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Quantum effects in the brain: a review of possible mechanisms

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In the mid-1990s Hameroff and Penrose proposed that quantum effects played a role in the nature of consciousness. The theory, known as orchestrated objective reduction, involves proteins called microtubules, which form part of the cytoskeleton of eukaryotic cells. The theory was largely dismissed due to the fact that quantum effects were thought unlikely to occur in biological systems, which are warm and wet and subject to decoherence. There has since been some evidence that biological systems may display quantum properties, particularly with respect to photosynthesis, a process fundamental to life on earth. Quantum effects are also possibly at play in other biological processes such as avian migration and olfaction. A more recent review of orchestrated objective reduction outlines the experimental discovery of quantum coherence in microtubules. The microtubule mechanism of quantum consciousness has been joined by other theories of quantum cognition. In 2014 it was proposed that general anaesthetic, which switches off consciousness, does this through quantum means, by causing changes in electron spin. A claim supported by experiments conducted on fruit flies. In 2015 Matthew Fisher outlined a mechanism for quantum computation in the brain using Posner molecules. Even more recently it has been shown that humans can sense magnetic fields, specifically that the human brain registers changes in earth strength magnetic fields. It is possible that this effect might be mediated by the radical pair mechanism, which has been investigated in the context of birds' ability to utilise the earth's magnetic field. This review aims to investigate the current argument for the role of quantum effects in the brain and how fully the theory is supported by convincing experimental evidence.

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Primary author: Ms ADAMS, Betony (UKZN)

Co-authors: Prof. PETRUCCIONE, Francesco (UKZN); Dr SINAYSKIY, Ilya (University of KwaZulu-Natal and National Institute for Theoretical Physics)

Presenter: Ms ADAMS, Betony (UKZN)

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