Qeios

Peer Review

Review of: "Aging as Cybernetic Attractor Decay: Beyond the Stochastic–Programmed Dichotomy"

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Certainly, recognizing the lack of necessity to choose one of the two mechanisms under consideration and allowing for their simultaneous influence on the phenomena under discussion is very valuable, and this thesis alone is sufficient to consider the article necessary and worthy of publication.

I am concerned about the rather simple understanding of *non-deterministic stochastic accumulation patterns,* which could lead to misunderstanding. It seems that this assumed understanding underlies the main statement: *aging arises from quasi-programmed processes, developmentally structured computational systems whose decline follows predictable trajectories, rather than from purely random damage accumulation.* It is good that this is tempered by the term *pure stochasticity* or *purely random*. It is difficult to assume that every possible damage has an equal probability of occurrence (before the possible action of a pre-prepared repair mechanism, which, if it exists, also has different effectiveness). These inhomogeneities underlie the existence of these equilibrium locations. I believe the author considers these 'repair mechanisms' to be deterministic, and the occurrence of damage itself to be *nondeterministic stochastic* events, but ignores the differences (from a flat distribution) in their probability distributions that I expected. These heterogeneities in distributions, especially of 'failures,' are controlled by natural selection, which allows us to expect equilibrium points, not points contrary to equilibrium. This is also the reason why repair mechanisms exist to restore equilibrium. It would be good if these terms *'purely'* were explicitly linked to a flat distribution, if, of course, that is the author's intention.

Despite this perhaps inaccurate objection, the conclusion: *This interpretation transcends classical frameworks and points toward a broader principle: understanding life history requires focusing on developmental architectures and their "intrinsic constraints and drivers", not merely on trait-by-trait optimization through Darwinian natural selection.* remains valid, and its formulation is correct. However, I

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am sensitive to the possibility of misunderstanding this conclusion, that what 'we should focus on' is not the result of Darwinian selection. Because it clearly is, although it concerns deeper relationships, not simple traits reacting with the environment. Perhaps it would be worth clearly excluding this possibility of misinterpretation, as I encounter a tendency towards such overinterpretations in the literature.

I am also not certain that Weismann repudiated his first proposal, considering it his mistake, and accepted the second as the only correct one. I won't investigate this myself, but the author's suggestion seems dubious to me. I rather suspect the source of this view lies in the simplifications of Weismann's readers. He may have treated both mechanisms as coexisting. I would suggest adding a basis for the existence of this surprising change of view.

"Aging," as I expect the author understands it, concerns multicellular organisms that reproduce sexually. This understanding is somewhat undermined by the statement: *a developmental program that previously operated for billions of years.* What developmental program are we talking about here, when multicellular organisms have existed for a shorter time?

It's unclear to me how to understand the crucial phrase: *computational decay follows predictable trajectories determined by "network topology and energy constraints", not because aging is "programmed."* To me, both alternatives presented here are *programmed.* Perhaps the point was that *decay* is purposeless, and *programmed aging* means that aging is the goal of this program. This distinction is unfounded – selection leaves an effect if it can. If the lifespan factor influences the selection decision (here, it could be only the less-regarded group selection), then it is taken into account regardless of what factors in the organism and its development determine that lifespan. *Decay* has some variable parameters, and these can be selected in this way by selection; then it is *programmed aging*. This formulation therefore requires defense against an understanding such as mine. **In summary:** I consider this article valuable, providing a significantly deeper look at the mechanisms of aging. This conclusion may be partially consistent with my own views presented in my publications, but I have tried not to make it dependent on my own perspective in this review. However, this may not be entirely possible. There are many details here that I would like to engage in a substantive discussion about, but that is not the basis for this assessment.

Declarations

Potential competing interests: No potential competing interests to declare.