Qeios

Peer Review

Review of: "Integrating Biological Principles into Observational Entropy"

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Overview:

The author aims to present a perspective on integrating observer-dependent information with the concept of “knowledge” to achieve a comprehensive understanding of the adaptation of living systems. The concept of information is controversial, and many efforts have been made to address this issue. However, a complete theory that unifies its quantitative and qualitative (meaning) aspects has not yet been developed. I appreciate the author tackling this challenging topic in this article.

Still, I found several issues that should be addressed in a revised version, including the paper’s structure, its conceptual vagueness, and confusion. I suggest these points for the author to consider when revising the article to enhance its quality as a perspective-oriented review.

Structure:

The article includes sections titled Introduction, Methods, Results, and Discussion, which feels awkward for a review article focused on a conceptual analysis. In the introduction, the author should clearly state the background and the specific problems to be addressed. The introduction should also outline the background, problems, and the goal, as these aspects are unclear to the reader. The ‘Methods’ section should be renamed to reflect its purpose better. The author should outline a strategy for addressing the problems in relation to the goal, define relevant terminology, and provide the conceptual tools necessary for analysis.

Conceptual vagueness and confusion:

As a researcher working in information and entropy in living systems, I believe there is conceptual vagueness and confusion in the article, which I suggest the author consider:

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(1) Entropy is mathematically defined in terms of probability. Probability is a quantity. In the subjective interpretation of probability, it represents the degree of certainty about the occurrence of an event, which is epistemic (subjective, observation-dependent). In the objective interpretation, probability indicates an objective property of event occurrence, such as the relative frequency of event occurrence, or the propensity of a system to yield that frequency. Depending on the interpretation of probability, entropy can also be subjective or objective. The subjective entropy represents the "uncertainty" of event occurrence, whereas the objective entropy represents the "disorder" of a system. Observational entropy corresponds to the subjective interpretation of entropy.

My suggestion: the author should make it clear about the following point: In biology, objective entropy based on relative frequency (which does not depend on observers) is also important for representing the order (pattern or organization) of living systems. Both concepts are needed for a comprehensive framework.

(2) Information is traditionally theorized as the quantity (amount) of information, as in Shannon's theory. Here, "information" can be understood as "distinction," and the amount of information indicates the amount of "distinctions" to determine (choose) one among many options; messages are simply items that can be distinguished from one another, and their meaning content is ignored in this framework (Warren Weaver clearly states this in "Mathematical theory of communication"; similarly, Gregory Bateson states that information is a difference that makes a difference, which also highlights the "distinction" aspect of information and excludes meaning). The amount of information is the amount of distinctions, represented as the entropy value (before observation [epistemic, subjective] or interaction [ontic, objective]) minus the entropy value (after it). Here, information is a quantity that indicates the reduction of entropy. The qualitative (meaning) aspect of information focuses on the "specification" of one in relation to others. For example, signals or signs indicate something different that can occur in a correlated manner. This might correspond to "knowledge" that the author calls in the article.

My suggestion: the author should make it clearer by providing explicit models or definitions of concepts, such as information, the amount of information, and knowing (knowledge). For example, "amount of knowledge" (in Discussion) is conceptually confusing. I think the author should use another word instead of "amount." Also, "information signals" (in Discussion) might not be an issue in everyday discussion; however, this phrase is unclear in relation to other related concepts discussed in this article. Words should be used very carefully.

(3) Regarding the concept of the observer, there are two types: external and internal. When a living system is considered an observer, it is an internal observer that physically interacts with other biotic and abiotic entities. In this case, entropy—whether epistemic or ontic—may be influenced by interactions between the observer and other components of the system. When a scientist observes a system from outside, they are an external observer.

My suggestion: the author should make the observer's stance (internal/external) more transparent.

Finally, my comments are based on my work that is closely related to the issue discussed in this Qeios article; if you are unclear about the details of my suggestions, please refer to my publications, which also provide explicit models as examples: Probability in Biology (doi.org/10.1016/j.pbiomolbio.2013.03.007), "Unification of Epistemic and Ontic Concepts of Information, Probability, and Entropy, Using Cognizers-System Model" (doi.org/10.3390/e21020216).

Declarations

Potential competing interests: No potential competing interests to declare.