Boundaries of Consideration:

Invertebrates, Computers, Plants

Peter Godfrey-Smith

University of Sydney

1. Foundational issues

2. Cases.

    2.1. Invertebrates

    2.2. Plants

    2.3. Computers

* Two papers that cover some of these topics in more detail:

"Individuality, Subjectivity, and Minimal Cognition," *Biology and Philosophy* (2016).

"Varieties of Subjectivity," *Philosophy of Science*, forthcoming.

1. Foundational issues

Concern for self as a feature of cellular life.

Cognition as a tool.

Subjectivity as an evolutionary product.

Gradualism about subjectivity.

Varieties of subjectivity.

The increasingly clear cases:

1. Cephalopods, especially the octopus. These are molluscs.

2. Crustaceans, such as crabs and shrimp. These are arthropods.

Discussed in *Other Minds* (2016).

Elwood "Evidence for pain in decapod crustaceans" (2012).

Wound-tending, evaluative trade-offs.

Eisemann et al. "Do insects feel pain? - A biological view" (1984) - negative evidence, based especially on immediate responses to damage.

Groening et al. (2016), "In search of evidence for the experience of pain in honeybees." Morphine self-administration test.

See also Barron and Klein, "What insects can tell us about the origins of consciousness" (2016). Plus Sneddon's comments in *Animal Sentience*.

Emotion-like states in insects:

Bateson et al. (2011). Agitated honeybees exhibit pessimistic cognitive biases. *Current Biology* 21: 1070–1073.

Perry et al. (2016). Unexpected rewards induce dopamine-dependent positive emotion–like state changes in bumblebees. *Science* 353:1529-1531.

Gastropods – slugs and snails.

Crook and Walters, "Notes on Nociceptive Behavior and Physiology of Molluscs: Animal Welfare Implications," (2011).

Walters, "Nociceptive Biology of Molluscs and Arthropods: Evolutionary Clues About Functions and Mechanisms Potentially Related to Pain" (2018).

Walters 2018, ""Nociceptive Biology of Molluscs and Arthropods..." :

[M]emory of a noxious event in snails can be linked to a fearlike motivational state that can dramatically alter the animal's response to other biologically significant stimuli.

During evolution, physiological and molecular mechanisms driving nociceptive functions became linked not only to sensory and discriminative processes that elicit immediate defensive responses, but also to motivational and cognitive processes that enable an animal to avoid ongoing and future threats related to a noxious experience. This requires an ability to maintain functional "awareness" of injury-induced vulnerability until the vulnerability subsides (perhaps until adequate repair of damaged body parts has been achieved). The phylogenetically widespread occurrence of memory of injury that may drive defensive motivational states is indicated by the examples of nociceptive sensitization described above in several molluscs and arthropods.

Plants:

• A "modular" organization, though without very clear divides between modules.

• Raises general questions about collective selves (as in bee colonies, etc).

• Considerable signaling within plants, especially registration of damage.
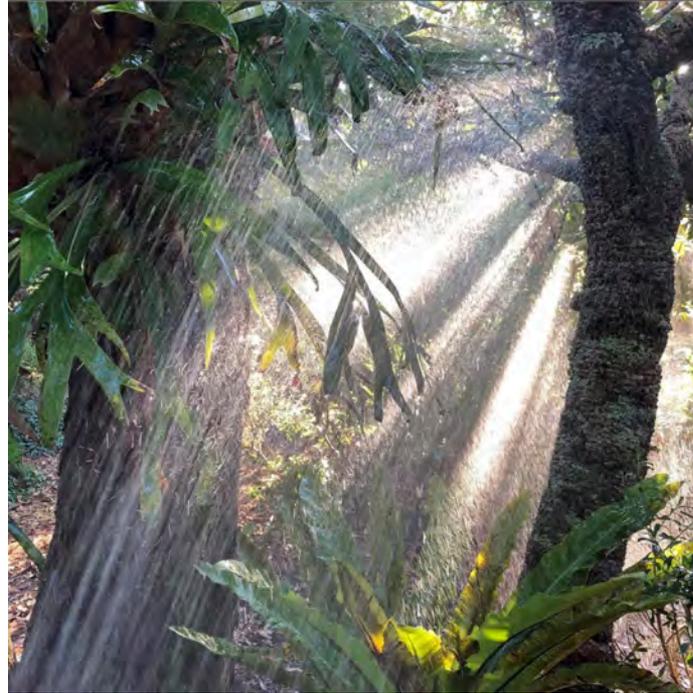
Fig. 1. Wounding triggers long-distance transmission of [Ca²⁺]$_{cyt}$ increases and systemic defense responses. (A) Caterpillar (dashed outline) feeding (white arrow) caused local [Ca²⁺]$_{cyt}$ increases (red arrowhead) that propagated toward younger leaves (yellow arrowheads). (B) Cutting leaf 1 (L1, white arrow, 0 s) caused a local [Ca²⁺]$_{cyt}$ increase (red arrowhead) that propagated toward target distal leaves (yellow arrowheads), e.g., leaf 6 (L6), but not to nontarget leaves such as L5. (C to E) [Ca²⁺]$_{cyt}$ signature (C), defense gene induction (D), and JA and JA-Ile accumulation (E). $N = 10$ (C), $N = 6$ (D), and $N = 3$ (E) separate experiments. Error bars, mean ± SE. *$P < 0.05$ leaf 6 versus 5. Scale bars, 1 mm (A) or 5 mm (B).
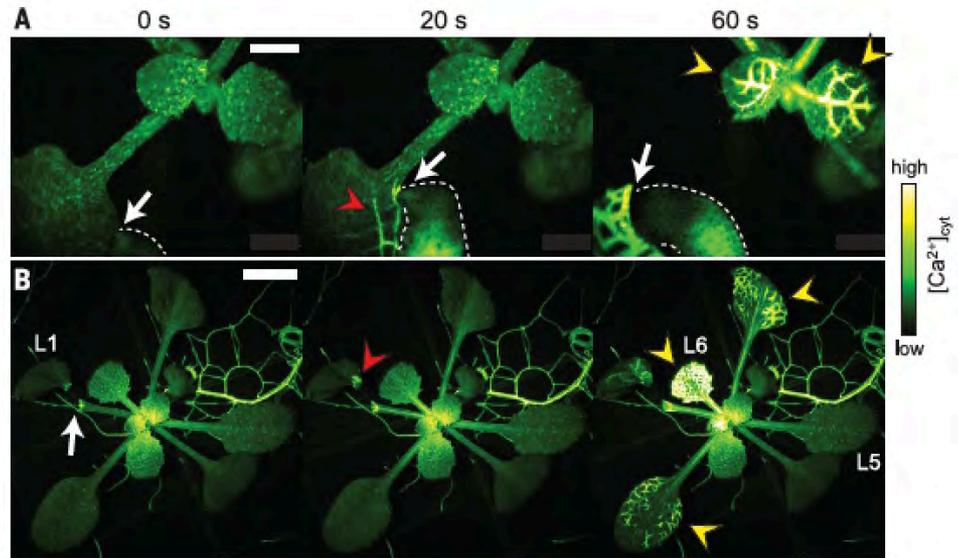
Toyota et al. 2018, "Glutamate triggers long-distance, calcium-based plant defense signaling"

Computers and AI systems:

Representation versus realization.

"Simulation" as ambiguous between these.

Brian Tomasik, "Do Artificial Reinforcement-Learning Agents Matter Morally?"
(arXiv, 2014)

I argue that yes, we do have ethical obligations to artificial RL agents,
even those that exist today, although the moral urgency of these obligations is
limited compared with our present duties to animals and our future duties to
more sophisticated RL agents. My argument has the following structure:

1. The sentience (and hence moral importance) of a mind is not binary but
comes in degrees depending on the number and complexity of certain
wellbeing-relevant cognitive operations the mind runs.

2. Present-day artificial RL algorithms capture, in a simplified fashion, important
animal cognitive operations.

3. These cognitive operations are not tangential but are quite relevant to an
agent's wellbeing.

4. Therefore, present-day RL agents deserve a very small but nonzero degree
of ethical consideration.

Thanks to Andrew Barron, Colin Klein, and Henry Shevlin.