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Failing to trace the causal and constitutive chains in Complex systems as a unificatory criterion for diachronic and synchronic emergence

In this paper, I put forward a benchmark account of emergence, which proves to be faithful to the mainstream classical and contemporary construals of the concept, and explicate the relationship that exists between its synchronic and diachronic declinations. The account of emergence I develop is the following:

- Emergence is a relation between an emergent **E** and its emergence basis **B** such that (a) **E** is ontologically determined by **B**, and (b) it is not possible, as a matter of principle, to trace the determinative chain that goes from **B** to **E** (or, put differently, it is not possible, as a matter of principle, to provide a complete and adequate account of the successive relations of determination that lead from **B** to **E**).

On this basis, I explicate the synchronic and diachronic facets of emergence by interpreting theses (a) and (b) in a synchronic constitutional and a diachronic causal way, respectively, as follows¹:

- Synchronic emergence is a relation between an emergent **E** and its emergence basis **B** such that (a) **E** is constitutively determined by **B**, and (b) it is not possible, as a matter of principle, to trace the constitutive chain that goes from **B** to **E** (or, to operationalize this last criterion, it is not possible to constitutively explain **E** from **B**);
- Diachronic emergence is a relation between an emergent **E** and its emergence basis **B** such that (a) **E** is causally determined by **B**, and (b) it is not possible, as a matter of principle, to

¹ The notions of constitutive and etiological explanations that are invoked here are coming from Salmon (1984, pp. 269-270).

trace the causal chain that goes from B to E (or, it is not possible to etiologically explain E from B).

I then develop a threefold argument devoted to showing that we have good reasons to believe that synchronic emergence entails diachronic emergence, and vice versa. The steps of the argument I put forward are the following:

- (1) Synchronic emergence is also necessarily diachronic emergence, except if one is committed to a thesis T_1 that I refer to as fixist parallelism;
- (2) Diachronic emergence is also necessarily synchronic emergence, except if one is committed to two theses T_2 and T_3 that I refer to as micro-physical epistemic indeterminism and higher-level epistemic indeterminism, respectively;
- (3) I provide reasons to suspect that T_1 , T_2 and T_3 are either false or controversial.

As a result, there are no good reasons to believe that there is anything in the natural world that may count either as purely synchronic emergence or purely diachronic emergence. Put differently, the benchmark account of emergence I propose is a “two-faceted” notion, i.e. it always encapsulates both synchronic and diachronic dimensions.

Finally, I compare this account of emergence – referred to, for the sake of simplicity, as e-emergence (“e” standing for “explanation”) – with alternative recent accounts that characterize (diachronic) emergence in terms of unpredictability (e.g. Stephan, 1999 [in the context of chaos theory]; or Humphreys, 2008 [in the context of computational science]) and topological non-equivalence (e.g. McGivern & Rueger, 2010 [in the context of classical physics]).

As far as the first account – called here p-emergence; “p” standing for “prediction” – is concerned, I show that it has a larger extension than e-emergence, insofar as there exist phenomena that may be unpredictable but yet completely (etiologically) explainable. This proceeds from the fact that the criterion of unpredictability is more restrictive than the one of etiological unexplainability or causal traceability, for being able to predict “what comes next” in the evolution of a given system is more demanding. that being able to explain “why such-and-such has finally come next”. Indeed, the former epistemic task requires a cognitive agent

to do something harder than the latter does, namely to perform her task more rapidly than the very evolution of the system under study. I also address the question of the historical origin of the p-emergence tradition. In this respect, I formulate and vindicate the hypothesis that, while e-emergence captures the original and mainstream technical sense of the concept – which has been put forward, for example, by British Emergentists in the beginning of the 20th century –, p-emergence originally arose around the 1990s, in the context of complexity science, as a conflation of this technical sense with the vernacular or colloquial sense of the concept, which conveys an idea of unexpectedness.

With regard to Rueger's more recent and idiosyncratic account of (diachronic emergence) – referred to as t-emergence; "t" standing for "topological" –, I emphasize two main points. First, and by putting it somewhat bluntly, I show that t-emergence simply turns out to be at right angle with both e- and p-emergences. Second and more generally, I identify some odd features of t-emergence – namely that (i) it is a formal relation within a state-phase representation that has no empirical enforcer in the natural world; (ii) it is not the emergence basis, but an extrinsic mechanism, that brings about the emergent; and (iii) the relationship between a putative t-emergent and its base is thoroughly symmetric – that lead to suspect that, fundamentally, it is simply not emergence at all. Ultimately, the whole analysis that is put forward in this paper allows to shed some light on the otherwise somewhat confused situation that surrounds the epistemology and metaphysics of complex systems, especially when it comes to issues like causation, constitution, explanation and prediction.

References

- [1] Humphreys, P. (2008). Synchronic and Diachronic Emergence. *Minds & Machines*, 18, 431 – 442.
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- [3] Salmon, W.C. (1984). *Scientific Explanation and the Causal Structure of the World*. Princeton: Princeton University Press.
- [4] Stephan, A. (1999). Varieties of Emergentism. *Evolution and Cognition*, 5, 49 – 59.