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Fish and plant sentience: Anesthetized plants and fishes cannot respond to stimuli
Commentary on Sneddon et al. on Sentience Denial

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Abstract: Recent denial of fish sentience is at variance with the fact that all living organisms need environmental awareness in order to survive in a continuously fluctuating environment. Moreover, fish sentience – like plant sentience – is also strongly supported by the sensitivity of fishes and plants to diverse anesthetics.

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“...what is alive must sense and can be anesthetized, the rest is dead.”
Claude Bernard (1878)

Anesthesia, like sentience and consciousness themselves, has long been a mysterious phenomenon in modern science (Rinaldi 2014, Koch 2018). The mechanisms that cause the loss of consciousness with diverse anesthetic compounds are still unknown.

We have recently reported that plants can be anesthetized by blocking action potentials and effects on synaptic vesicle recycling (Yokawa et al. 2018). Treatment with diethyl-ether stopped the leaf-closing movements of both Mimosa pudica, a sensitive plant, and the Venus flytrap, the well-known carnivorous plant. After removal of diethyl-ether from their treatment chamber, the plants immediately began recovering their action potentials; their response to touch was restored in 15 min. Leaf responses to touch disappeared even when just the root part of the Mimosa pudica was submerged in lidocaine (local anesthesia). In addition, seed dormancy was prolonged under anesthesia, and seeds immediately regained germination when the anesthetics were removed. Diverse anesthetics effectively affect plant cells, immobilizing the movements of plant organs under anesthesia (Yokawa et al. 2018). We have proposed that possible targets of plant anesthesia are cellular membranes, which are fundamentally important for all living organisms. This mechanism was already suggested by
French physiologist Claude Bernard in 1878, when he presented convincing anesthetic experiments using Mimosa plants (Bernard 1878; Grémiaux et al. 2014). In our study, we documented the effects of anesthetics on membranes of cells in the root apex transition zone, resulting in an excessive accumulation of reactive oxygen species (ROS) and aberrant endocytic vesicle recycling at the root synapses (Yokawa et al. 2018).

Similar high sensitivity to anesthetics has been reported for fishes (Neiffer and Stamper 2009, Sneddon 2012). Lopez-Luna demonstrated that administering analgesic drugs to fish alleviated their response to noxious chemicals (Lopez-Luna et al. 2017a) or noxious temperatures (Lopez-Luna et al. 2017b). When anesthetized, both plants and fishes lose their ability to respond to stimuli; their movements are lost too, and they are obviously devoid of environmental awareness. Removal of anesthetics results in rapid recovery. These data strongly support sentience in both plants and fishes (Trewavas and Baluška 2011, Calvo et al. 2017, Gagliano 2017, Sneddon et al. 2018).

It is still difficult to say whether fishes and plants feel pain or have nociception. However, it is known that plants respond quickly and sensitively to wounding and initiate wound-healing processes immediately. Once the plant body is physically damaged, wound-mediated cellular signaling is rapidly initiated, transferring danger information throughout the entire plant body. This ‘danger’ signal is also communicated to other neighboring plants by secretions and airborne chemicals. This changes the status of plant cells as well as the tissues of adjacent plants, allowing them to cope with upcoming threats. Moreover, plants endogenously produce multiple anesthetics of their own (Tsuchiya 2015, 2017) under conditions of stress or wounding (Baluška et al. 2016); these too have membranes as their targets (Tsuchiya 2015). In order to survive, all organisms need some version of a sense of pain which is perceived via their organism-specific sentience.

References


The Other Minds Problem: Animal Sentience and Cognition

Overview. Since Descartes, philosophers know there is no way to know for sure what — or whether — others feel (not even if they tell you). Science, however, is not about certainty but about probability and evidence. The 7.5 billion individual members of the human species can tell us what they are feeling. But there are 9 million other species on the planet (20 quintillion individuals), from elephants to jellyfish, with which humans share biological and cognitive ancestry, but not one other species can speak: Which of them can feel — and what do they feel? Their human spokespersons — the comparative psychologists, ethologists, evolutionists, and cognitive neurobiologists who are the world’s leading experts in “mind-reading” other species — will provide a sweeping panorama of what it feels like to be an elephant, ape, whale, cow, pig, dog, bat, chicken, fish, lizard, lobster, snail: This growing body of facts about nonhuman sentience has profound implications not only for our understanding of human cognition, but for our treatment of other sentient species.

Gregory Berns: Decoding the Dog’s Mind with Awake Neuroimaging
Gordon Burghardt: Probing the Umwelt of Reptiles
Jon Sakata: Audience Effects on Communication Signals
PANEL: Reptiles, Birds and Mammals
WORKSHOP: Kristin Andrews: The “Other” Problems: Mind, Behavior, and Agency
Sarah Brosnan: How Do Primates Feel About Their Social Partners?
Alexander Ophir: The Cognitive Ecology of Monogamy
Michael Hendricks: Integrating Action and Perception in a Small Nervous System
PANEL: Primates, Voles and Worms
WORKSHOP: Jonathan Birch: Animal Sentience and the Precautionary Principle
Malcolm MacIver: How Sentience Changed After Fish Invaded Land 385 Million Years Ago
Sarah Woolley: Neural Mechanisms of Preference in Female Songbird
Simon Reader: Animal Social Learning: Implications for Understanding Others
PANEL: Sea to Land to Air
WORKSHOP: Steven M. Wise: Nonhuman Personhood
Tomoko Ohyama: Action Selection in a Small Brain (Drosophila Maggot)
Mike Ryan: "Crazy Love": Nonlinearity and Irrationality in Mate Choice
Louis Lefebvre: Animal Innovation: From Ecology to Neurotransmitters
PANEL: Maggots, Frogs and Birds: Flexibility Evolving
SPECIAL EVENT: Mario Cyr: Polar Bears
Colin Chapman: Why Do We Want to Think People Are Different?
Vladimir Pradosudov: Chickadee Spatial Cognition
Jonathan Balcombe: The Sentient World of Fishes
PANEL: Similarities and Differences
WORKSHOP (part 1): Gary Comstock: A Cow’s Concept of Her Future
WORKSHOP (part 2): Jean-Jacques Kona-Boun: Physical and Mental Risks to Cattle and Horses in Rodeos
Joshua Plotnik: Thoughtful Trunks: Application of Elephant Cognition for Elephant Conservation
Lori Marino: Who Are Dolphins?
PANEL: Mammals All, Great and Small
Larry Young: The Neurobiology of Social Bonding, Empathy and Social Loss in Monogamous Voles
WORKSHOP: Lori Marino: The Inconvenient Truth About Thinking Chickens
Andrew Adamatzky: Slime Mould: Cognition Through Computation
Frantisek Baluska & Stefano Mancuso: What a Plant Knows and Perceives
PANEL: Microbes, Molds and Plants
WORKSHOP: Suzanne Held & Michael Mendl: Pig Cognition and Why It Matters
James Simmons: What Is It Like To Be A Bat?
Debbie Kelly: Spatial Cognition in Food Storing
Steve Phelps: Social Cognition Across Species
PANEL: Sea to Land to Air
WORKSHOP: To be announced
Lars Chittka: The Mind of the Bee
Reuven Dukas: Insect Emotions: Mechanisms and Evolutionary Biology
Adam Shriver: Do Human Lesion Studies Tell Us the Cortex is Required for Pain Experiences?
PANEL: Microbes, Molds and Plants
WORKSHOP: Delcianna Winders: Nonhuman Animals in Sport and Entertainment
Carel ten Cate: Avian Capacity for Categorization and Abstraction
Jennifer Mather: Do Squid Have a Sense of Self?
Steve Chang: Neurobiology of Monkeys Thinking About Other Monkeys
PANEL: Sea to Land to Air
WORKSHOP: The Legal Status of Sentient Nonhuman Species