



Commentary: Fractals and the Irreducibility of Consciousness in Plants and Animals

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ABSTRACT

In the present manuscript, we make few comments on the ideas proposed in Gardiner (2013), with little discussion and emphasis on Gardiner *et al.* (2010). In the latter article; which forms the base for Gardiner (2013), authors reviewed interesting research studies concerned with the fractal nature of the brain structure and its functional aspects and thereby proposed consciousness to be an emergent property occurring at higher dimensions. Even though above studies could be appreciated for their contributions in developing novel theoretical models and deeper understanding of consciousness, there exist few exceptions based on which their proposals may not be universally valid. Here, we consider the cases of 'Cardiac arrest' and 'Near-Death experiences (NDEs),' to comment and get deeper insights into such ideas. In this regard, present commentary serves as a useful contribution to any further studies along these lines.

Key Words: Fractals, Consciousness, EEG, Near-Death Experiences (NDE), Cardiac Arrest, Brain

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A commentary on 'Fractals and the irreducibility of consciousness in plants and animals.' By Gardiner J, *Plant Signaling & Behavior*, 2013; 8: 8, e25296, DOI: 10.4161/psb.25296

Introduction

There have been hardly any scientific studies supporting epiphenomenal nature of consciousness that could capture its various aspects and functionalities (Greenfield and Collins 2005; Tononi 2005). Gardiner *et al.* (2010) and Gardiner (2013) is one such effort to try and bring about the connection the fundamental units; fractals, could probably have with the enigmatic subject; consciousness. It is well known that fractals popping out at various levels could serve as the fundamental units or building blocks and

are believed to be the most optimal way of processing or designing any functional system (both physical and biological: Mandelbrot 1983). This is reason why the Nature embraces fractal signatures in designing and fabricating different life forms (at physical and functional levels: Mandelbrot 1983; Reddy and Pereira 2016a, b). While in search, for more fundamental theories of consciousness, it looks obvious that one would attempt to craft such elusive concept by using fractals (Gardiner *et al.* 2010; Gardiner 2013; Reddy and Pereira 2016b). It is natural that such thought would reflect in mind; because we are surrounded by fractal systems both inside and outside; indeed, we are beings made from fractals themselves at various levels (Reddy and Pereira 2016a).

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Fractal Dimensionality of Consciousness

Here, the main intention is to make few comments on the ideas proposed in Gardiner (2013), with little discussion and emphasis on Gardiner *et al.* (2010). In the latter article, authors reviewed interesting research studies concerned with the fractal nature of the brain structure and its functional aspects and thereby proposed consciousness to be an emergent property occurring at higher dimensions. They quote '*consciousness indeed occurs in greater than four dimensions.*'

This hypothesis emerges from the data analysis of EEG recordings of a human brain. Based on the studies that analyze the fractal dimensionality of EEG patterns, they suggest that the fractal dimension of consciousness could be somewhere between 5 and 8. Hence, they say brain functions as a 'Quantum Computer' in 5-8 dimensions and that quantum gravity (which is also known to include higher dimensions: Randall and Sundrum 1999; Kisselev *et al* 2005) could play a role in generating consciousness. They also argue that this is consistent with data from other living systems as well, for example, the fractal dimensionality of EEG patterns in the lizard (*Gallotia galloti*) is found to be 6 (González *et al* 1999). Also, these above conjectures (from Gardiner *et al* 2010) are baseline assumptions for Gardiner (2013), where they argue that it won't be possible to come up with a model or rule that govern consciousness, since it is fractal in nature. That is because; fractals, in general, can only pass information in one direction (uni-directionality) and can't be extrapolated backward (irreversibility) to determine the rules/laws that govern them.

Observations from Cardiac Arrest and Near-Death Experiences (NDEs) Cases

We really appreciate above studies that contribute in developing novel theoretical models and deeper understanding of consciousness. With the notion that such a contribution is plausible only when we try investigating it in every possible way; we would like to make few comments here. In the above-mentioned studies (Gardiner *et al* 2010 and Gardiner 2013); they base their statements purely on the electric activity of the brain that can be captured by using EEG. One should note that even though EEG patterns could serve as a means to represent and understand the brain activity, in general, this alone can't be considered as a sole governing variable. This is because; EEGs can only detect brain activity in one-half of the area of the

cerebral cortex and hence we can't estimate the activity going on in the other half of the cerebral cortex and also in deeper structures of the brain (Paolin *et al* 1995; Bardy 2002; French 2005). That is connecting EEG patterns alone to consciousness ignores the genesis of EEG (where it requires synchronized polarization of apical dendrites in the cortex). This means that asynchronous polarization may cause small ripples looking like a flat line and that any other (non-aligned) dendritic tree structure (such as found in the hippocampus and other sub-cortical areas) are not even picked up by the EEG equipment. This is even more pertinent as the sub-cortical regions have more vascularisation than the cortical regions. Thus, looking purely at EEG and focusing on the fractal nature of it, ignores basic neuroscience and in particular everything deeper than an inch from the skull. This is the reason why few propose not to consider EEG data as a perfectly reliable indicator for the case of brain death.

Cardiac arrest cases are best exemptions to quote such situations (Van Lommel *et al* 2001, Parnia *et al* 2001, 2002, 2014; French 2005). In Parnia and Fenwick (2002), they claim cardiac arrest to be the closest possible model near to the dying process and hence they could provide a glimpse into the experiences associated with the death and dying process. Interestingly, during cardiac arrest, EEGs show an initial rapidly slowing envelopes and finally remains flat (called isoelectric line) until cardiac output resumes. This is the clinical state during which most of the subjects claim to have Near-Death Experiences (NDEs). NDEs are a spectrum of transpersonal experiences which are associated with vivid memories and involve great clarity of thought (for more details, see Greyson (2000a), Roe (2001) and Irwin (2003; Chapters 11 and 12, pp. 163-196)). This disproves the one-to-one connection between EEGs and consciousness. If Gardiner *et al.* (2010) and Gardiner (2013) is right, then how could there be a clear consciousness and memory retention when EEG is just a flat line. In the case of cardiac arrest subjects, if we look for the fractal dimension of EEGs, one finds it to be zero but still consciousness exists. Then how come one can say consciousness emerge as a higher dimensional property based on the fractal dimensionality of EEGs alone? In this regard, one may have to look for more indexing parameters that consider all such exceptions to come up with a complete model of consciousness.



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