Cognition and Behavior

Implementing Goal-Directed Foraging Decisions of a Simpler Nervous System in Simulation

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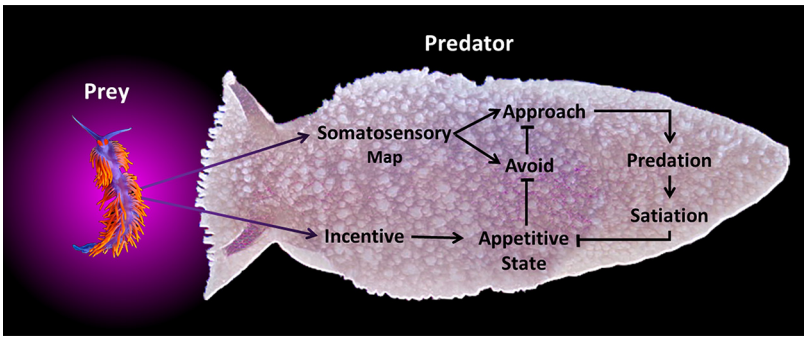
Visual Abstract



Economic decisions arise from evaluation of alternative actions in contexts of motivation and memory. In the predatory sea-slug *Pleurobranchaea* the economic decisions of foraging are found to occur by the workings of a simple, affectively controlled homeostat with learning abilities. Here, the neuronal circuit relations for approach-avoidance choice of *Pleurobranchaea* are expressed and tested in the foraging simulation Cyberslug. Choice is organized around appetitive state as a moment-to-moment integration of sensation, motivation (satiation/hunger), and memory. Appetitive state controls a switch for approach vs. avoidance turn responses to sensation. Sensory stimuli are separately integrated for incentive value into appetitive state, and for prey location (stimulus place) into mapping motor response. Learning interacts with satiation to regulate prey choice affectively. The virtual predator

Significance Statement

Contemporary artificial intelligence lacks the attributes of natural intelligence, in particular the abilities to relate information affectively. Accordingly, it is notable that the most complex animal behaviors serve primitive homeostatic goals, and emerge from the primitive mechanisms generating motivation and reward learning. Here is shown in simulation the function of a basic neuronal circuit for cost-benefit decision, derived from studies of a predatory generalist, the sea-slug *Pleurobranchaea*, and based on affective integration of information. Its simplicity may reflect distant ancestral qualities on which complexities in economic, cognitive, and social behaviors were built. The simulation validates experimental data and provides a basic module for expansion of behavioral complexity.