Does the sentience framework imply all animals are sentient?
Commentary on Crump et al. on Decapod Sentience

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Abstract: The eight criteria proposed in Crump et al.’s framework for evaluating pain sentience in decapod crustaceans are just the tip of the iceberg when it comes to markers that could increase confidence in an animal’s sentience more generally. Some of the commentaries have already pointed out that pain is only one kind of sentience (Souza Valente). It has also already been pointed out that there are other criteria for pain that could be usefully added to the framework’s eight (Burrell). This expansive thinking about criteria that can be used to increase confidence in sentience raises the question: in an expansive framework for evaluating sentience generally, will there be any animals we could study where confidence wouldn’t be increased were we to use a general model of evaluating sentience via marker frameworks? I consider how the general approach could increase confidence in the sentience of animals such as C. elegans and Porifera.

1. What can sentience frameworks do? The framework proposed by Crump et al. (2022) helpfully transforms the animal sentience question from “are decapods sentient?” to “how confident can we be that decapods are sentient?” Given the nature of sentience as a first personal feeling that is not directly observable even in other humans, answering the old question requires a satisfactory answer to the skeptical problem of other minds. Since such an answer remains elusive, the first question isn’t one that can be usefully subject to scientific investigation. The new question is. But it is important to be clear about what such a framework can and cannot do.

Sentience tests built on frameworks like the one proposed are not designed to serve as a decision procedure to sort sentient from non-sentient beings. Without a secure theory of sentience to guide us, we cannot be confident that a lack of evidence for pain experience signifies a lack of sentience more generally. We also can’t be confident in any claims that a marker is necessary for sentience of any particular sort. The presence of the marker can raise our confidence. In the target article’s sentience framework, so long as none of the criteria are deemed necessary for the experience of pain, or so long as experiencing pain isn’t necessary for sentience, lacking a
criterion wouldn’t be evidence against sentience. What frameworks like these offer are more in the way of positive tests for sentience—new ways of seeing particular sorts of sentience.

2. **Expanding sentience frameworks in two ways.** While accepting the evidence Crump et al. present in favor of decapod crustacean sentience, I think their approach could be expanded in such a way as to increase confidence in the sentience of any animal whatsoever. This is for two reasons: there are innumerable types of sentience, and there are innumerable, and growing, sets of criteria for each type of sentience.

The framework presented in the target article, like other sentience tests, focuses on a particular sort of sentience—pain. But, as has already been pointed out in Souza Valente’s (2022) commentary, pain is only one kind of sentience. Pleasure, temperature sensation, perception, color experience, dream experience, imagination, smell, hunger, touch, nostalgia for the past, self-awareness, guilt, etc. are other forms of sentient experience, and these too only begin to scratch the surface when it comes to the varieties of sentience we can already identify. In each category of sentience we will be able to develop sets of criteria—markers—like the ones identified by Crump et al. But their eight criteria are not the end of the story when it comes to pain markers. As pointed out in Burrell’s (2022) commentary, we can already identify further markers for pain in addition to the eight used in the framework, such as activity dependent neuromodulation in sensory circuits. Burrell goes on to point out the limits of our knowledge when it comes to human pain experience, but he expresses optimism that we can gain new knowledge. This suggests that as pain science progresses, we will be able to add even more criteria to pain sentience tests, thus expanding far beyond the eight provided in the current framework.

This double expansion—into types of sentience tests for different varieties of sentience, and into additional criteria for each type of sentience—promises (or threatens) to lead to an explosion of positive tests for sentience. There is reason to suspect that with the expansion of sentient tests, we will gain increased confidence in the sentience of any animal deemed worthy of investigation.

3. **Increasing confidence in nematode sentience.** To illustrate, consider the case of *C. elegans*, which show flexible behavior, have short term and long-term memory, can learn through association and through habituation, can integrate information from different sensory modalities, and can choose to respond differently to different levels of intoxicating substances, “support[ing] the view that worms can associate a physiological state with a specific experience” (Rankin 2004,
One might expect the framework to conclude an increased confidence in nematode pain experience. As Irvine (2022) notes in her commentary, there is evidence of criteria 1, 4, and 7 in *C. elegans*, offering “substantial evidence” on the basis of the guidelines of the framework. But since criterion 2, integrated sensory processing, is deemed lacking and presumed central to sentience, the evidence is disqualified by the authors. This move raises questions. Either the framework sneaks in necessary conditions for sentience without arguing for them, or they take criterion 2 as necessary for adequately fulfilling some of the other criteria (perhaps 7). Without a secure theory of sentience, it is premature to deem any criterion as necessary, so the first way of understanding the author’s move is not currently warranted. That leaves us with the possibility that, given the redundancies between the criteria, we lack evidence of criterion 7 in *C. elegans* given the lack of criterion 2. However, this move can be subverted given recent evidence in favor of criterion 2 that comes from a recent study mapping the brain of *C. elegans* that argues in favor of sensory integration and computation in that model (Brittin et al. 2021).

| 1. Nociception          |
| 2. Sensory integration  |
| 3. Integrated nociception|
| 4. Analgesia: (a) endogenous (b) exogenous |
| 5. Motivational trade-offs |
| 6. Flexible self-protection |
| 7. Associative Learning |
| 8. Analgesia preference: (a) self-administer (b) location (c) prioritised |

**Eight criteria for pain sentience**

(Crump et al., 2022, §2.2)

As Irvine notes, we see evidence that nematodes have criterion 1 (nociceptors), 2 (sensory integration), 4 (responsiveness to analgesics), 7 (associative learning), and perhaps 8 (analgesia preference) (as discussed in Irvine’s commentary). Given high confidence that nematodes have even three of these markers, the current framework would conclude that there is substantial evidence of sentience in nematodes.

But it doesn’t end there. We can go on, finding evidence by looking at different varieties of sentience. Evidence of dreaming can be gleaned from sleep patterns, which were identified as a marker of consciousness by the *Cambridge Declaration of Consciousness*. *C. elegans* show sleep patterns similar to mammalian ones (Spies and Bringmann 2018). Evidence of pleasure can be gleaned from the existence of neuropeptides such as oxytocin and its homologues, following the suggestion in Burrell’s commentary to expand the range of neurotransmitters that can serve as evidence of sentience. The oxytocin homologue nemotocin, which has been identified in *C. elegans*, plays roles similar to mammalian oxytocin, as it is implicated in learning and in mating (Beets 2012) and regulates behaviors that promote the survival of infant larvae (Scott et al. 2017).
4. Generalizing to all animals. Seeing how the expansion in criteria and tests can identify sentience in animals often dismissed as candidates for sentience because of their low number of neurons highlights the neuro-bias that often emerges in these discussions. If we set such a bias aside and follow the general methodology outlined in the target article, we can only increase our confidence in an animal’s sentience. And if there are hundreds or thousands of tests, odds are we will find some evidence that will increase confidence.

Consider the simple yet fascinating Hydra who, like all Cnidaria, lack a centralized nervous system and hence a brain, though they do have sensory and ganglion neurons. Hydra behaviorally sleep, they have sleep-regulatory genes, responsiveness to neurotransmitters and hormones, and hence researchers study them to gain insight into the evolution of sleep (Kanaya 2020). Or the infamous sea squirts Styela plicata (a tubular tunicate that is attached to the seabed and is closely related to sponges); they share with C. elegans their own oxytocin homologue, “Styela oxytocin-related peptide” which has been found to regulate tissue contraction (Ukena et al. 2008). We may even find markers in the sea sponge larva Porifera. After spawning, the emerging sponge larvae demonstrate negative phototaxis as they find a location to settle, and their settlement time is increased by the introduction of substrates into the environment (rubble and biofilm) (Wahab et al. 2011). Will future research find evidence of motivational trade-offs between light levels and rubble when it comes to selecting a place to settle?

The details matter, because they can show us how different animals are sentient, and can help to map out differences and similarities in sentience patterns across species. Proposals to organize the criteria, untangle the redundancies and weigh the significance of different criteria will significantly aid in the project of mapping the sentience profiles of different species (as suggested in the commentaries of Irvine 2022; Jablonka & Ginsborg 2022; Brown 2022). This is especially important for welfare considerations, because in order to promote an animal’s wellbeing we need to know what they can feel, and not just that they can feel. However, the general lesson to extract from this brief set of examples is that there is a lot more evidence of sentience in the least familiar animals. And if we accept that claim, perhaps it is time to accept as a working hypothesis in the cognitive science of consciousness studies that all animals are sentient. This premise will promote research into a range of sentience dimensions across the animal kingdom. If it
encourages research on simpler models, it may hasten progress in developing a secure theory of consciousness.

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