Quantum bits and consciousness: Biochemical information processing

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Dr Peter Verheyen, DMD from the Sola Society & Academy, at Vienna University, explores quantum bits and consciousness, focusing this time on biochemical information processing

Consciousness is an extremely difficult concept. A widespread theorem in neuroscience states that consciousness arises from biological information processing. It can subsequently be defined as 'notion or awareness of the environment' in its purest form. Under this definition, consciousness must have developed together with the very first life.

Notion and awareness of the environment are essential to survival. The earliest self-reproducing systems some 3.95 billion years ago must have had an idea and awareness of their surroundings, because they had to be able to distinguish food sources, energy and construction, from toxic substances and destruction.

Today's single-celled organisms also move towards food sources and, turn away from poisonous substances, and even show individual and collective 'behaviour'. The information transfer required for this interaction takes place chemically. The most primitive forms of consciousness must, therefore, have involved the transfer of chemical signals. When single-celled organisms began to organise themselves into colonies, they exchanged information via chemical signals and quorum sensing.

As life forms evolved from unicellular to multicellular complex organisms, this chemical signal transfer remained indispensable as a means of communication between all distinct units or cells, as well as a means of interaction with the environment.

At some point in evolution, life had to develop another way to register, forward, store and exchange information to organise increasingly complex life forms and allow them to interact with the environment. The signal transfer method that is familiar to us, electrical signal transfer, involves electrons, but their unpredictable behaviour makes them impractical and unusable in complex life forms.

Biochemical information processing

Life developed a signal transfer – or information management – system involving action potentials and ion channels – a flow of positively charged sodium and potassium ions and a Na–K–ATPase pump. This apparently allowed information to be exchanged more efficiently and, especially, more reliably in the warmth and humidity of biochemical systems; the signals carrying the information could be efficiently channelled. This can be called a biochemically encrypted signal or information transfer.

Recent insights reveal the existence of a ‘bioelectrical code’. Information could be transferred and saved using ions and ion channels, enabling cells to communicate and store information for dynamic control of growth and form. The intricate electrical circuits in the brain may have evolved from this much simpler and slower primary signal transfer between cells in an organism, and likewise, the nerve cells, with the unique characteristic that they do not divide.

With the development of these specialised structures – the nerves – having the sole function of signal transfer and information management, life entered a new phase of evolution. Not only could information be registered, forwarded, stored and exchanged, but with the appearance of the first knots of nerve cells, information could also be processed.

This made possible the appearance of the senses – biochemical measuring instruments that could detect the environment with high precision and send the information via nerve pathways for processing. The more complex these knots became, the more information from the environment they could process and the better and more efficient they became at it. The first primitive brain structures developed. This marked the start of an evolution towards complex brain structures that could also interpret incoming information, where interpretation signifies ‘to give meaning to.’

Sensory information explained

Sensory information that could be interpreted made it possible to interact actively with the environment. It was no longer necessary to merely experience the environment passively – active interaction made it possible to influence and adapt to it. The increasingly complex organisation of this interpretation ability ultimately led to self-awareness – the notion or awareness of one’s ‘own’ environment.

The most complex forms of neural organisation led to awareness of the ability to interact with the environment, to self-aware interpretation of information, to intelligence. Intelligence created the possibility of influencing the environment, actively interacting with and adapting it, and trying to understand it.

The role of information appears to be crucial in the emergence of complex awareness and self-awareness. A newborn baby has no self-awareness. This only develops from the first year of life onwards, following a constant stream of information through sensory perception.

Sensory information is essential for a well-functioning brain, complex awareness, and self-awareness.

Self-awareness is not a metaphysical concept or construct. The brain constantly constructs a ‘sense of self’ through sensory information.

Is consciousness inherent to life?

Consciousness, as we know, is based on the exchange of information via chemical and electrical signals. It is inherent to life: without consciousness, no life, without life, no consciousness.

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