Qeios

Peer Review

Review of: "Multi-Scale Temporal Resonance Theory of Consciousness (MSTRT): From Molecular Mechanisms to Minimal Functional Specifications, Necessary and Sufficient Conditions, and the Role of Sensory Input, Memory, and Motivational Drive"

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This paper proposes an interesting story about consciousness.

The concept of Phase Amplitude Coupling (PAC) is not new (see work from Pavla&Pavla), but the paper proposes here a good perspective that links the cellular and biomolecular aspects of consciousness with a dynamical approach at the brain scale.

Some typos are present, i.e., acronyms are missing for the clarity of the paper.

The different conditions necessary for consciousness are useful even if another proposition is made below.

The minimal functional specifications proposed here are also an interesting approach, as well as the comparison with the other theory of consciousness.

Overall, the paper should focus more on phase amplitude coupling with the link at the cellular level and remove the mathematical framework part that is only a combination of some indices.

Below are more specific comments for each part of the paper.

p5. Fig1. phase-amplitude coupling (PAC/MI) => phase-amplitude coupling / Modulation Index (PAC/MI).

Fig1. structural index (FRP) => Functional Resonance Potential (FRP).

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$CSDI_{2.0}$ = FRP × EDRR × $Match_{2.0}$ => This lists the different models available but without a clear link between them.

What is the meaning of '2.0'?

P6. Layer 5 pyramidal neurons (L5 PNs), thalamocortical circuits, cortical recurrent connections, and the claustrum. => Ref?

P7. length constant λ -> Ref?

P12. AMPA/NMDA => Acronym?

P20. Please provide an explicit description of a dysmetria between feedforward and feedback connectivity.

P22. 2.5.2: 'global phase alignment' -> this is a strong argument based on the molecular features, but there is no relation with global synchronization and no reference to highlight this point.

P23. Quantum effect: this part needs more development or maybe is not necessary in the paper.

P24. The brain consumes approximately 20 watts => Reference?

P25. Chap 3. Mathematical Framework

This chapter should be suppressed or completely rewritten. This is only a collection of metrics used for the study of brain activity. Figure 3, at the beginning of the chapter, proposes a nice overview of different metrics available in neuroscience for studying brain activities at different scales, but in the paper, there is no link between these indices. There is a mention of the PCI (Perturbational Complexity Index), but the reference is missing: Casali, AG; Gosseries, O; Rosanova, M (2013). "A theoretically based index of consciousness independent of sensory processing and behavior". Science Translational Medicine. The same applies to each index; a reference is needed.

P26. Fig3. Typo: PCI -> (Perturbational Complexity Index)

P27. In relation to the comment above, section 3.2.1.ii) about the spectral component Number (SCN). The SCN is not detailed anywhere else in the paper; it is therefore not correct to say that MSTRT predicts SCN ≥ 3 for consciousness.

3.3.2: cross-region phase clustering (CRPC) vs inter-site phase clustering (ISPC) -> There is a confusion between these two terms.

Chap 4. & Chap 5. These two chapters should be combined into one to make the overall reading more accessible.

Chap6.

"three commonly assumed requirements—" -> There is no reference about these assumptions.

A current model proposes a distinction between the level of consciousness (wakefulness) and the content (awareness) of consciousness as drivers for consciousness to be present (see work from Laureys, S. (2005). The neural correlate of (un)awareness: lessons from the vegetative state. Trends in Cognitive Sciences). Added with the object of consciousness, this would be a more convincing triplet to establish the necessary or contingent conditions.

6.3.4: Minimal temporal integration that gives experience its "thickness."

6.4.1: Volition should be added as a motivational drive.

6.4.9: A future artificial system satisfying the formal requirements of MSTRT might achieve consciousness => it would be also appropriate to integrate in the chapter the hard problem.

P45. that consciousness is a mode of processing rather than a type of content.

P48. Table 1 & 2 are the same.

Declarations

Potential competing interests: No potential competing interests to declare.