Review of: "Neural Quantum Superposition and the Change of Mind"

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Potential competing interests: No potential competing interests to declare.

As a preface, I want to emphasise that I am writing this review from the perspective of an experimental psychologist and a cognitive neuroscientist. Consequently, my contribution to this discussion will be necessarily limited to these domains and neglect the underlying mathematical formalism, as well as the discussed background in physics and chemistry.

This being said: I really enjoyed reading this paper, in which the author laid down a structural similarity between quantum mechanics in the famous double-slit experiment and conscious decision making as it would emerge in a Human mind / brain. I have three points for possible further discussions:

1. With regards to the collapse of the wave-function, which, as I understand, distinguishes the physics example from psychological choice behaviour, because conscious Human minds are capable of reversing their decisions. In my view, decision making applies to an interaction between an agent with its environment within some finite duration of time. Thus, once a decision has been made and acted upon in the real world, the superposition of neural quantum states has collapsed in consciousness, too. For example in the case of visual perception, I cannot “see” two hypothetical objects with different contents at the same spatial location simultaneously. Even in the case of ambiguity (like for a example in the Rubin’s vase-face illusion), I will “see” only on or the other object (either the face or the vase) at a given time and at a given place in the real world. Similarly in the physics example, if there were no photofilm with which the electrons interacted, there would also still be a superposition of quantum states and no collapse. Thus in my eyes, the structural similarity also holds for this aspect. Of course, as a Human mind, I can reverse my actions, which typically is accompanied by some sort of “error detection” and regret, but this would necessarily have to happen at a different time or within a different context. My previous conscious percept, however, would still have collapsed into one or the other object. I would be very grateful for some clarifications by the author on this point.

2. In the context of choice behaviour in neural function, I want to point out that single neurons (or isolated brain areas) very rarely contain all the information necessary for making decisions about our world. It is mathematically very implausible that all possible configurations that could occur in the real world are hard-wired into the firing of single neurons. Instead, intelligent and flexible thoughts, perceptions and actions arise from the collective activity of many distributed neural ensembles, which interact with each other through synaptic connections. It is within these connections (not the neurons (!)) that conscious choices are made by weighing one connectivity pathway more strongly than the other. Interestingly, this collective activity from many neurons manifests itself in oscillatory, wave-like activity patterns, once we measure it. In this sense, the choices are already wave-like encoded in the brain. Maybe this perspective is of interest to

you.

3. With respect to the enigmatic field (outside of the brain) necessary for quantum consciousness, to which you allude to at the of your paper: In recent neuroscience work, there is renewed interest into the concept of ephaptic coupling, which is a form of neural communication distinct from chemical or electrical (i.e. gap-junctions) synapses. Instead, ephaptic coupling can occur between neurons and extracellular fields. It has been shown that ephaptic coupling can regulate the synchronisation and timing of action potentials and influence complex cognitive processes, like memory formation, through two-way interactions between neurons and fields. Maybe this could be the field your formalism is looking for?