Sentience in invertebrates: A report on a two-part webinar

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"Whoever denies that it hurts a dog to be kicked, or a duck to be plucked, is rightly seen by most of us as a psychopath. But when it comes to bugs and slugs – so unlike us, without those familiar movements, and vocalizations, and facial expressions, or even faces – we aren't so sure."
– Stevan Harnad, in the introduction to the webinar

Rather than wait till the end of this report – as publishing tradition would dictate – to disclose a conflict of interest, I'll note mine at the outset. And it is this: *I love insects*. By this I do not mean the kind of emotion that set Victorian naturalists cleaning the British countryside of butterflies, at a time when essential field equipment included not just a lens and collecting boxes but a chequebook too, so that one was in a position to bid on the spot for any rare 'aberrations' that a fellow collector had caught (Salmon, 2000). That zeal is well illustrated by a comment in an 1864 letter penned by the collector James Charles Dale (quoted as an epigraph in Salmon [2000]): "I would go through fire and water for insects."

Rather, by love of insects, I mean a natural affinity with them, a bullet-proof sense of pleasure that comes from being in their presence (assuming they are not trying to suck my blood), and a relationship with them that I will describe as being one of reverence. (*No*, I am not confused by the meaning of that last word. And, *yes*, I'm perfectly happy with my use of it.) By the same token, I loathe the mistreatment of these creatures.

There is a TED-Ed lecture from 2012, for instance, that I find abhorrent. In the video, TED Fellow and neuroscientist Greg Gage cuts off the leg of a living cockroach. As he does this, he utters the following words with a tone that I find nauseating in its nonchalance: "Yeah, it's gross. [*Snip.*] All right. So there we go."

But the viewer is not meant to be concerned, for the cockroach had been dumped in a pot of iced water a minute earlier, so that they had become *chillaxed* (to use Gage's flippant vocabulary). As he removes this being, the

footage seems to reveal that another insect, whom we saw floating on the surface of the iced water a minute earlier, has now drowned. That Gage gives the demonstration wearing a T-shirt decorated with a large cockroach graphic, as if he were their friend, only makes the viewing experience worse for me. What is demonstrated, above all else, is the kind of cruel behaviour somehow considered unproblematic in the human-supremacist worldview.

The incident also reveals an inexcusable ignorance of non-human interests. In an interview for the BBC (2012), describing his leg-removal experiments, Gage commented: "We won't harm the insects [...] His legs will grow back: he's not an adult yet." What is clear is that this scientist has not just a weak grasp of the word 'harm' but some major gaps, too, in his knowledge of basic insect biology. The live cockroach whose leg he amputates in the name of edutainment, in the TED-Ed lecture, possesses wings and is therefore, incontestably, an adult.

What is equally clear – for the moment, at least – is that my views are shared by only a small minority of people. On YouTube, the video of that lecture has, at the time of writing, elicited 6600 clicks on the up-pointing thumb and only 214 on the down-pointing one (including my own).[1] Yet, a small minority can make a difference. Complaints from viewers about competitors being asked to eat live insects for the sake of entertainment on the reality TV show *I'm A Celebrity* led to producers choosing to cease the practice. Commenting on the development, conservationist Chris Packham described it as a positive "first step" for the programme and observed that there "was never any ambiguity that eating live invertebrates was abuse and also exploitation for entertainment" (BBC News, 2019).

For the reasons presented above, among others, I was delighted to receive an email during the September just gone announcing a two-part webinar on invertebrate sentience. I eagerly accepted the invitation to attend, and I offer a report on this virtual meeting below.

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The two-part online webinar, titled 'Invertebrate Animal Sentience', was convened by WellBeing International and the journal *Animal Sentience* and was financially supported by the Centre for Effective Altruism. It took place across 20 and 27 October 2021, with both sessions being skilfully moderated by Stevan Harnad, Editor-in-Chief of *Animal Sentience*. (The videos can be accessed at: https://wellbeingintl.org/get-involved/webinars/.) My descriptions of the presentations below are arranged thematically, rather than being covered in the order in which they were given.

In introducing the first session, Stevan defined sentience as "a state that it feels like something to be in." What one is feeling, he continued, "can be sensations like touch, colour, sound, warmth or movement. Or it can be emotions like joy or fear."

The overarching question for the webinar, noted Stevan, was whether (and which) invertebrates are sentient. The seeking of empirical evidence to support

the case for sentience in any one species is far from straightforward. But "the answer matters," he said, "at the very least to them, if they *can* feel. For where there is feeling, there can be hurt."

Stevan was eager to stress that the question's importance extends far outside the often-impassionate arena of science: "Is it really *our* problem, the human theorists contemplating it, the curious scientists busily testing our hypotheses on our 'target' species, pondering and probing whether or not they feel? Or, is [it] the problem of those *other minds*: of each individual member of those species – *if* our conclusion is not that they don't feel, but that in fact they do?"

Research

Hermit crab shell selection and sentience

In his presentation, Bob Elwood (Professor Emeritus, Queen's University Belfast, UK) explored what the selection of a new shell by a hermit crab (Figure 1) might reveal about sentience, drawing on research by himself and colleagues.

Hermit crabs, Bob explained, determine the value of a potential new gastropod shell to move into based on a variety of factors, including size, weight, shape and colour. These are assessed by a crab through a combination of sight, manipulation with their appendages while outside the shell, and testing of the shell while inside it. Following a comparative multifactor assessment of the two shells, in which memories of previous shell encounters are drawn upon, the crab decides whether or not to make the switch. Crabs are even able, in reaching a decision, to take into account the size of gaps that they may seek to move through in their immediate surroundings. The situation becomes yet more intricate when several hermit crabs are present around vacant shells.

Taken together, Bob noted, the behaviours that are seen indicate an ability of hermit crabs to evaluate the relationship between their own actions and those of other hermit crabs, to remember at least some of their own actions and the

Figure 1. A hermit crab.

consequences, to assess risk and benefits, and to be aware of their environment – all of which point towards sentience.

Furthermore, in experiments using small electric shocks, hermit crabs have been found to show not just an aversion to the negative experience (or *stimulus*, in the cold scientific lingo) – something evident in their increased tendency to take a new shell – but also a memory of it that lasts for at least 24 hours. This, Bob explained, is evidence that crabs have the capacity to feel pain, further bolstering the case for their sentience.

Cephalopod sentience

When talking about invertebrates, observed Jennifer Mather (Professor of Psychology, University of Lethbridge, Canada) in a presentation on cephalopods, we must "start thinking of them themselves: not them in terms of what *we* know and what *we* are, but in terms of what *they* are." The vertebrate experience, she expanded, is of limited applicability only.

Jennifer proceeded to review the growing evidence base in cephalopods that supports a sense of self and the processing of experiences. In the case of cuttlefish, it has been found, for instance, that, following a positive experience, they can interpret and remember not only *what* was rewarded, but *when* and *where* the reward was made – implying the presence of a cognitively advanced learning system.

Another study to which Jennifer referred concerned the veined octopus's use of tools – a "benchmark for cognitive sophistication," in the words of the researchers (Finn *et al.*, 2009). This cephalopod has been observed to use empty half coconut shells or the discarded shells of other marine animals for shelter (Figure 2). The researchers reported that these octopuses carried coconut shells in a non-defensive manner, so that they were able to use them

Figure 2. A veined octopus taking shelter in a discarded shell (Bernard DuPont; CC BY-SA 2.0).

for protection when the need arose, and that they achieved this by adopting a different, more cumbersome, form of locomotion – something they termed 'stilt-walking'.

Shifting to pain perception, Jennifer described a recent study reporting that octopuses learned to avoid places in which they underwent a negative experience and that, following this occurrence, they preferred places where an analgesic was present (Crook, 2021). Furthermore, injection-site grooming was observed in all animals who received an injection of dilute acetic acid, but this behaviour ceased after they received a local anaesthetic. The researcher concluded from the evidence that octopuses are likely to experience pain *affectively* (*i.e.* in a way that leads to a negative emotional state). Jennifer, who was more cautious in interpreting the results, suggested that further work would be needed to demonstrate this.

Sentience in bees

Lars Chittka (Professor of Sensory and Behavioural Ecology, Queen Mary University of London, UK) began his presentation, which covered bees and other insects, by quoting the ethologist Karl von Frisch (a joint recipient of the 1973 Nobel Prize in Physiology or Medicine, whose work focused on honeybees): "A bee sits at the feeder and imbibes sugar water. You cut off her abdomen at the thin waistline with scissors. Her head and thorax stay in place and the meal proceeds, only that [...] everything leaks out at the back [...] Such behaviour is incompatible with the perception of pain."

"Now, that view," Lars commented, "is still shared by the vast majority of the insect science community [...] but it's almost certainly nonsense. What Karl von Frisch denies here is even the presence of basic *nociception* – the reflex-like withdrawal from harmful stimuli – and insects certainly have that."

The persistence of the viewpoint, Lars added with visible regret, is evident in the commercial availability of small electrophysiology kits that can be 'fitted' to live cockroaches – by the sanding and stabbing of the exoskeleton, the amputating of the vital sensory organs that are the antennae, and the fixing of the various components with superglue – so that the insect's movements can be controlled remotely using an app. Such a sequence of acts is appalling in its wanton violence towards other-than-human life, yet children are being encouraged to do these very things, under the guise of scientific education. The company that sells these, Backyard Brains, was co-founded by Greg Gage. (In a video from a TED conference in 2013, Gage demonstrates a cockroach 'fitted' with this equipment and laughs as his associate Tim Marzullo makes the insect spin in a tight circle with a simple thumb press on his smart phone [TED Archive, 2017]. Gage then inanely comments: "he's a bit confused.")

Speaking more generally, Lars observed that "millions and millions of insects are sacrificed on a weekly basis [in laboratories], and sometimes subjected to invasive 'treatments' with electrophysiology."

Nevertheless, he noted, the viewpoint is beginning to be challenged by scientific evidence, including in bees – the focus for his own research. In what he describes as the "rich inner world" of these insects, research is revealing the

existence of a library of accessible memories, the ability to problem-solve, and the occurrence of different emotional states.

Finally, Lars highlighted the important early work in support of emotions in insects by Charles Henry Turner, an African American scientist who has been described as having been "shamefully neglected" (Abramson, 2017: 31). "Unable to secure an academic job despite his publication record," Abramson (2017: 31) writes, "Turner did most of his research while teaching on the meagre salary paid in African American high schools [...] without proper lab facilities, a library or graduate students."

Implications for policy and legislature

Legal protection for the welfare of invertebrates

Jonathan Birch (Associate Professor of Philosophy, London School of Economics and Political Science, UK) explained that sentience matters not just ethically but legally. In the case of the latter, it is impacting the scope of animal welfare law in more and more countries.

"What we need," Jonathan argued, "is to have clear, fair criteria for inclusion: criteria that do not set the bar so high an invertebrate could never meet it [or] imply a double standard in how we treat invertebrates versus how we treat vertebrates." These criteria, he continued, could draw on neurological, cognitive and behavioural facets of an animal's being. No single criterion, he argued, should be seen as *sufficient* in itself; nor should any one criterion be seen as *necessary*.

Based on Jonathan's assessment of current evidence, he felt that there was already a strong argument to be put to policy-makers for extending animal welfare legislation to cover the various cephalopods, as well as decapods such as crabs, lobsters and crayfish (Figure 3). At present, almost all countries lack such legislation, meaning that there is no legal mechanism to prevent, for instance, the live-boiling of lobsters.[2]

Figure 3. A caught lobster, perhaps awaiting death by being boiled alive.

Figure 4. Dried migratory locusts from an insect farm (Wilhelm Thomas Fiege; CC BY-SA 4.0).

Insect farming: a growing industry

Helen Lambert (past Sentience Manager at World Animal Protection, UK) reflected on the nascent but rapidly growing industry of insect farming. In animal welfare, Helen explained, there has not until now "been the urgency to focus on insect sentience." There are thus many unanswered questions.

The industry is pushing ahead nonetheless, continued Helen, and it is going to place truly vast numbers of animals under human control with little or no thought for the individuals being farmed. This is because it has "been assumed that insects cannot feel, and so their welfare doesn't matter. Questions such as best slaughter practices [boiling is one of the methods currently used], best housing conditions, and how to monitor and address health and disease issues need to be addressed from the insect's perspective – and not just from best guesses but from empirical evidence."

Helen argued that, within invertebrate sentience, there is a need to prioritize research into the small number of insects being put forward in policy documents as candidates, either as adults or as larvae, for mass consumption by humans or domesticated vertebrates. These include black soldier flies, palm weevils, and certain species of ant, cricket and locust (Figure 4).

A sentiocentric extension of consideration

Irina Mikhalevich (Assistant Professor of Philosophy, Rochester Institute of Technology, USA) began her presentation with a sentiocentric definition of moral standing. "There is generally wide, although not universal, philosophical agreement," she contended, "that sentience is necessary [...] for moral standing." Expanding on this, she opined that a "being that matters morally in its own right is one whose life can go well or poorly from its own perspective." (I discuss this assertion below, in the section titled 'My concluding thoughts'.)

Irina then turned to explore the grounds for moving beyond a vertebrate-centred conception of welfare. The principle of moral consistency, she argued, calls for the extension of policy protection beyond vertebrates to also cover those invertebrates in whom evidence for sentience exists.

An evolutionary perspective

In his presentation, Giorgio Vallortigara (Professor, University of Trento, Italy) described how the evolutionary psychologist Nicholas Humphrey, building on work by the philosopher Thomas Reid, has argued for a basic distinction between sensation (what is happening to oneself) and perception (what is happening externally to oneself), with only the former being associated with consciousness. Developing this line of thought, Giorgio presented an argument that the evolutionary origin of sensation, as distinct from perception, lies in organisms' experience of moving. A worm, for example, has a need to differentiate between the external sensation that results from self-directed movement through soil and that relating to something else impinging on the body surface.

My concluding thoughts

It is clear that invertebrate sentience, as a scientific pursuit, is in its infancy. There is nothing approaching a consensus on possible qualifying criteria; and there is uncertainty as to whether putative indicators, where stipulated, have been satisfied. In part, this relates to the extraordinary diversity of the organisms in question.

Yet, with the ramping-up of insect farming, there is an escalating urgency to potentiate legal protection for invertebrate welfare. Only time will tell us how much this will depend on scientific evidence on a taxon-by-taxon basis and how much this could arise instead from reasonable extrapolation and by taking precaution to be a guiding principle. It strikes me that no study is needed, for instance, for one to reach the conclusion that cutting the leg off a live cockroach is inhumane.

Then, there arises the issue of safeguarding the welfare of invertebrates *within* the research environment. For how much longer, for example, will the application of negative 'stimuli' to cephalopods and decapods be deemed ethically acceptable by the scientific community? (This was one of many questions touched upon during the discussion segments of the webinar.)

Finally, if, in contrast to Irina Mikhalevich, we believe that moral standing within the ecosphere permeates beyond the bounds of sentient life and instead contend that agency by itself establishes intrinsic value (Curry, 2018), then we will find important additional reasons to feel compelled to safeguard invertebrate interests. (For a thoughtful examination of the interests of moths in relation to human interference, without any appeal to sentience, see Whyte [2020].)

In a bio- or ecocentric worldview, an improved understanding of sentience will still be of much significance – in helping us to honour moral standing – but a challenge is laid down to the urge to proclaim that sentient or intelligent

beings are the Earth's elite group. For, as Eileen Crist (2020) has noted: "It's a subtle but irresistible thing that the (Western) mind wants to do – to deploy categories that perpetuate the habit of hierarchical reasoning, categories that tacitly exclude many, if not most, nonhumans. The special league of 'intelligent' species is arguably something of an unconscious human-supremacist sleight of hand."

Notes

1 In another sample, I found myself in the majority. Specifically, I asked an eight-year-old and an eleven-year-old whether they thought it was acceptable to cut off a live cockroach's leg for the purpose of education. They answered, independently, that it definitely could not be justified in this context.

2 At the time of writing, debate is taking place in the UK on whether decapod crustaceans and cephalopod molluscs could be included within the scope of any legislation arising from the Animal Welfare (Sentience) Bill (Horton, 2021).

References

Abramson CI (2017) Charles Henry Turner remembered. *Nature* **542**: 31.

BBC (2012) *Science in Action*, 19 April. Available at https://is.gd/sxk5I8 (accessed December 2021).

BBC News (2019) I'm A Celebrity: ITV ends 'bushtucker trials' that include eating live bugs. *Newsbeat*, 16 November. Available at https://is.gd/ZV5R3S (accessed December 2021).

Crist E (2020) Grace versus dystopia. *Earth Tongues*, 17 November. Available at https://is.gd/DDWRue (accessed December 2021).

Crook RJ (2021) Behavioral and neurophysiological evidence suggests affective pain experience in octopus. *iScience* **24**: 102229.

Curry P (2018) *Ecological Ethics: An introduction* (updated 2nd edition). Polity Books, Cambridge, UK.

Finn KH, Tregenza T and Norman MD (2009) Defensive tool use in a coconut-carrying octopus. *Current Biology* **19**: R1069–70.

Horton H (2021) Boiling of live lobsters could be banned in UK under proposed legislation. *The Guardian*, 19 November. Available at https://is.gd/kgci3Z (accessed December 2021).

Salmon MA (2000) *The Aurelian Legacy: A history of British butterflies and their collectors*. University of California Press, Berkeley, CA, USA.

TED Archive (2017) *Making neuroscience accessible – Greg Gage* (presentation). Available at https://is.gd/jwMVpv (accessed December 2021).

Ted-ED (2012) *The cockroach beatbox – Greg Gage* (lecture). Available at https://is.gd/h3nrEh (accessed December 2021).

Whyte I (2020) The ethics of mothing. *Earth Tongues*, 27 August. Available at https://is.gd/ntEgM4 (accessed December 2021).