Study suggests spins of 'brain water' could mean our minds use quantum computation

In the ongoing work to realize the full potential of quantum computing, scientists could perhaps try peering into our own brains to see what's possible: A new study suggests that the brain actually has a lot in common with a quantum computer.

The findings could teach us a lot about the functions of neurons as well as the fundamentals of quantum mechanics. The research might explain, for example, why our brains are still able to outperform supercomputers on certain tasks, such as making decisions or learning new information.

As with much quantum computing research, the study looks at the idea of entanglement – two separate particles being in states that are linked together

"We adapted an idea, developed for experiments to prove the existence of quantum gravity, whereby you take known quantum systems, which interact with an unknown system," says physicist Christian Kerskens from the University of Dublin.

"If the known systems entangle, then the unknown must be a quantum system, too. It circumvents the difficulties to find measuring devices for something we know nothing about."

In other words, the entanglement or relationship between the known systems can only happen if the mediating system in the middle – the unknown system – operates on a quantum level, too. While the unknown system can't be studied directly, its effects can be observed, as with quantum gravity.

For the purposes of this research, the proton spins of 'brain water' (the fluid that builds up in the brain) act as the known system, with custom magnetic resonance imaging (MRI) scans used to non-invasively measure the proton activity. The spin of a particle, which determines its magnetic and electrical properties, is a quantum-mechanical property.

Through this technique, the researchers were able to see signals resembling heartbeat-evoked potentials, which are a type of electroencephalography (EEG) signal. These signals aren't normally detectable via MRI, and the thinking is that they showed up because the nuclear proton spins in the brain were entangled.

The observations recorded by the team require verification via confirmation via future studies across multiple scientific fields, but the early results look promising for non-classical, quantum happenings in the human brain when it's active.

"If entanglement is the only possible explanation here then that would mean that brain processes must have interacted with the nuclear spins, mediating the entanglement between the nuclear spins," says Kerskens.

"As a result, we can deduce that those brain functions must be quantum."

The brain functions that lit up the MRI readings were also associated with short-term memory and conscious awareness, and that suggests the quantum processes – if that's indeed what they are – play a crucial role in cognition and consciousness, suggests Kerskens.

What researchers need to do next is to learn more about this unknown quantum system in the brain – and then we might fully understand the workings of the quantum computer that we're carrying around in our heads.

"Our experiments, performed only 50 meters away from the lecture theatre where Schrödinger presented his famous thoughts about life, may shed light on the mysteries of biology, and on consciousness which scientifically is even harder to grasp," says Kerskens.

The research has been published in the Journal of Physics Communications.

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