Investigating *C. elegans* Learning as a Possible Approach to the Study of Consciousness

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To study the mechanisms of consciousness, it would be useful to identify a highly manipulable organism that has perception, a key element of consciousness. Perception can be defined as the ability to have an inner qualitative experience of the environment, beyond simply sensing and responding. Perception is the subjective experience of what something feels like, such as sugar tasting sweet, snow feeling cold, and 700 nm light looking red. One way to determine whether an organism is capable of perception is to determine whether it can be aware of its surroundings. In people, awareness of one's environment can be measured indirectly by a learning paradigm called trace conditioning. In each trial of a trace conditioning experiment, a neutral stimulus (e.g. sound) is presented and removed, and after a period of time (e.g. 1 second) a different, aversive stimulus (e.g. an air puff to the eye) is presented and removed. After several trials, a person is said to have learned if she starts responding to the neutral stimulus in an aversive way. On average, those who successfully learn are aware of their environment, meaning that they verbally report that the neutral stimulus predicts the aversive stimulus. A slightly different version of this experimental design, called delay conditioning, occurs when the aversive stimulus is presented before the neutral stimulus is removed, and the two stimuli coterminate. Whether delay conditioning also correlates with awareness is still a matter of debate (Clark & Squire, *Science* 1998; Papka *et al.*, *Psychological Science* 1997; Lovibond & Shanks, *J. Exp. Psych.* 2002).

Since trace conditioning (and possibly delay conditioning) correlates with awareness, this type of learning might serve as a test of whether non-lingual organisms have the ability to perceive. I am investigating whether *C. elegans* can perform delay and trace conditioning. Specifically, I am conducting experiments pairing various odorants (e.g. isoamyl alcohol) with aversive stimuli (e.g. violet light, carbon dioxide). If the presentation of the odor alone is sufficient to induce an avoidance response after the training period, I plan to seek mutant worms that cannot perform this task. In this way, I hope to identify genes and neural circuits required to perform delay and trace conditioning in worms. Perhaps these same genes will also be involved in perception and consciousness in other animals.

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