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Comment

Markov border crossings
Comment on "The Markov blanket trick: On the scope of the free energy principle and active inference" by Vicente Raja et al.

Ezequiel A. Di Paolo [a,b,c,*]

[a] *Ikerbasque, Basque Foundation for Science, Bizkaia, Spain*
[b] *IAS-Research Center for Life, Mind and Society, University of the Basque Country, Donostia, Spain*
[c] *Department of Informatics, University of Sussex, Brighton, UK*

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In 1962 W. Ross Ashby proposed a thought experiment. He suggested that a sufficiently large dynamical system evolving towards a steady state could serve to understand the adaptation of an organism to its environment. "Split the equilibrium in two," he wrote, "call one part 'organism' and the other part 'environment': you will find that this 'organism' is peculiarly able to survive against the disturbances from this 'environment.' " [1, p 272]. This image is evocative of the often neglected mutual influence between organisms and their environments, of their dynamic relation of co-dependence.

Ashby did not specify how the partition should be drawn. In fact, this was partly the point. His use of quotation marks attests to this. There are many ways to split such a system and, given a partition, it is still possible to arbitrarily select one part to play the role of 'organism' and the other part that of 'environment.' Because of this, Ashby's idea, while interesting, is biologically limited. It cannot capture any sense in which an organism might constitute itself or self-organize beyond the external decisions made by an observer. Life, in this picture, exists only in the eye of the beholder.

In their critical analysis of the role played by Markov blankets in the Free Energy Principle (FEP), Raja and colleagues [2] reach similar conclusions. They argue that Markov blankets are anything but uncontroversial ways of distinguishing an entity from its environment. Blanket states are more specific than Ashby's "splitting the equilibrium in two," but ultimately they suffer from a comparable problem of arbitrariness. Depending on the case, the choice of where to draw a blanket is *ad hoc* as long as one can identify suitable states fulfilling the requirement of conditional independence between states at each side of the partition. The choice seems to rely on assuming information about the case of interest that the formalism is supposed to provide, the authors argue.

In the biological case, Markov blankets are too weak in their blindness to constitutive aspects of what counts as an organism. As with Ashby's thought experiment, even with a reasonably drawn Markov blanket, we still have a choice about which half of the steady state to call the 'organism' and which half the 'environment.' This indeterminacy,

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* Correspondence to: Ikerbasque, Basque Foundation for Science, Bizkaia, Spain.
E-mail address: ezequiel.dipaolo@ehu.es.

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speedily resolved by the convenient labelling of the various states (see Figure 2 and equations 6 in [2]), seems odd for a theory meant to shed light on what a living system is.

Simultaneously, Markov blankets are too strong to account for the way the internal states of an organism are often directly affected by external states without any statistical mediation or loss of integrity, as anyone who's ever been tipsy after a few beers or felt dizzy from heat exhaustion can verify (see [3]).

Determining why a thing is what it is and nothing else (when this is actually the case, which isn't at all obvious in processes of becoming) or why it is distinct from its environment (if in fact it is) seems like too heavy ontological lifting for relatively straightforward statistical relations of conditional independence. Raja et al. suggest that the reason for using Markov blankets is more historical than principled and may have to do with the fact that they lead seamlessly to the structure required to provide a Bayesian inference account. Had other tools been used instead, maybe the implications would have been different. For this reason, the authors find the justification for using Markov blankets wanting, and the seeming inevitability of active inference derived with their help, illusory: A Markov blanket trick.

Raja et al. note two important aspects of biological and cognitive systems that are hard to capture using the Markov blanket formalism: relational features and constitutive self-organization. Relational features are part and parcel of all sense-making, as in action selection or perceptual discrimination. The authors mention the case of affordances such as 'climbability' and relational variables such as heading during locomotion. These relations between states, some of which cross the Markov blanket, seem hard to capture by internal variables. Hard but not impossible. The authors admit the possibility of internal states tracking relational features such as heading or affordances, but suggest that this would amount to multiplying entities unnecessarily since the relations are already present without any need for internal duplication.

While I agree with the authors' dissatisfaction concerning relational features, I do not find it surprising that ultimately there is a valid response within the FEP framework to this worry, namely the internal modelling of such relational features. This solution confirms that active inference is ultimately to be interpreted always in representational terms. Enactivists and ecological psychologists would agree with the authors about the wastefulness of representing what oftentimes is so directly available. Lack of economy, however, is not the same as inconsistency.

In contrast, cases in which relational features can be shown to play a *direct* operational role in the realization of cognitive activity are a different story. These are indeed outside the remit of the FEP because relations in these cases affect performance *without mediation*, i.e., as further examples of Markov border crossing. Take for instance walking downhill on a road with a gentle slope. The relation between the body and the slope modifies the dynamics of the walking pattern so as to constitute a particular gait that is different from walking on a horizontal plane. This need not be modelled internally; the body simply falls into this different attractor pattern. In fact, passive dynamic walkers, long studied in robotics, walk rather naturally down such slopes (e.g., [4]). The activity of walking is realized without any internal control (these machines have no internal state at all), lending plausibility to the notion that similar soft couplings between brain, body, and environment are at play more generally. Birds soaring or rising with the help of updrafts are another example. In such instances, relational features are operative participants in the realization of the activity itself. For enactivists and ecological psychologists the point extends to all kinds of biological and cognitive activity. Even if this generalization is not accepted by FEP defenders, the direct involvement of relational features in realizing sense-making is, in cases such as the above, hard to deny.

Concerning constitutive self-organization, as the authors argue, the FEP conditions do not specify relations of material production among components of a system. If we assume that metabolism is an inescapable aspect of all living systems, this a significant omission. Organisms self-produce and self-distinguish as active, ongoing processes undergoing all kinds of historical change (ontogenesis, learning, lifetime development, aging, and so on; see [3]). As with the case of relational properties, it may still be possible for FEP defenders to entrench in a position that ultimately makes no claims about the specificity of biological *things* except the general expectations that may be derived from their being *things* (if and when the right conditions are met). Again, this would be a self-consistent position, if a rather defeatist one for a principle claiming to explain biological phenomena.

But I believe the importance of the authors' insistence on this point lies elsewhere. Constitutive self-organization is an index of the ambiguous relation between the concept of *constitution* and the concept of *interaction*. It is precisely what is at stake in postulating boundaries between organisms and their environments. Typically—the FEP is no exception—an ontological order is presupposed between these ideas. After all, one must already be a constituted entity before entering into interactions, right? In fact, this is not quite true, at least not in biological or cognitive systems where interactions participate in processes of self-production and self-distinction both in metabolism and in complex

forms of agency [5]. Interaction and constitution, both ongoing and materially overlapping processes, are not only mutually related; they interpenetrate in dialectical fashion without wholly losing their difference.

A theory of biological boundaries as flexible, adaptable, and transmutable processes is still missing in current accounts of life and mind. Markov blankets, they don't quite do the trick.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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