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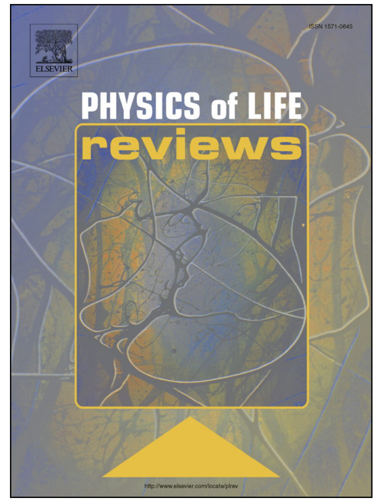

The Emperor's new topology

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Commentary on Tozzi et al

The Emperor's new topology

Comment on “Topodynamics of Metastable Brains” by Arturo Tozzi et al.

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I enjoyed reading Tozzi and colleagues’ treatment of the mindful brain, from the perspective of *topodynamics* (Tozzi et al.) [this issue]. It offers a thought-provoking and inclusive review of the most challenging issue in neuroscience; namely, the relationship between neuronal dynamics and the more abstract processes – or perhaps geometries – that underwrite cognitive operations and the very act of thinking. Tozzi et al [this issue] offer a graceful integration of two formal perspectives on brain functioning. The first appeals to a model of brain-mind functioning called *operational architectonics* (Fingelkurts et al., 2010), while the second promotes a topodynamic description, in terms of projections and mappings that take place on abstract structures, equipped with different dimensions, curvatures and constraints (Tozzi and Peters, 2016). In the words of the authors, this "throws … a bridge between the subjective, immediate datum of the naive complex of sensations and meditations and the objective quantitative, data … from experimental neuroscientific procedures." The writing style is artful and challenging; covering many ideas at an almost breathless (if poetic) pace. One could be forgiven for thinking that there is an element of "the Emperor’s New Clothes" in this earnest and grand description. I say this as a provocative critique of the writing style – and to celebrate one of the key insights of the article: namely, we may not be looking in the right place to see the *Emperor's New Clothes* because they actually live in a higher dimensional space in which physical (and phenomenal) dynamics are embedded.

The article starts with a deconstruction of operational architectonics that appeals itinerancy and metastability, which are hallmarks of experimentally observed electromagnetic transients and trajectories – as measured with electroencephalography and magnetoencephalography (Fingelkurts et al., 2010). The basic idea calls on an underlying *operational space-time* (OST) in the brain that intervenes between the brain’s physical space-time and the experiential, subjective, phenomenal structure of mind (*phenomenal space-time*) to which it is isomorphic. This means that there is a one-to-one correspondence between the phenomenal level that supervenes on “and is ontological inseparable” from the operational level. The particular characteristics of both the physical and phenomenal dynamics can be construed as a succession of *operational modules*, characterised by a generalised synchrony among neuronal assemblies. The transitions between these modules or (unstable or metastable fixed) points in the (physical or phenomenal) phase space is treated as an itinerant orbit showing the characteristic metastability of brain dynamics that emerge in critical regimes (Kitzbichler et al., 2009, Deco and Jirsa, 2012).

This formulation of neuronal dynamics is then cast in terms of topodynamics by appealing to a higher dimensional geometry that allows one to talk about symmetries and invariances that emerge (and are destroyed) as we go from one level to another (Tozzi and Peters, 2016). The particular focus of this treatment is the *Borsuk-Ulam theorem* (BUT) and its generalisations or variants (Bartsch and Clapp, 1996). Formally, the BUP states that every continuous function from an n-sphere into Euclidean n-space maps some pair of antipodal points to the same point. There are many ways to intuit the implications of this theorem. Perhaps the simplest is as follows: imagine that you go for a walk in a park and at some point you walk through a pond. Under the condition that you return to your starting point, there must be two points in your path at which you are at exactly the same height; namely, when you enter and leave the pond water. This induces an invariance or symmetry that the authors generalise to understand neuronal dynamics in operational space-time. In other words, they suggest that the itinerant succession of