The Neural Mechanism Underlying Stimulus Evaluation of the Honeybee Brain

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Bees encounter numerous stimuli in nature. However, some prompt a stronger response than others as not all stimuli are of equal value. It is not well understood in any animal model how stimulus evaluation takes place in the brain. In honey bees, the mushroom bodies are the learning and memory centers in the midbrain, which integrate information of multimodal stimuli such as scent, taste, and sight. This structure is comparable to the hippocampus in the human brain. For the bee, an inhibitory feedback loop (protocerebral-calycal tract or PCT) that links the output and input end of the mushroom bodies is strategically situated to evaluate the incoming stimuli. It is hypothesized that PCT neurons will track the relative importance of different scents that are associated with varying concentrations of sucrose. A multichannel extracellular recording method is used to monitor the responses of PCT neurons while the animal is undertaking the associative learning task. Some putative PCT neurons increased their response magnitude to ethyl-2-methyl butyrate (a fruity scent) after being associated with 30% concentration of sucrose reward. Preliminary results support the original hypothesis, leading to further avenues of investigation on a general stimulus evaluation mechanism in the central nervous system. Furthermore, a better understanding of the learning process provides deeper insight into the mechanisms of how the brain learns. It can be applied to reverse-engineering of the human brain which promises opportunities for producing bionic technologies that can mimic the proper electrical signals of learning behavior.

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