The Neurophysiology of Consciousness

A new model of consciousness is proposed which is based upon validated neurophysiological principles. The model postulates the existence of a fundamental unit of consciousness in the form of triangular neuronal configurations. The postulated triangular units of configuration are common to both hard-wired integrations as well as to newly created and abstraction-driven integrations. Molecular memory is proposed as the probable foundation for neuronal memory.

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Introduction
Ongoing studies in the areas of neurophysiology and neuropsychology have provided a greater understanding of the neurological processes supporting human consciousness. However it also becomes apparent that the functioning brain is a product of multi-faceted influences. This may be inferred from the fact that the process of sensory perception and association is very much a function of embryological determinants which in itself incorporates evolutionary elements. Furthermore we need to appreciate that we do not live in a mechanistic Newtonian environment alone. Rather, there exists also an entire quantum reality with its non-locality dimension which manifests its influence beyond the five senses reality defined by the phenomena of mass, energy, time and space (distance). This extra-sensory dimension would necessarily influence neuro-psychological integration in a very significant way and would need to be included as a determining factor in any neuro-psychological model of consciousness.

Processes of Consciousness
The neuron and all its properties is the fundamental unit supporting consciousness in its broadest sense. These neuronal properties give rise to neuronal integration through inter-neuronal synapses. Neuronal protein synthesis and the subsequent growth of axonal and dendritic processes is initially a product of genetic influences. At the phenotypic level, the early neural tube differentiates into specific neuronal types under the influence of transcription factors such as sonic hedgehog. This differentiation is spatial in configuration. Similarly, work done previously by Burr indicated that the presence of measurable electric fields precede cellular differentiation and growth. This was later confirmed by Becker. The subsequent growth and synapsing of axons will reflect these determinants.
This initial hard-wiring therefore proceeds through several logical steps:

1. Differentiation by transcription factors and electro-chemical influences
2. Growth of cell processes within a pre-determined configuration
3. Synaptic development

With further foetal maturation, environmental factors begin contributing to this hard-wiring phase of neuronal development with a progressively increasing influence. It has been shown that maternal hormones, notably cortisol, as well as neuropeptides, cross the placenta and influence neuronal development. The completion of the hard-wiring phase of development probably coincides with the end of the formative years of life.

Reviewing the hard-wiring configuration at the level of the primary and secondary sensory areas as well as at the level of association, it becomes apparent that neuronal cells and collections of neuronal cells are stereotypically, spatially arranged for function. The areas most clearly demonstrating this arrangement are the visual and auditory cortices. In effect, the sensory process at the cortical level is characterized by the fragmentation of the incoming signal into its most fundamental components. In the visual cortex, the incoming light signal is fragmented to a level at which first order receptive cells respond only to fixed points of light frequencies or darkness. Thereafter subsequent order cells higher up in the filtering hierarchy begin synthesizing the sensed information received from the lower order cells through specific receptivity to further qualities of the sensed signal such as static and moving lines in all angles of orientation. The information is further filtered through progressively higher order neurons, individually responsive to more qualities of the sensed signal and in this way begin to synthesize the perceived information. This process continues until it arrives at a point where the cells at the apex of this filtering and re-synthesizing hierarchy are the representation of the perceived entity. This apical representation is most likely situated in an association area. This sensory-association process may be summarized as follows:

1. First order cells receive the incoming sensory information in a fragmented form.
2. A hierarchy exists such that the sensed information is transferred through successive order cells, each being responsive to more of the features of the sensed information than the preceding order.
3. The configuration of all the cells is stereotypically arranged to carry out this required function
4. The overall configuration of participating cells is triangular (pyramidal or conical in three dimensions) in that the base comprises the greatest numbers of cells, each specific only to very small increments of sensed information, while higher orders comprise progressively fewer cells, each specifically representative of more information. The least amount of cells would be situated at the apex of the configuration – the specific representation of the sensed entity.
This process represents the labeling of individual entities in the environment. Once a foundation of labeled entities is established, the process continues with the integration of associations of labeled entities. In this way awareness evolves into understanding and the evolution of frontal lobe qualities progresses.

**Creativity**

The hard-wired process described above will give rise to an adequate integration, supportive of human consciousness and independent function. This represents a common foundation, stereotypically similar for all individuals. We deduce this from the observation that neuro-anatomy and neuro-physiology is similarly spatially localized in different individuals. At this point we would need to project further in terms of this integration process to provide a model supportive of individual creativity. To explain creativity we would need to expand the hard-wiring beyond the apices of triangular configurations, specifically representative of entities and their associations. In effect hard-wiring represents an integration of environmental entities and their associations. Creativity on the other hand reflects a future-based, abstract integration.

We can assume that many “un-labeled” neurons and processes exist within the milieu of the integration process. These neurons would provide the substrate for further integration. In the event that the apices of two or more representative triangles of configuration are triggered, neighbouring neurons and their processes may be recruited and incorporated in the synaptic circuit. In effect, the recruited neurons would be those caught in the common penumbra of triggered apices. This is illustrated in figure 1. This process would be more likely to occur if the triggering were repetitive. As in all neuronal circuit creation, the initial neurotransmitter mediated connection would evolve into a structurally permanent circuit through protein synthesis and axonal/dendritic growth. The integration of apices elevates neuronal association to a higher order. The expansion of consciousness is therefore a consequence of repeated integration of subsequent apices of representation.

![Figure 1](image-url)
The Basis of Memory
Having proposed a neurological model in support of hard-wired learning and forward-projected abstraction, we still need to address the essence of where memory is stored. More specifically, is memory circuit-based or molecular based? The obvious analogy may be found in computer technology. For the most part, memory has been circuit-based. However more recently, molecular memory has been developed as an alternative mode for memory storage and retrieval. Clinical and radiological evidence would suggest that human memory is more molecular-based. Evidence in favour of this postulate is the finding that on stimulating a point in the cortex, a comprehensive subjective experience occurs inclusive of primary sensory components as well as emotion at a rate which is faster than neuronal processes can propagate. Supporting studies have shown that a protein synthesizing enzyme, alpha calcium/calmodulin-dependent protein kinase II, promotes several aspects of neuronal memory. When blocked, memory becomes significantly impaired.

If we were to postulate the existence of molecular memory, there must exist a process in which each neuronal component of an integration synthesizes a coded protein unique to itself and the information specifically represented. Each subsequent order of neuronal integration would necessarily need to incorporate the coded protein derived from all lower order neurons, within their own unique coded protein. Ultimately the neurons occupying the apical position of the integration would synthesize a protein incorporating coded components of all the neurons of the integration. In this way the requirements for molecular memory would be fulfilled.

Quantum Non-Locality Influences
The non-locality dimension of the quantum environment represents a timeless and spaceless milieu in which matter/energy/frequency is in a state of constant flux. It has been shown that processes of human consciousness may convert and precipitate information from this quantum dimension into our five senses-based reality. This is termed collapsing the wave of possibilities.

Hameroff and Penrose have previously proposed a model in which neuronal components of an integration synthesize cytoskeletal microtubules. The microtubules comprise a crystal-like lattice structure, the basic subunits of which are tubulins. The authors hypothesize that the tubulins cooperatively interact (compute) with other neuronal tubulins. However the main thrust of this hypothesis was not primarily to explain the feasibility of molecular memory but rather to provide a possible mechanism whereby quantum information could interface with neuronal circuitry. Their postulated tubulins fulfilled both requirements in that molecular memory exclusive to individual neuronal components becomes a distinct possibility coupled with a quantum access point through which quantum information could influence neuronal processing.
Summary
It is proposed that the fundamental unit of consciousness is a triangular neuronal configuration. Specific representation of environmental entities and their associations exists at the apex of the triangular configurations. It is further postulated that memory is molecular and is a function of neuron-specific proteins. Each order of neurons incorporates protein coded for by lower order neurons. The initial hard-wired integration is determined by genetic factors and earlier nurture influences. Creativity or abstraction reflects a process in which substrate neurons are recruited within the penumbra of triggered triangular apices. This consequently expands the integration and thus also the segment of the represented environment. Molecular memory is further proposed as the access point for quantum, non-locality influences.

References


