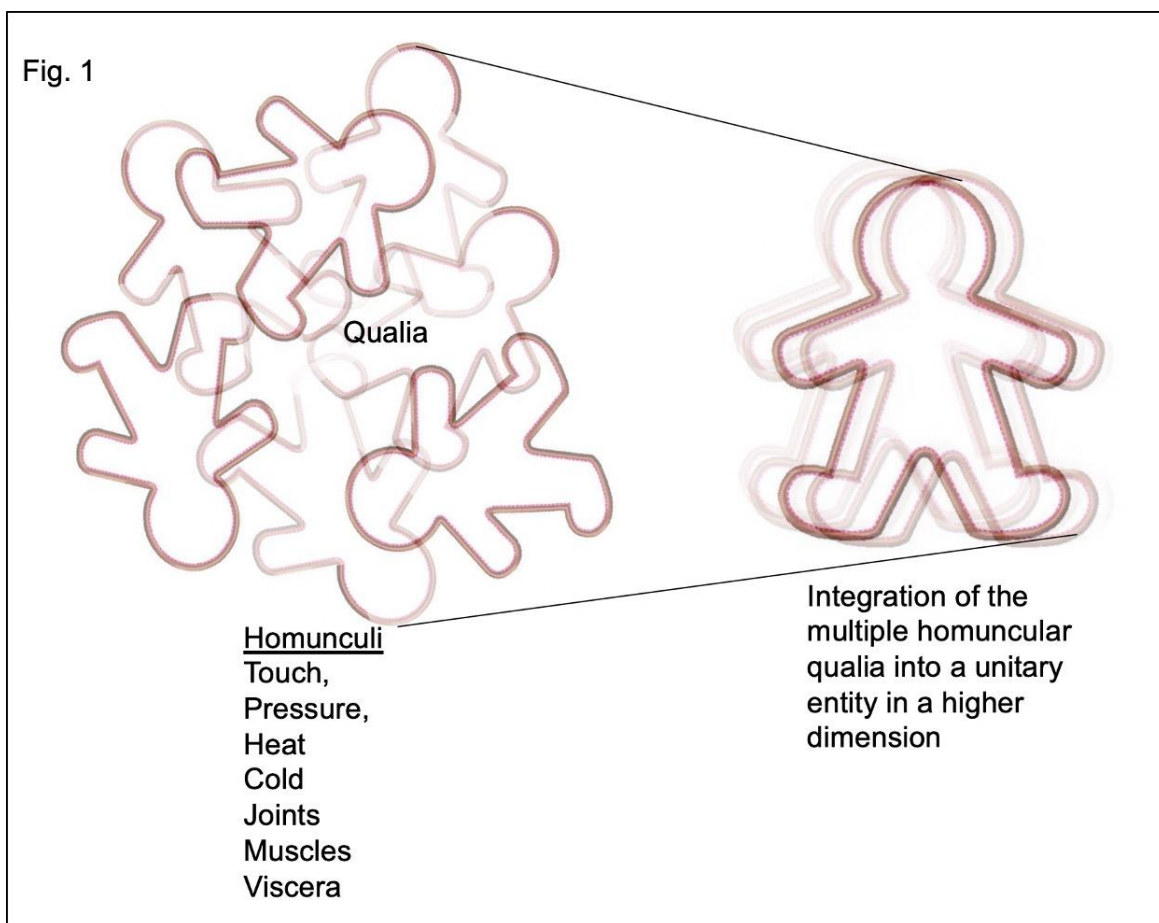


Figure 1. Schematic representation of the ability of the brain to integrate, i.e., unify into a coherent “simplified” entity, information about a variety of inputs representing a variety of bodily modalities, e.g., those listed in the figure. The ability to “register” the different complex inputs from multiple bodily afferent sources into the “qualia” of a coherent unitary entity may be so complex that it requires an additional, or “higher” dimension for the integration.

As each homunculus constitutes a biophoton plasma perturbation, the sites where the perturbations intersect produce bright spots — biophoton plasma “crests”, as in “Chladni

figures” or “nodal patterns” **. We conjecture that it requires a process requiring a higher dimension to integrate the biophoton plasma crests into what we experience as conscious awareness (Figures 2, 3).

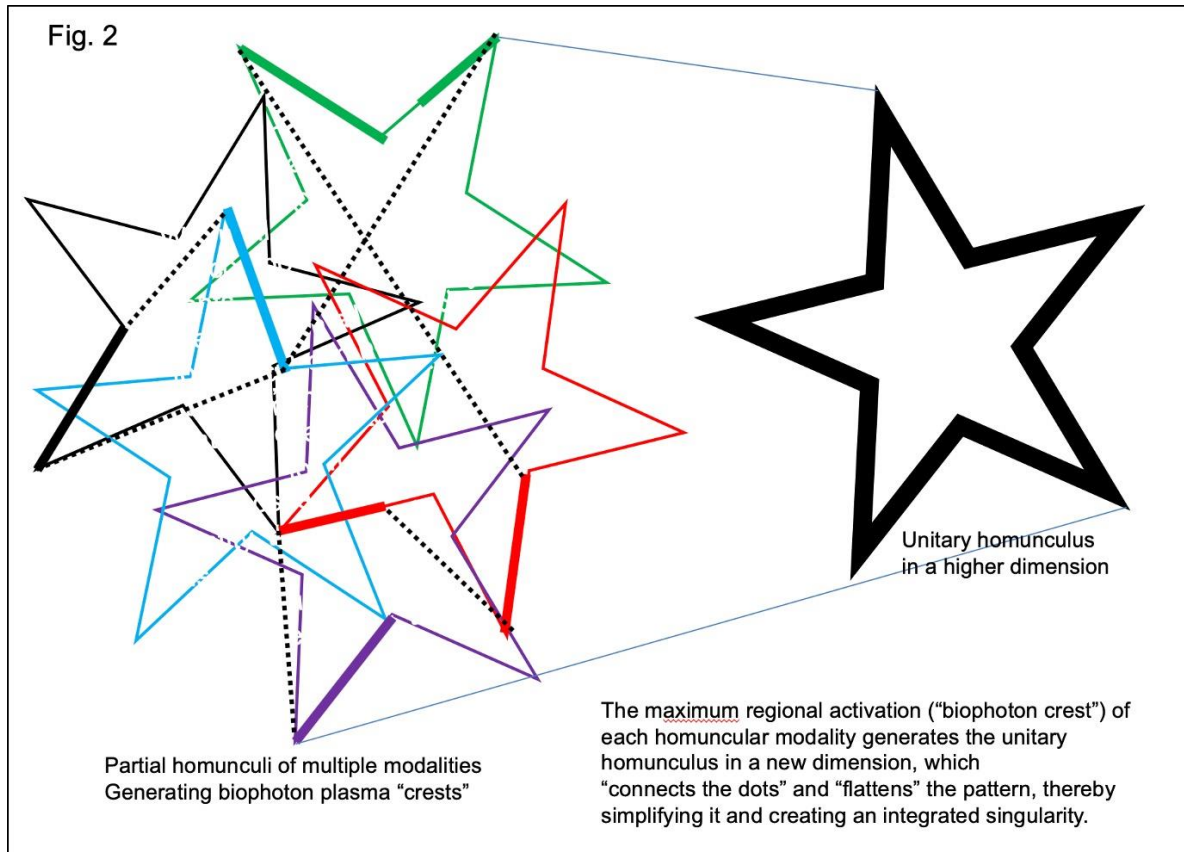


Figure 2. A schema similar to that of Fig. 1, (the star represents the homunculus). In this example, only parts of each homunculus (the “biophoton field crests”- provide the inputs, and they are all integrated into a single entity. We conjecture that the “higher” dimension would enable the diverse inputs in space and time to be registered to each other, thereby enabling the integration into a coherent entity.

A metaphor for this process is if a plaster statue were shattered into many pieces scattered about. In the higher dimension, in which the orientations of the fragments would be irrelevant, the fragments would be arranged into the “entity” of the intact statue – a “gestalt” process. We can experience the result of the operation of the different dimension, but we cannot “see” the process.

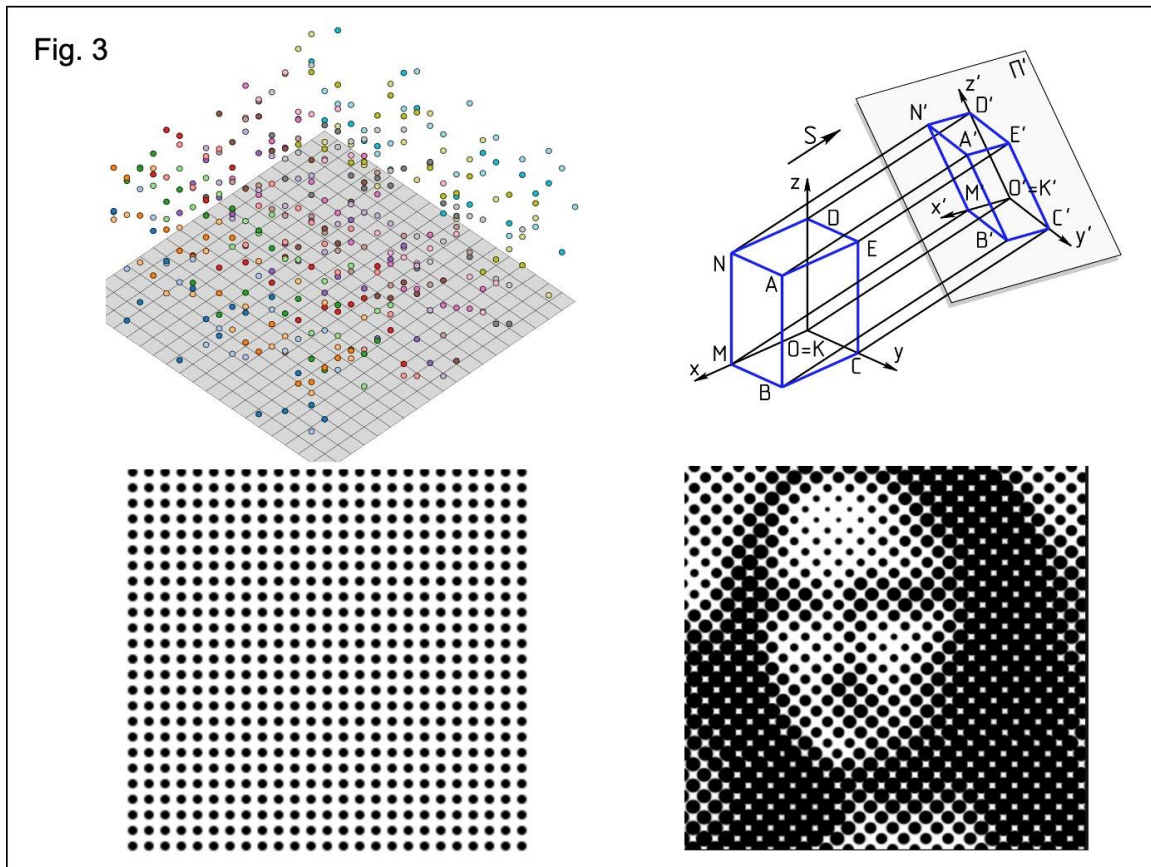


Figure 3. Another perspective on Figures 1 and 2: The “higher” dimension processing could render the complex input pattern (shown as distributed dots [representing biophotons] within the volume of the brain, upper left), “simplified” like the projection of a 3-D object onto a 2-D surface (upper right). This would facilitate their organization into a coherent pattern (lower left), which would enable their interpretation based on experience and memory (lower right).

Why does the brain, but not the spinal cord, generate conscious awareness?

There is general agreement that conscious awareness is generated by neuronal activity within the brain, but not in the spinal cord. While persons with severed spinal cord may have intact reflexes (e.g., leg withdrawal to foot pinch) resulting from neuronal activity within the spinal cord, that neuronal activity, although part of the person’s body, does not generate conscious awareness. The essential difference between brain and spinal cord is that neuronal *integration* is performed in the brain, different from that in the spinal cord. We believe that such integration is essential to conscious awareness. “Integration” implies coalescing diverse elements (e.g., tactile, proprioceptive, visual, olfactory stimuli) into a single entity (figure 4).

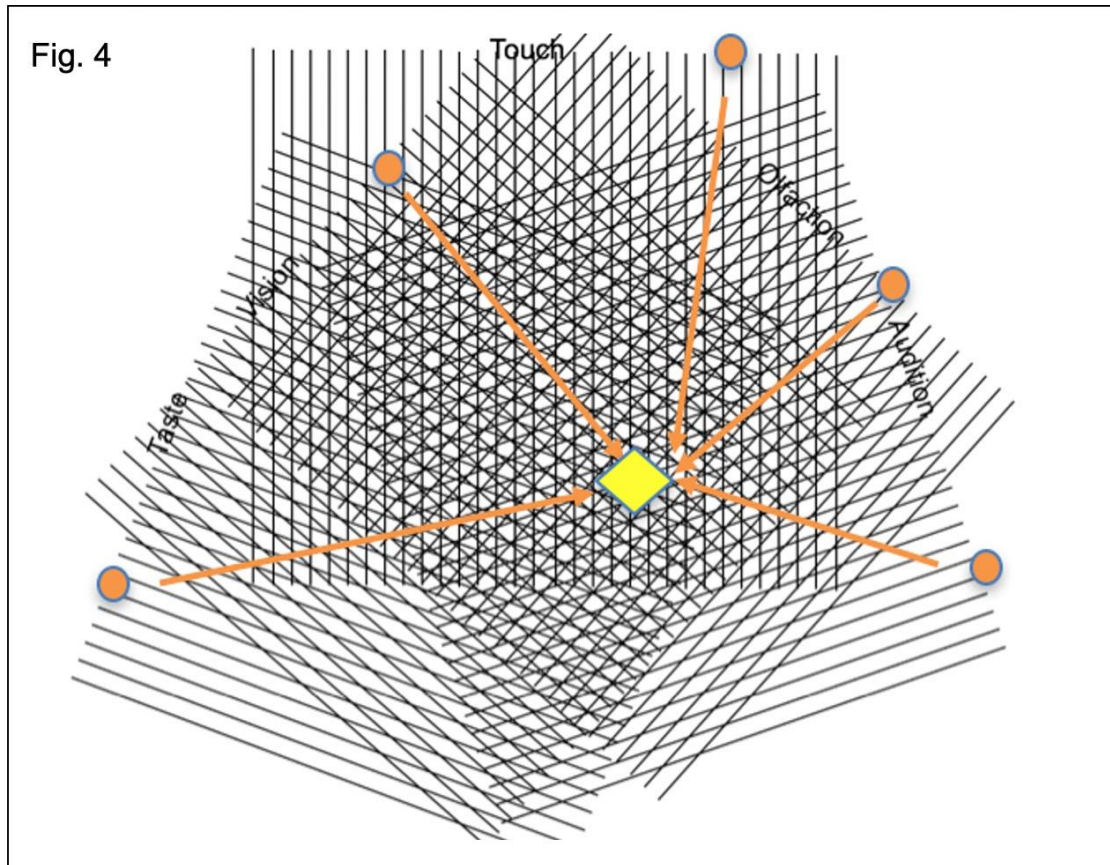


Figure 4. A schematic representation of the process of neural “integration” by the brain. Each sensory modality can respond to a range of stimuli, e.g., different qualities (“qualia”) of vision, taste, olfaction, tactile texture, each quality (e.g., sweet, salty, sour, bitter; or red, yellow, green, etc.) represented by a different line in each modality. In this example, given a specific combination (i.e., “set”) of these qualities, i.e., specific visual appearance, taste, odor, texture, etc., our brain “integrates” them, thereby enabling us to discern the difference among a real pineapple, a ceramic model of a pineapple, a photograph of a pineapple, pineapple juice, etc.

“Integration” also implicates experience, recognition, and therefore, memory, which enables comprehension of an initially uninterpretable sensory pattern (figure 5).

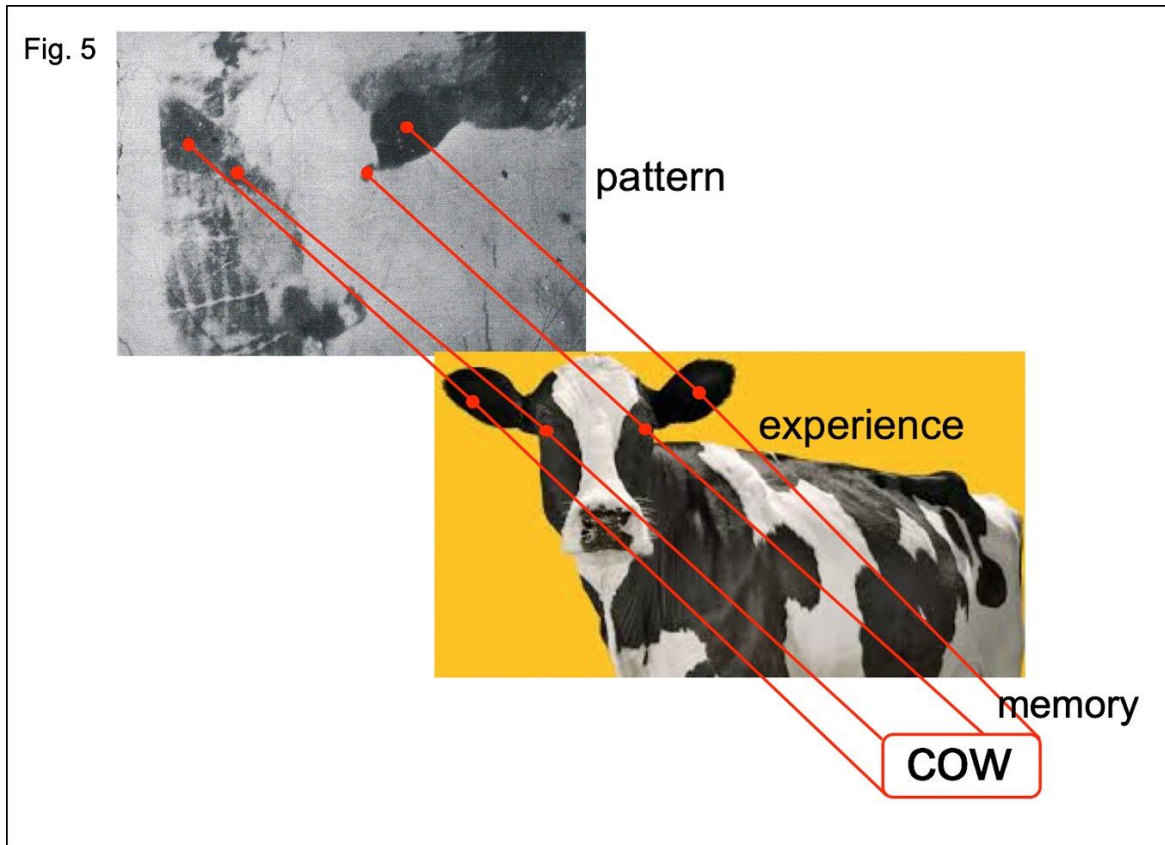


Figure 5. When first observing the image in the upper left, many persons report seeing a complex, uninterpretable random pattern. However, they may suddenly “see” the cow in a spontaneous moment of recognition, or when told what it is, or when eyes, ears and nose are pointed out. The prior experience and memory of a cow’s face thus imposes structure to the previously meaningless pattern. Thus, both experience and memory would seem to be essential to “make sense” of an array of stimuli, and thus be a requisite for conscious awareness.

Evidence that experience and memory are necessary for such integration, which enables conscious awareness, is exemplified in the case of individuals who were blind from birth or early childhood who later had the blindness-inducing cataracts surgically removed. Oliver Sacks (1993) describes such a fifty-year old man:

Upon surgical removal of the first cataract, the man would look at “...an angle, an edge, a color, a movement -- but would not be able to synthesize them, to form a complex perception at a glance. This was one reason [his] cat, visually, was so puzzling: he would see a paw, the nose, the tail, an ear, but could not see all of them together, see the cat as a whole. Moving objects presented a special problem, for their appearance changed constantly. Even his dog, he told me, looked so different at different times that he wondered if it was the same dog.... [Stair] steps, in particular, posed a special hazard, because all he could see was a confusion, a flat surface, of parallel and crisscrossing lines; he could not see them (although he knew them) as solid objects going up or coming down in three-dimensional space”.

Sacks, referring to a report by the English surgeon, Cheselden, in 1728 who removed cataracts from a 13-year old boy who had been blind from birth, stated, ‘He had no idea of distance. He had no idea of space or size. And he was bizarrely confused by drawings and paintings, by the idea of a two-dimensional representation of reality... It had been similar with many other patients in the two hundred and fifty years since Cheselden's operation: nearly all had experienced the most profound...confusion and bewilderment.’

We believe that these forms of conscious awareness are qualities that depend on the unique inter-connectivity of neurons of the brain, in contrast with the relative lack of such connectivity structure in the spinal cord. The neuronal circuitry of the brain, i.e., the connectivity among brain regions, provides the streaming informational structure – memory of experiences, learning, motor patterns while the biophoton field crests generate the conscious experience, i.e., the light for the “mind’s eye”. The higher dimension would enable the complex biophoton patterns to be coalesced into simplified entities over time that we perceive...i.e., our stream of consciousness.

What is the observer?

The “observer” is the neurons that will respond to the neuronal activity of the moment, when that activity will reach the observer via the biophoton plasma. The observer needs to be observed by another observer that also observes what was not activated at the same moment, hence having a “figure” (activity) and a “ground” (lack of activity, or low-level activity, that is equivalent to relative non-activity). That activity and lack of activity combined, in turn is observed by the neurons that next respond to it. This pulsatile, continuous chain of activation and observer, then observer serving as activator, activating a new observer, could shuttle back and forth between the cerebral hemispheres via the corpus callosum, such that the observers are both stimulating and observing each other. A metaphor of this reciprocal process is the awareness of one’s finger touching one’s palm. The sensation of the finger (observer, figure) is of touching the palm (observed, ground), but the palm can also be perceived as the observer of the finger, involving a shift in attention. Then, one can try to imagine both observers and observed concurrently, a situation in which the observer and the observed become the observed and the observer, respectively. When applied to the entire brain, that is all there is for the brain activity; a situation that is conscious awareness...responding to what is, and what isn’t, simultaneously, hence combining figure and ground as an entity. In reality, all that we know and experience is what is happening in our brain at any moment; our senses and brain activity completely create our awareness of reality.

Where is “I”?

In order for the observer and the observed to have reciprocal and interchangeable roles and comprise a unitary entity, despite a necessary time lag between the moment that the observation occurred and the moment when the event occurred that generated the observation, all occurring at different phases of the neuronal activity cycles, a “collapse” of the time lags into a unitary entity would seem necessary (figure 6).

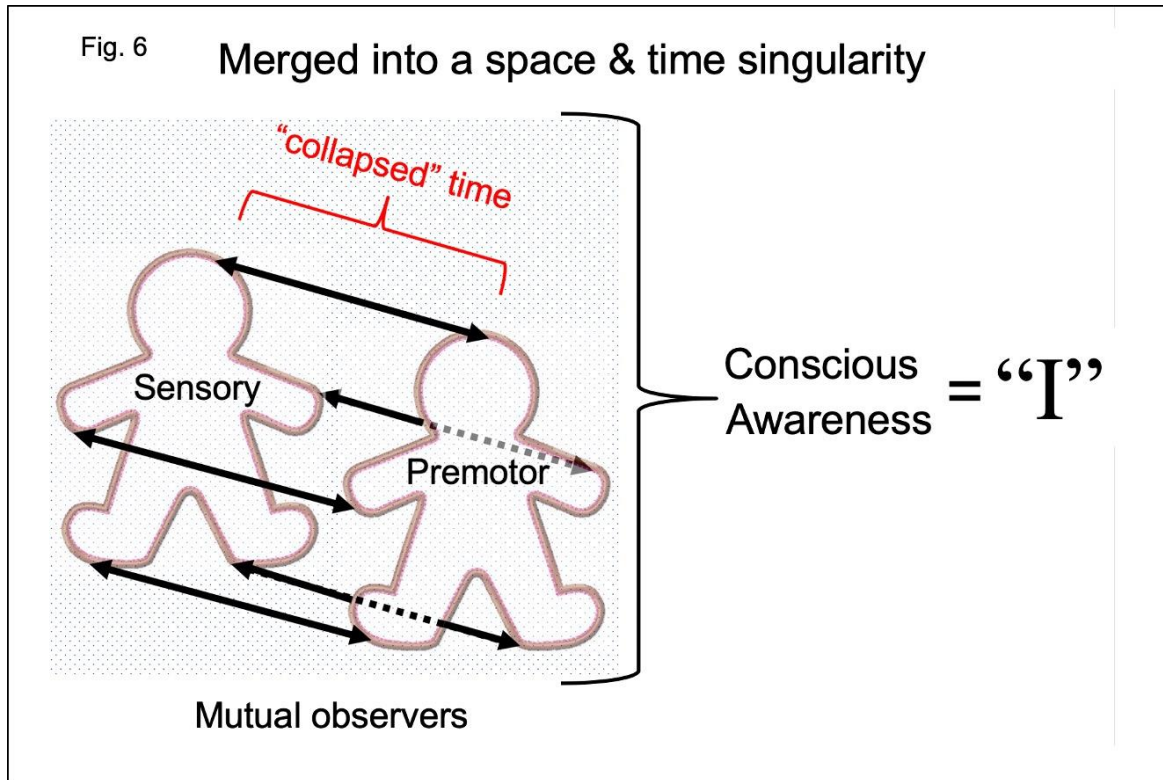


Figure 6. Our conjecture that the merging of the “observers” comprising the sensory and premotor systems into a single entity in which the time differences involved in the synaptic delays are “collapsed” and thereby rendered irrelevant, requiring an additional, “higher” dimension, is the process that underlies conscious awareness, and which generates “I”.

We conjecture that such time collapse, which enables the observer and the observed to be a singularity, also requires a higher level of integration than that which exists in our 4-dimensional conceptual universe. In order to account for the processes of coalescing the multiple disparate sensory “homunculi”, together with collapsing (i.e., “simplifying”) the temporal disparities among them all into a unitary entity, we conjecture that our conscious awareness requires, and occurs in, a different, higher, dimension. We experience, but cannot “view,” this dimension. The implication is that “I” resides within a higher, or 5th, dimension, in which we and our brain are embedded. It is in the higher dimension that the temporal and spatial disparities among all our different, concurrently active neural systems – cranial sensory, somatic sensory, visceral sensory, proprioceptive, autonomic and somatomotor, and memory can meld into a singularity, which is our totality at each moment...that is where “I” is.

Conclusion

In answer to the initial question we raised, i.e., *when* in relation to neuronal firing does conscious awareness occur, we propose that because of the analog nature of the ionic or biophoton plasma generated by the action potential, *any and all* moments during the action potential could become a component of the maximum-intensity wave front (i.e., the biophoton “crest”) that gives rise to

conscious awareness at any moment. Thus, the plain answer to the question of “when” during the action potential conscious awareness is generated, is: at *any* time, when and if that activity happens to be a contributor to the highest-energy biophoton crest at that moment. Referring back to the aquarium metaphor, if a particular wave crest at a particular moment is the generator of conscious awareness at that moment, and the equivalent in the brain would be an ionic or biophoton wave crest (i.e., maximal energy compared to any other activity ongoing in the brain at that moment), then depending on the configuration of the neurons, action potentials at different locations on different axons could each be perturbing their surrounding ionic fields to be contributing to that particular maximal energy wave crest at that moment.

Like a computer, the brain circuitry involves input, memory and integration, and output, but unlike a computer, the brain utilizes an emergent property, generated by the action potentials, that modulates the activity of surrounding neurons via a non-synaptic, “ephaptic” ionic plasma that gives rise to a biophoton plasma to which the surrounding neurons can respond non-synaptically.

We suggest that this “analog” product of the “digital” action potentials and complex neuronal circuitry generates a surrounding ionic plasma, which generates a biophoton plasma to which light-sensitive elements in surrounding neurons respond, in turn generating *their* biophoton plasma. This plasma constitutes a simplification, hence a more interpretable, representation of the neuronal activity. These nevertheless complex plasmas, originating from different brain regions, interact, forming higher energy wave crests. We conjecture that these wave crests constitute the “currency” of consciousness and are integrated in a higher dimension in which temporal differences and spatial orientations are coalesced into comprehensible patterns. The combination of observer and observed brain regions and the continuously changing distribution and roles of observer and observed brain regions all jointly constitute our entire brain activity and non-activity from moment to moment, which comprises our subjective conscious awareness into “I”.

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