Consciousness, Complexity, and Evolution

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Abstract: The idea that consciousness and complexity are closely related has been a major driver of the popularity of Integrated Information Theory (IIT) of consciousness, despite its major formal, phenomenological, and neuroscientific shortcomings. Here, I argue that we can recover this intuition by replacing its biologically neutral notion of complexity with an evolutionary one that I shall dub 'pathological complexity'.

The evolution of consciousness and complexity have for a long time been seen as inherently linked. In thinking about the possibility of sentience in machines and non-human organisms, our collective willingness to attribute phenomenological experience to them seems to be primarily driven by a measure of their complexity. For organisms such as jellyfish that are too simple in terms of their behavioral repertoire and nervous system organization, it seems all but impossible to attribute them the rich kind of mindedness that we associate with human consciousness. Furthermore, it's precisely the biological complexity of cephalopods that has led to calls for a recognition of their sentience and hence for them to be included in animal welfare science and legislation (New England Anti-Vivisection Society, et al. 2020; Browning 2019). It's in this context that Giulio Tononi's (2004; 2005; 2008; 2012) Integrated Information Theory (IIT) has become extremely popular in the public, despite its comparative unpopularity within the larger scientific community.

The identification of consciousness with *integrated information* itself, once a certain complexity of measured by 'phi' Φ is reached, has long been viewed as problematic - indeed, untestable. Merker, Williford, and Rudrauf provide us with a barrage of well-worked out arguments against IIT, showing that it fails for a variety of formal, phenomenological, and neuroscientific reasons. Nevertheless, the popularity of IIT is not entirely ill-motivated and my goal here is to recover some of its merits while offering an additional criticism of the project. IIT has obvious virtues such as the *in-principle* applicability to systems very different from ourselves, allowing them to be placed along a continuum from more to less conscious (Tononi & Koch 2015). Furthermore, the idea of beginning with minimal theoretical commitments and a very simple model is familiar from other sciences studying complex phenomena (Veit 2019a,b). Aided by the perceived link between complexity and consciousness, one may be forgiven for thinking that IIT provides us with a good starting point. Yet, instead of providing us with a simple and general framework that can be tested and improved, Merker, Williford, and Rudrauf convincingly argue that the entire framework is resistant to change and empirical progress, thus holding us back, rather than enabling us to move forward.

An additional problem of the theory is its failure to take evolutionary considerations on board; and this may be its greatest problem yet. Now, there is admittedly something deeply right about IIT. Of course, complexity matters! No one can deny that and the explicit acceptance of a gradualist model of consciousness seems to lend itself very well to evolutionary considerations (Veit & Huebner 2020). But it cannot *just* be a mere one-dimensional scale of information integration that matters for subjective experience. The biological world not only contains gradations but also varieties, and this should be part and parcel of a biological account of consciousness. The IIT simply asserts that it's their chosen measure of complexity that matters – more so that it's all that matters – but doesn't offer any compelling reasons why this should be so (Browning & Veit forthcoming). As Dan Dennett once said at the 2017 NYU Animal Consciousness conference: "Complexity

matters, but which complexity?" In order to determine which complexity *matters* for consciousness, we cannot avoid the teleonomic question of what consciousness is *for*. But this question has deliberately received very little attention within both the IIT framework and the science of (human) consciousness, despite the Darwinian insight that it's only once we address the function of a complex biological phenomenon that we can truly begin to understand it.

In an effort to begin with a minimal and theoretically neutral model, IIT deliberately avoids commitments to the evolutionary rationale of consciousness. But this silence on biological matters is ultimately the primary reason why the theory must be abandoned. From an evolutionary perspective we must focus on the complexity of a new biological mode of being (Browning & Veit 2021). This is why an investigation of consciousness as a *response to*, rather than a mere *product of* complexity ought to be how we can begin a true biological science of consciousness; one that emphasizes varieties and gradations instead of an all-or-nothing quality, as was advocated early on by Griffin (1976) and more recently by Godfrey-Smith (2019) in their emphasis on the different lifestyles of animals. Instead of asking for a neutral measure of complexity that constitutes consciousness, we deliberately ask for an evolutionary loaded sense of living complexity that makes consciousness *worth* having - this I shall refer to as 'pathological complexity': the complexity of an organism's life history (Veit 2021). Does that just replace one theoretically intractable notion of complexity with another? Not quite, since there already exists a science that has done the work for us. Pathological complexity can be operationalized as the computational complexity of the optimization problem studied by state-dependent or state-based behavioural and life history theory. It a biological measure of complexity that scales up alongside organism's degrees of freedom and that exploded during the Cambrian (Veit forthcoming). Based on this notion of evolutionary complexity, we can build an alternative framework for the study of consciousness on what I call the pathological complexity thesis:

Pathological Complexity Thesis:
The function of consciousness is to enable the agent to respond to pathological complexity.

Like the IIT, the pathological complexity thesis offers us a general theoretical framework and model for thinking about consciousness. As such, it will inevitably share some of the problems all theories at this level of generality are faced with. But it overcomes one central problem of the IIT: this is a sense of complexity that makes evolutionary *sense*. And it's this important feature that can serve as a scaffold for future bottom-up approaches that take Darwinian thinking seriously, emphasizing both gradations and varieties of subjective experience in animal life, and allowing us to make predictions about the phenomenological complexity of other animals – which can then feed back into our understanding of the pathological complexity they evolved to deal with.

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