

Habit formation by extended Pavlovian training in crickets

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Repetitive learning experience often induces a change of associative substrates underlying learning performance. This is best examined in instrumental conditioning in mammals, where performance early in learning is flexible and goal-directed, but it becomes more automatic, depending on stimulus-response (S-R) associations after extended training, a phenomenon called habit formation. In classical (Pavlovian) conditioning, however, the nature of the change by extended training is less well understood. In classical conditioning of crickets, we have suggested that octopaminergic (OA-ergic) neurons mediate reinforcing properties of appetitive conditioned stimulus (US) and that activation of OA-ergic neurons is required for performance of conditioned response, and proposed a model in which conditioning forms two kinds of memory traces, one representing associations between a conditioned stimulus (CS) and a US and the other representing S-R associations, and activation of both traces is required for performance. Here we examined whether learning performance becomes independent of activation of OA-ergic neurons, and thus of CS-US associations, by extended training. OA receptor antagonist impaired performance after limited training but not after extended training, indicating that activation of CS-US associations is not required for performance. The results show, for the first time, that extended Pavlovian training leads to formation of S-R habit.