

Review of: "Growing Confidence and Remaining Uncertainty About Animal Consciousness"

Tadeu Souza¹

¹ Universidade Federal do Rio Grande do Sul

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The paper discusses critical elements of consciousness in various animal species, including invertebrates, and presents a thought-provoking argument on the topic. Overall, the article is well-structured and presents a coherent narrative. However, I would like to suggest a few improvements to enhance the clarity and substantiation of the author's viewpoint.

Firstly, the abstract could be further improved by including a brief clarification of the overall intention or objective of the paper. This would help readers understand the main focus and significance of the research. Furthermore, while the authors convey their perspective on the existence of consciousness in invertebrates, it would be valuable to acknowledge that their viewpoint represents a hypothesis. Expressions like "in our opinion," "as we hypothesized," or "we believe" can be utilized to make this distinction. Additionally, the inclusion of empirical studies demonstrating the prevalence of neuroscientists who believe in the existence of consciousness in other animals, mainly invertebrates, would strengthen the author's position. An example of such a study can be found in the case of fishes (Lambert et al., 2022).

Equating consciousness with subjective experience may weaken the argument for its existence in invertebrates and some vertebrates. This criticism is introduced in Mello e Souza (2022), discussed by LeDoux *et al* (2017), and defended by Dehaene et al (Science, 2017), who argue that consciousness requires global availability. I believe that explicitly emphasizing this criticism in the article will strengthen the article and provide a more balanced perspective without

Additionally, the sentence "While conceding once again that a full account of animal consciousness entails more than the neural processes that give rise to it, no one doubts that neural processes are a necessary part of the account" seems to be highly dualistic. Therefore, it would be beneficial to acknowledge that this is an opinion and, if necessary, to provide examples of other accounts that contribute to consciousness.

In conclusion, I commend the authors for their commendable writing and persuasive argumentation. The article sheds light on the intriguing topic of consciousness in animals and encourages readers to engage in further reflection and exploration. While a few improvements can enhance the clarity and substantiation of the author's viewpoint, the overall quality of the writing and the strength of the argumentation are indeed admirable.

Please consider my suggestions for the article's improvement. Thank you for considering my review, and I look forward to seeing the revised version.

Sincerely

Major points

Define phenomenal consciousness before listing its features.

The abstract could be further improved by including a brief clarification of the overall intention or objective of the paper.

Equating consciousness with subjective experience may weaken the argument for its existence in invertebrates and some vertebrates. This criticism is contextualized by Mello e Souza (<https://doi.org/10.1016/j.neuroscience.2022.03.015>) and discussed by LeDoux et al (Proc Natl Acad Sci U S A, 2017;**114**(10): p. E2016-E2025), and defended by Dehaene et al (Science, 2017, 358(6362): p. 486-492), who argue that consciousness requires global availability. I believe that discussing this criticism in one paragraph will strengthen the article and provide a more balanced perspective. The article only mentions it in "A reasonable assumption is that the agency of consciousness — the 'witness' to the relevant neural processes — is itself a specific neural process." Therefore, consciousness might arise later in evolution. This reinforces my criticism mentioned before."

The sentence "While conceding once again that a full account of animal consciousness entails more than the neural processes that give rise to it, no one doubts that neural processes are a necessary part of the account" is highly dualistic. It would be beneficial to acknowledge that this is an opinion and cite other accounts that contribute to consciousness.

Minor points

Expressions like "in our opinion," "as we hypothesized," or "we believe" in the sentences below:

"By the time arthropods became a dominant feature of the Cambrian seascape, however, neural complexity had advanced to the level of hierarchical organization deemed necessary for consciousness; so some form of consciousness has likely existed for close to half a billion years (Feinberg and Mallatt, 2016)."

"Broad agreement in principle has been reached among neuroscientific researchers concerning the definitional outlines of primary (sensory) consciousness and the ontological features of phenomenal experience across the animal kingdom"

Include empirical studies demonstrating the prevalence of neuroscientists who believe in the existence of consciousness in invertebrates would support the sentence "Broad agreement in principle has been reached among neuroscientific researchers concerning the definitional outlines ...". An example of such a study can be found in the case of vertebrates (see <https://www.mdpi.com/2076-2615/12/9/1182>).

"Might" is more adequate than "may" in "The earliest vertebrates probably had concentrated sensory centers in their midbrains, hence consciousness may have been mediated by the midbrain in that group (Lacalli, 2018)."

Correct the sentence "Animal evolution produced... subjectivity and agency."

Is Butler and Hodos (1996c) the reference for "The complexity and details of these connections vary across the different

vertebrate classes, with amniotes (...) to sensory input and motor output"?

This paragraph seems to require a sentence or two to be complete: "A reasonable assumption is that the agency of consciousness — the 'witness' to the relevant neural processes — is itself a specific neural process. (...) Metaphorically, at least, a screening room (Cartesian Theater) in which or by which such a process takes place may be a fit analogy."

References

Dehaene et al., *Science*, 2017, 358(6362): p. 486-492

Lambert et al., *Animals* **2022**, 12(9), 1182

LeDoux et al *Proc Natl Acad Sci U S A*, 2017.**114**(10): p. E2016-E2025

Mello e Souza *Neuroscience* 497 (2022) 14–29