

This short statement was intended as a 'Letter to the Editor' -type of article, with the general public as the intended audience. Following feedback from the community we are currently in the process of revising and expanding it into a longer article that will flesh out the rationale behind the letter; this is not the final version.

The Integrated Information Theory of Consciousness as Pseudoscience

The media, including news articles in both *Nature* and *Science*, have recently celebrated the Integrated Information Theory (IIT) as a 'leading' and empirically tested theory of consciousness¹⁻⁵. We are writing as researchers with some relevant expertise to express our concerns.

The media coverage sprang from a public event where the authors of a large-scale adversarial collaboration shared their findings, which were reported as empirically testing and partially supporting IIT¹⁻⁵. This message was communicated directly to journalists and the general public prior to the preprint being available^{1,2}, and hence, prior to peer-review. The experiments seem very skillfully executed by a large group of trainees across different labs. However, by design the studies only tested some idiosyncratic predictions made by certain theorists, which are not really logically related to the core ideas of IIT^{3,6,7}, as one of the authors himself also acknowledges⁸. The findings therefore do not support the claims that the theory itself was actually meaningfully tested, or that it holds a 'dominant', 'well-established', or 'leading' status^{1-5,8}. This important nuance was unfortunately lost in the media coverage¹⁻⁵. These claims of dominance have also been questioned in the scientific community⁹⁻¹¹, yet they have been repeatedly broadcast to the public by proponents of IIT over the years^{6,8,12-16}.

IIT is an ambitious theory, but some scientists have labeled it as pseudoscience^{15,16}. According to IIT, an inactive grid of connected logic gates that are not performing any useful computation can be conscious—possibly even more so than humans¹⁷; organoids created out of petri-dishes, as well as human fetuses at very early stages of development, are likely conscious according to the theory^{18,19}; on some interpretations, even plants may be conscious²⁰. These claims have been widely considered untestable, unscientific, 'magicalist', or a 'departure from science as we know it'^{15,21-27}. Given its panpsychist commitments, until the theory as a whole—not just some hand-picked auxiliary components trivially shared by many others or already known to be true²⁸⁻³¹—is empirically testable, we feel that the pseudoscience label should indeed apply. Regrettably, given the recent events and heightened public interest, it has become especially necessary to rectify this matter.

If IIT is either proven *or perceived by the public as such*, it will not only have a direct impact on clinical practice concerning coma patients³², but also a wide array of ethical issues ranging from current debates on AI sentience¹³ and its regulation, to stem cell research, animal and organoid testing¹⁸, and abortion¹⁹. Our consensus is not that IIT and its variants decidedly lack intellectual merit²². But with so much at stake, it is essential to provide a fair and truthful perspective on the status of the theory. As researchers, we have a duty to protect the public from scientific misinformation.

Therefore, we hope to make clear that despite its significant media attention, IIT requires meaningful empirical tests before being heralded as a ‘leading’ or ‘well-established’ theory. Its idiosyncratic claims and potentially far-reaching ethical implications necessitate a measured representation.

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A draft of this letter was initially produced together by the first 10 listed authors (from Fleming to Slagter). They are listed in alphabetical order of their last names within the first 10 positions. For other co-authors who joined after the draft was already written, their authorship order is also listed in alphabetical order, independently from the first 10 listed authors.

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References

1. Finkel, E. Consciousness hunt yields results but not clarity. *Science* **380**, 1309–1310 (2023).
2. Lenharo, M. Decades-long bet on consciousness ends - and it's philosopher 1, neuroscientist 0. *Nature* **619**, 14–15 (2023).
3. Seth, A. Finding the Neural Correlates of Consciousness Is Still a Good Bet. *Nautilus* (2023).
4. Thousands of species of animals probably have consciousness. *The Economist* (2023).
5. Zimmer, C. 2 Leading Theories of Consciousness Square Off. *The New York Times* (2023).
6. Reardon, S. 'Outlandish' competition seeks the brain's source of consciousness. *Science* (2019) doi:10.1126/science.aaz8800.
7. Lau, H. Where is the 'posterior hot zone'? Open Review of Ferrante et al (2023): 'An Adversarial Collaboration to Critically Evaluate Theories of Consciousness' (by the ARC-Cogitate Consortium). *PsyArXiv* (2023) doi:10.31234/osf.io/93ufe.
8. Cogitate Consortium et al. An adversarial collaboration to critically evaluate theories of

- consciousness. *bioRxiv* 2023.06.23.546249 (2023) doi:10.1101/2023.06.23.546249.
9. Michel, M. *et al.* An Informal Internet Survey on the Current State of Consciousness Science. *Front. Psychol.* **9**, 2134 (2018).
 10. Yeung, A. W. K., Cushing, C. A. & Lee, A. L. F. A bibliometric evaluation of the impact of theories of consciousness in academia and on social media. *Conscious. Cogn.* **100**, 103296 (2022).
 11. Francken, J. C. *et al.* An academic survey on theoretical foundations, common assumptions and the current state of consciousness science. *Neurosci Conscious* **2022**, niac011 (2022).
 12. Zimmer, C. Sizing Up Consciousness by Its Bits. *The New York Times* (2010).
 13. Koch, C. Will Machines Ever Become Conscious? *Scientific American* (2019) doi:10.1038/scientificamerican1219-46.
 14. Koch, C. Is Consciousness Universal? *Scientific American* (2014) doi:10.1038/scientificamericanmind0114-26.
 15. Jarrett, C. Consciousness: how can we solve the greatest mystery in science? *BBC Science Focus Magazine* <https://www.sciencefocus.com/the-human-body/consciousness-how-can-we-solve-the-greatest-mystery-in-science/> (2020).
 16. Wilson, K. Cracking consciousness: how do our minds really work? *The Spectator* (2022).
 17. Aaronson, S. Why I Am Not An Integrated Information Theorist (or, The Unconscious Expander). *Shtetl-Optimized* <https://scottaaronson.blog/?p=1799> (2014).
 18. Jeziorski, J. *et al.* Brain organoids, consciousness, ethics and moral status. *Semin. Cell Dev. Biol.* **144**, 97–102 (2023).
 19. Frohlich, J. *et al.* Not with a ‘zap’ but with a ‘beep’: Measuring the origins of perinatal experience. *Neuroimage* **273**, 120057 (2023).
 20. Trewas, A. Awareness and integrated information theory identify plant meristems as sites of conscious activity. *Protoplasma* **258**, 673–679 (2021).
 21. Michel, M. *et al.* Opportunities and challenges for a maturing science of consciousness. *Nat Hum Behav* **3**, 104–107 (2019).
 22. Michel, M. & Lau, H. On the dangers of conflating strong and weak versions of a theory of consciousness. *Philosophy and the Mind Sciences* (2020).
 23. Open letter to NIH on Neuroethics Roadmap (BRAIN initiative), signed by dozens of scientists. <http://inconsciousnesswetrust.blogspot.com/2020/05/open-letter-to-nih-on-neuroethics.html> (2019).
 24. Doerig, A., Schurger, A., Hess, K. & Herzog, M. H. The unfolding argument: Why IIT and other causal structure theories cannot explain consciousness. *Conscious. Cogn.* **72**, 49–59 (2019).
 25. Merker, B., Williford, K. & Rudrauf, D. The integrated information theory of consciousness: A case of mistaken identity. *Behav. Brain Sci.* **45**, e41 (2021).
 26. Hanson, J. R. & Walker, S. I. Formalizing falsification for theories of consciousness across computational hierarchies. *Neurosci Conscious* **2021**, niab014 (2021).
 27. Hanson, J. R. & Walker, S. I. On the non-uniqueness problem in integrated information theory. *Neurosci Conscious* **2023**, niad014 (2023).
 28. Malach, R. Local neuronal relational structures underlying the contents of human conscious experience. *Neurosci Conscious* **2021**, niab028 (2021).
 29. Block, N. Perceptual consciousness overflows cognitive access. *Trends Cogn. Sci.* **15**, 567–575 (2011).
 30. Lamme, V. A. F. Why visual attention and awareness are different. *Trends Cogn. Sci.* **7**, 12–18 (2003).
 31. Zeki, S. The disunity of consciousness. *Trends Cogn. Sci.* **7**, 214–218 (2003).
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