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Dissociation between conscious and unconscious processes as a criterion for sentience

Commentary on [Segundo-Ortin & Calvo](#) on *Plant Sentience*

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Abstract: Based on the literature on human consciousness, we suggest that to demonstrate sentience in a system, one needs to demonstrate both conscious and unconscious processing in the system. Major theories of consciousness require the existence of both conscious and unconscious processes. Contrasting effects of conscious and unconscious processes have been successfully used in human studies and have begun being applied in animal sentience research as well.

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Segundo-Ortin & Calvo (2023) describe plant behavior that presumably involves sentience. The problem is that the cognitive capacities observed in plants cannot be a reliable source of evidence for sentience on their own (see other commentaries on the target article, e.g. Bennett, 2023; Damasio & Damasio, 2023; Dung 2023, Struik, 2023). Since plants also cannot report on their subjective states, identifying plant sentience becomes challenging. Based on the consciousness literature, we develop an argument that to ascribe sentience to a system one needs to show both conscious and unconscious manifestations of the system. This view is based on a theoretical and a methodological argument. Given that potential criteria for sentience were primarily developed in the human consciousness literature, we will use that literature to establish the argument.

Theoretical argument. Psychological and neuroscientific theories of consciousness describe consciousness in contrast to processes that can occur unconsciously. According to the Global workspace theory (Baars, 1988; Dehaene & Changeux, 2011), the brain contains multiple distinct modules that operate entirely unconsciously. Consciousness arises when a network that facilitates communication between isolated modules (the global workspace) is activated. The theory clearly describes features of both conscious and unconscious behavior, as well as the distinct neural signatures of conscious and unconscious cognitive processing. Likewise, according to the theory of higher-order thought (Brown et al., 2019) a representation can only be a conscious representation if it is itself a target of another (higher-order) representation. For example, a pattern of activation in the visual cortex triggered by an image of a bottle remains unconscious until it is the target of a higher-order representation whose contents are “I am now seeing a bottle”. The higher-order, or metarepresentation, itself remains unconscious. Hence, higher-order theories of consciousness require the existence of unconscious representations alongside conscious ones. Finally, according to the recurrent processing theory (Lamme & Roelfsema, 2000), information processing remains unconscious unless recurrent activations are involved.

Methodological argument. Unconscious processing in humans is often studied through a contrastive approach (Baars, 1994) that aims to dissociate what one can do with and without awareness. For example, the whole field of neuroscience of consciousness has been focused on finding dissociable signatures of conscious and unconscious processing in the brain (Crick & Koch, 2003). In humans, demonstrating qualitatively different effects of conscious and unconscious stimuli was proposed as a behavioral measure of conscious awareness that goes beyond simple above-chance performance in the task of interest (Cheesman & Merikle, 1986). Many studies have shown that conscious and unconscious processing produce different or even opposite behavioral effects (e.g. Bijleveld et al., 2010; Destrebecqz & Cleeremans, 2001; Merikle & Joordens, 1997). The same approach has begun to be used in the animal sentience literature. For example, Ben-Haim et al. (2021) used a cueing paradigm where Rhesus macaques identify the location of the stimuli presented. The location was cued by either a supraliminal or a subliminal visual cue. The authors found that supraliminal cues speeded correct detection of the targets while subliminal ones slowed it down. Dung (2022) lists such double dissociation between conscious and unconscious processes as a strong criterion for animal consciousness. A possible application in the plant context might be to try to contrast processing of external stimuli that have local effects in a plant to processing that leads to a larger coherent movement of a plant (c.f. Meroz, 2021; Meroz et al., 2019).

On the basis of the above arguments, we suggest that anyone attempting to demonstrate plant sentience empirically begin by developing a workable dissociation paradigm.

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