Can Fractal and Complexity Measures of Electrophysiological Signals Be Used to Study Subjective Experience?

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Keywords — Complexity, Criticality, Consciousness

1. Quantifying information during conscious experience

> **Callout Title (optional)**
> Your callout text goes here.

2. Complexity measures for EEG

Richness of conscious experience pose a question to the neuroscience

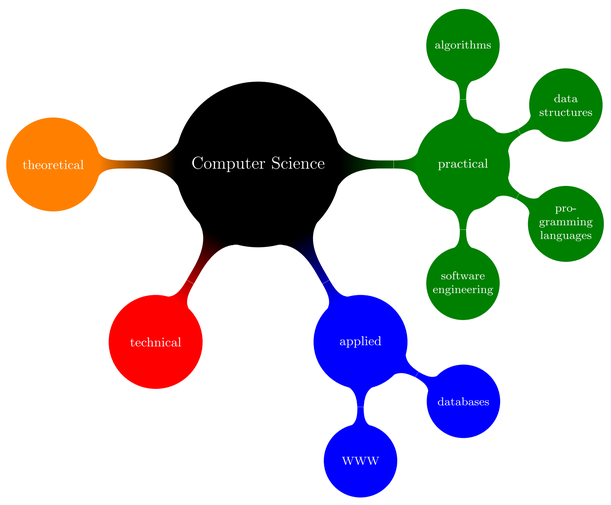

Figure 2: A Stick Figure

Figure 1

3. Brain criticality

Criticality is the singular state of complex systems poised at the brink of a phase transition between order and randomness.

4. Power laws and 1/f noise

X. Ji *et al.* [1]

5. Consciousness measures and Complexity

- Repertoire of states
- Integration and unity
- Effects of psycholics on complexity

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Add graph about 1/f aperiodic term

- add tables with differnt measures explained
- add soort of SCHEMES
- START FROM WRITING MESSAGES
- autopoiesis as reference?? self organisation of life

graph of different frameworks - how we could combine it with neurophenomenology?

- flexibility in relation to environment?
- complexity of signal reflects structure of the generators?
- microstates
- complexity of brain signal will reflect inner processes but also envirobmnet
- meditation vs effort

-richness of experience - Information theory - dynamical systems

Header 1	Header 2	Header 3
Cell 1	Cell 2	Cell 3
Cell 4	Cell 5	Cell 6

This poster presents a perspective on bridging quantitative measures of neural dynamics with phenomenal consciousness. The connection between self-organizing systems and spectral 1/f phenomena predates the recent surge in studies. Currently, these measures are being used to differentiate states of consciousness (e.g., distinguishing between minimally conscious and vegetative states, identifying sleep phases) and are also applied in research on psychedelics (e.g., the “entropic brain” hypothesis, where stimulants increase the complexity and richness of neuronal communication).

Increased entropy or fractal dimension often correlates with positive affective states (e.g., psychedelics) and cognitive flexibility, whereas reduced complexity is observed in conditions such as depression. These patterns frequently involve NMDA receptors modulation (excitation-inhibition framework), providing a mechanistic link to various conditions that alter subjective experience, including schizophrenia and ADHD. Additionally, age-related changes in spectral slope correlate with cognitive reserve capacity, suggesting that variations in brain dynamics may # fundamentally shape phenomenological experience across the lifespan.

6. Summary

Despite its promise, there is not yet a coherent framework linking everyday subjective experience with these quantitative measures of neural dynamics. This poster synthesizes primary research directions and highlights potential underlying biological mechanisms while also pointing to the imitations.

7. Possible studies ideas

- Ideas put figure about increased number of papers(qualitative experinec + aperiodic + complexity)

Bibliography

[1] X. Ji *et al.*, “Sources of Richness and Ineffability for Phenomenally Conscious States,” *Neuroscience of Consciousness*, vol. 2024, no. 1, p. niae1, May 2024, doi: 10.1093/nc/niae001.