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

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I. INTRODUCTION

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.

II. 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.