

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

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Louis Irwin has written a carefully researched and expertly written scholarly article about human consciousness. His paper eloquently differentiates the different definitions and meanings that have been attributed to the word 'consciousness'. In terms of quality and rigor, I give Dr. Irwin's paper the highest marks. It should by all means be published.

I will follow with some thoughts that the conclusion to this wonderful paper has inspired. I don't mean them to be critical of the theories reviewed. Rather, I will try to provide a summary of explanations and theories that I have been developing that I believe are not covered and which might provide food for the reader's thought.

I will focus my comments on the very last section of the paper, which summarizes the three aspects needed for a comprehensive understanding of how animals generate consciousness.

- THE FIRST is the mechanism by which animals create phenomenological experience.
 - I have argued that the mechanism is rarely defined precisely. I argue that there are two types of mechanisms that must be addressed regarding experience and behavior. The first is **learning mechanism**, which I argue has ignored the most highly conserved learning mechanism in the animal world (doi: 10.1016/j.earlhumdev.2020.105183). The second is the highly conserved ANS **signaling pathway mechanism** to the heart that I argue accounts for all emotional behavior and motivation (doi: 10.3389/fpsyg.2022.841207). I argue that Western science started with Descartes' assumption that consciousness is tied to cognition. I posit that almost all theories on emotions and consciousness are psychobiological and therefore in one way or another rest upon this assumption. My theory starts with a fundamentally different assumption. It holds that emotional physiology and behavior is driven by the autonomic socioemotional reflex (ASR) mechanisms that develop during gestation. The ASR mediates the mother-infant relationship and determines how the two react to one another during close physical contact.
 - Key to the emotional connection theory is that mammalian consciousness is tied to the 'other'. Emotions are not only self-regulated by the brain (which they are). More primally, emotions and consciousness are dependent upon emotional connection to another at the ANS level. For instance, orphanage studies support this idea. Babies that are not held or touched, termed failure to thrive, often die. This argument, of course, raises the ontological question of which comes first, consciousness or emotional connection.
- THE SECOND is the gap between the phenomenological experience of consciousness and its neurological correlates remains controversial

- Here, I would point out again that all traditional fields of science that deal with consciousness have prioritized the neurological correlates of the CNS. The gap between the CNS (brain) and ANS (heart) is, I argue, more immense than imagined. The controversy, in my opinion, should be broadened to include theories and ideas that have been for the past 500 years since Descartes deemed heretical or unimaginable.
- Our research group at Columbia University Medical Center has extensively studied preterm infant EEG. We have shown that Family Nurture Intervention, which facilitates mother-infant autonomic emotional connection, performed by mothers for an average of 6 weeks in the NICU, normalized brain function (doi: 10.1126/scitranslmed.abq4786). Our paper on consciousness offers a theory on how the ANS influences the CNS (doi: 10.1371/journal.pone.).
- THIRD is the agency of consciousness — the ‘witness’ to the neural processes that give rise to phenomenological experience, as opposed to all the other neural activity that simultaneously remains unconscious — has not been determined for humans, much less for any other animal.
 - I agree with this statement most whole-“heartedly,” pun intended. My argument is that science needs to reconsider its current brain-centric perspective (especially the Cartesian Theater mentioned) on emotions and consciousness. Similar to Copernicus, who argued that the Sun is the center of our solar system, I argue that our two nervous systems are misnamed. The ANS, having evolved from the cell’s inside tissue (endoderm), should actually be seen as ‘central’ to consciousness - and the CNS, having evolved from the cell’s outside tissue (ectoderm), should be viewed as ‘peripheral’.

In conclusion, I congratulate Dr. Erwin on this very important paper, and I look forward to reading more of his papers.