Boundaries and borders gone! But life goes on

Abstract:

Unlike machines, living systems are distinguished by the continual destruction and regeneration of their boundaries and other components. Stable Markov blankets may be a real feature of the world, or they may be merely a construction of particular models, but they are neither a feature of organisms nor of any model that can capture the necessary conditions of their existence.

Main Text:

Suppose we took the view that fundamental reality is one great big Bayes net, decomposable into distinct units whose state is governed by local interactions that respect the causal Markov condition. Fristonite metaphysicians would not be the first to advance such a reduction – see Weslake (2006) for a critical review. Then, even if our partial models and their particular blankets are pragmatic constructions, there would still be a fact of the matter about where the *real* Markov blankets lie.

Unfortunately, as the authors note, we would end up with far more overlapping 'real Markov blankets' than we'd know what to do with. This seems problematic if they are to be treated as distinctive of living systems, and if we wish, as Kirchoff et al. (2019) apparently do, to "think about any system that possesses a Markov blanket as some rudimentary (or possibly sophisticated) 'agent'..." (p.2)

There is, however, a more significant problem than the promiscuous vitalism this entails. This is the fact, oddly neglected in the free energy literature, that living systems are specifically distinguished by their rare ability to persist through, and constitutive dependence upon, the continual destruction and regeneration of their boundaries.

In the free energy literature, the cellular membrane is taken as the canonical example of a biological agent's Markov blanket. Friston (2013, 2019) repeatedly contrasts this to the candle flame which cannot possess a Markov blanket "because its constituent particles are in constant flux." (p.50, 2019).

Yet the membrane's stability is illusory, its constituent parts being relentlessly exchanged through endo- and exocytosis for regeneration, growth, and particle transport. In the slime mold *Dictyostelium*, membrane turnover enables locomotion, with estimated times for complete turnover in the order of 4-10 minutes (Aguado-Velasco & Bretscher, 2017). The same goes for the interior of the cell, where we find turnover times for its enzymes, that are far shorter than the lifespan of the cell itself (Toyama & Hetzer, 2013).

A 'literalist' who treats the fundamental relata of causality as the states of particular token particles will find that the components of any 'real' Markov blanket they identify around an organism will dissipate on timescales shorter than that lifespan of the organism whose 'very existence', they claim, 'depends' on that boundary's preservation (Allen & Friston, 2018).

We don't have to take the states of specific particles as the nodes of reality's network. One's metaphysics of causality could be statistical reductionism, but where the relata are higher-level macrophysical variables (Papineau, 2013). In an organism, as in a machine, we could suggest that what must be fixed is not particular material components but the formal parts making up its functional organization. While it would seem less plausible to regard a set of formal parts as constituting a physical boundary *in the world*, this would be compatible with the realist position that the Markov blanket describes something objective *about the world*.

Still, the realist needs to explain how we identify this organization amid the constant turnover of the stuff that realises it, in order to then evaluate any statistical or causal relationships that might hold between its parts. Once we have done so, it's not clear what further the Markov blanket formalism offers beyond establishing a beachhead for the deployment of the free energy principle

The instrumentalist is in a slightly easier position, needing only to offer a pragmatic justification for dividing the world up in a particular way, and being free to admit that the represented stability of some network (and resulting Markov blanket) is a modelling distortion that abstracts away from material turnover, in order to focus on other features of the organism's dynamics.

This is fine if the purpose of our model is only to describe a specific behaviour, such as the regulation of body temperature. But if our model is supposed to provide the basis for a general theory of life, as Friston (2013, 2019) presents the FEF, then to acknowledge that it, like all models, is partial and distorted is not sufficient. The task of a model of 'life in general' is to highlight the *right* things, and neglect only those contingent features of the particular instances we happened to have encountered.

To abstract away from metabolic turnover is not merely to neglect some capacities common to many organisms, it is to fundamentally misconceive what an organism is, and what differentiates it from a mechanism. Unlike in machines the structures that constrain an organism's dynamics, its membrane, its enzymes, etc. are inherently unstable and recursively dependent upon those dynamics for continued repair and reproduction (Bickhard, 2009; Montévil & Mossio, 2015). The flow of matter is not just channelled *through* fixed constraints like fuel in an engine, it constitutes those constraints. In organisms, as Nicholson (2018) puts it, ‘everything flows.’

A statistical network and its attendant Markov blanket describe how a system’s structure constrains its dynamics, they do not address any reciprocal dependence of this structure upon those dynamics. Once Huygen’s coupled pendulums wind down, the connecting beam remains as a constraint on possible interactions should they be perturbed again.

Organisms are not just homeostatic mechanisms, ‘acting’ only in response to perturbation. They are intrinsically unstable structures – stabilised only via their own ceaseless activity and dependent upon the environment as a resource for such self-production. As Jonas (1953) criticized of the free energy framework’s cybernetic precursor, “A feedback mechanism may be going, or may be at rest: in either state the machine exists. The organism has to keep going, because to be going is its very existence” (p.191).

Markov blankets may be useful for modelling coupled feedback mechanisms. Such mechanisms may even *literally* have Markov blankets. But for a theory of living systems, the principal issue is not whether Markov blankets are features of reality, or just of our models. It’s that cells are much more like candle flames than they are like pendulums. While it may sometimes be convenient to treat an organism like a machine, this fiction obscures why the cell is alive, and the pendulum is not.

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