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## Of course crustaceans are sentient: But there's more to the story

Commentary on [Crump et al](#) on *Decapod Sentience*

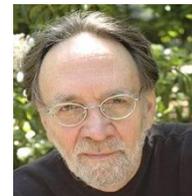
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**Abstract:** We are in basic agreement with Crump et al. that animal welfare, particularly with regard to the experience of pain, is a topic of importance. However, we come to the issue from a different perspective, one in which all species are sentient and can feel pain. The implications of this theory are discussed.

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According to our theory (dubbed the Cellular Basis of Consciousness [CBC] by Reber, 2019), all crustaceans are, of course, sentient, and all feel pain, because *all* organisms are sentient and all have valenced (positive/negative) experiences. This theory has been developed in a series of recent papers (e.g., Baluska et al. 2022; Reber & Baluška, 2020). Recognizing that all living organisms are sentient resolves many of the issues that Crump et al's target article struggles with. It also, of course, creates new issues, like working out the underlying biomolecular processes and structures that cause sentience in living cells (see Baluška et al. 2021).

Crump et al. begin at the usual place, in fact, the only place available, given their overall approach. They work to identify the circumstances under which they can conclude that a species is sentient. The path they take is the one that virtually everyone takes. They start with human consciousness, human experience, human mental life, and work back through the evolutionary tree looking for data suggesting that whatever species they're focusing on is also sentient. In our

review of this literature we've encountered research programs that focus on, among others, insects (Klein & Barron, 2016), corvids (Nieder, et al., 2020), and cephalopods (Birch, et al., 2021). They invariably find sentience for the simplest of reasons: It was there all along.

Crump et al. do note that: "The international scientific community increasingly recognises sentience in at least some invertebrates." This is true, and the various researchers they cite concur. If one looks at a different subset of the "international scientific community," however -- cell and plant biologists -- the concurrence will dovetail on the unicellular species, the prokaryotes and protists. There are good reasons why Lynn Margulis (2021) titled one of her more important papers "The conscious cell" and why biologist Pamela Lyon, in her 2015 review of the literature, used the even more provocative title, "The cognitive cell."

Crump et al. present a nice coverage of the data base but it's from their particular point of view, which necessarily focuses and relies ".on behavioural and cognitive markers, coupled with our knowledge about the animal's nervous system." We think this is a mistake, a common one. Crump et al., Like many others, begin with a common assumption that a nervous system is needed for sentience. This is a claim without support. We have yet to see any convincing evidence that it is true. Or any principled reason why it should be. Yes, mental functioning changed when neurons evolved, and, yes, there are many properties of a sentient nature that emerged with neural circuits and brains; but consciousness and cognition were there before. The novel functions and processes were simply building upon the existing mental world of the species that came earlier. Many evolutionary innovations made important changes over geological time: photosynthesis, respiration, warm-blooded metabolism, action potentials, legs. A nervous system is, of course, one of the more important innovations, but it didn't cause sentience. It simply modified its manner of expression.

Another struggle that adopting the CBC will resolve is marked by the issue that Crump et al. raise: "[T]he 'private' nature of sentience is why we cannot resolve the question of invertebrate sentience with certainty." This concern of theirs is an extension of the first-person problem which philosophers of mind have long struggled with. Our offer to Crump et al. is, again, our CBC theory which, once adopted, removes the problem. Since all creatures are sentient, there's no longer any need to worry about "private" internal states. Simply use the behavioral evidence that shows that even the simplest species, the prokaryotes, archaea and bacteria, have valenced perceptions, learn associatively (including learning repeating patterns), establish memories, make decisions, navigate arbitrary environments, form colonies, and communicate within and between species (Lyon, 2015; Reber, 2019; Reber & Baluska, 2020). It's worth noting here that in Lyon's 2021 review, she points out that much of the lack of coordination between cell biologists and those who are in the broader field of consciousness studies exists because the latter are simply unaware of the range and sophistication of prokaryote behavior. She notes that a closer look and a deeper appreciation of the nature of cellular life would resolve many of the current problems in the field. (We agree, obviously.)

Crump et al., modifying the older Smith & (1991) Boyd criteria for identifying which species can experience pain, develop a more sensitive and insightful set of eight criteria. We read them over and note that if references to neural traits and neurotransmitters are deleted and

"animal" is replaced by "organism," prokaryotes fit the criteria very nicely, including sensitivity to anesthetics – though, so far as we know, evidence for #8 is lacking. A simple question almost asks itself: Why would a species be sensitive to anesthetics if it didn't feel pain? We note in passing that many of the species Crump et al. presume to be insentient produce their own anesthetics – including plants (Yokawa et al, 2019).

One line in the target article surprised us: "However, simple forms of associative learning appear to occur unconsciously in humans." They do indeed, and one of us spent most of his scientific career on this issue. See, for details, any of the 19 chapters in *The Cognitive Unconscious: The First Half-Century* (Reber & Allen, 2022) for a fuller sense of just how ubiquitous unconscious or "implicit" learning is. Infants learn language and the mores of their culture without being aware of either the process or the products of acquisition. Most beliefs are formed without awareness. Biases and prejudices are as well. There is essentially no element in the functioning of our or any other species that doesn't have some unconscious component. This isn't the place to outline how the theory of implicit functions (see Reber, 1993) fits under the large umbrella of the CBC but, for the curious, it is outlined in Reber (2019, 2022).

From our perspective, the animal welfare issue plays out in a slightly different way from the one outlined by cle. We acknowledge, of course, that all the issues raised by the target article are important. Let us close by pointing out that one of the more intriguing implications of the CBC model is that it extends the concerns of advocates of animal welfare to additional species and serves to keep us all the more tuned to the ethical issues.

## References

- Baluška, F., Miller, W. B. & Reber, A. S. (2021). [Biomolecular basis of cellular consciousness via subcellular nano-Brains](#). *International Journal of Molecular Sciences* 2021, 22, 2545..
- Baluška, F., Reber, A. S. & Miller, W. B. (2022). [Cellular sentience and cognition as the primary source of biological order and evolutionary creativity](#). *Biosystems*, 218 (2022) 104694.
- Birch, J., Burn, C., Schnell, A. Browning, H., & Crump, A. (2021). [Review of the evidence of sentience in cephalopod molluscs and decapod crustaceans](#). Report prepared for the London School of Economics.
- Klein, C. & Barron, A. B. (2016). [Insects have the capacity for subjective experience](#). *Animal Sentience* 9(1).
- Lyon, P. (2015). [The cognitive cell: bacterial behavior reconsidered](#). *Frontiers in Microbiology*, 14 April, 2015.
- Margulis, L. (2001). The conscious cell. *Annals of the New York Academy of Sciences*, 929, 55-70.
- Nieder, A., Wagener, L., & Rinnert, P. (2020). A neural correlate of sensory consciousness in a corvid bird. *Science*, 369, 1626-1629. [DOI: 10.1126/science.abb144](#)

- Reber, A. S. (1993). *Implicit learning and tacit knowledge: An essay on the cognitive unconscious*. NY: Oxford University Press.
- Reber, A. S. (2019). *The First Minds: Caterpillars, 'Karyotes, and Consciousness*. NY: Oxford University Press.
- Reber, A. S. (2022). Implicit learning: Background, history, and theory. In A. S. Reber & R. Allen (Eds.), *The Cognitive Unconscious: The First Half-Century*. Oxford University Press.
- Reber, A. S. & Allen, R., Eds. (2022). *The Cognitive Unconscious: The First Half-Century*. Oxford University Press.
- Reber, A. S. & Baluška, F. (2020). [Cognition in some surprising places](#). *Biochemical and Biophysical Research Communications*, 564, 150-157
- Smith, J. A.; and Boyd, K. M. (Eds.) (1991). *Lives in the balance: The ethics of using animals in biomedical research*. Oxford University Press.
- Yokawa, K., Kagenishi, T., & Baluška, F. (2019). [Anesthetics, anesthesia, and plants](#). *Trends in Plant Science*, 24(1), 12-14.