OPERANT CONDITIONING OF FEEDING BEHAVIOR IN *APLYSIA*

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Considerable progress has been made towards a cellular analysis of classical conditioning. In contrast, the cellular mechanisms underlying operant conditioning are poorly understood. This deficit results, in part, from the lack of a suitably tractable preparation that exhibits operant conditioning and that is amenable to cellular analysis. To address this issue, the feeding behavior of the marine mollusk *Aplysia* was used to develop an *in vivo* operant conditioning procedure.

In this procedure, freely behaving *Aplysia* were operantly trained to modify the rate at which they bite (i.e., open their jaws and extend the odontophore) in order to receive a reinforcing stimulus. The reinforcement was a brief (3 s) train (30 Hz) of electrical stimuli (7 V) applied to the anterior branch of the esophageal nerve (E n.) via surgically implanted electrodes. This pattern of stimulation mimicked neural activity in E n. that normally occurred during feeding. Three groups of animals were examined. In one group (Contingent Reinforcement), the reinforcing stimulus was delivered each time the animal executed a bite during a 10 min training period. In a second group (Yoke Control), animals received the *same pattern* and amount of stimulation as an animal in the Contingent Reinforcement group. Thus, there was no contingency between the behavior of the Yoked animals and the delivery of the stimulus. In the third group (Control), animals underwent surgical and handling procedures that were identical to the other groups, but the Control group did not receive any nerve stimulation. The conditioning was evaluated by counting the number of bites during a 5 min observation period. The observation period either immediately followed the training (Fig. 1A) or was 24 hr later (Fig. 1B).

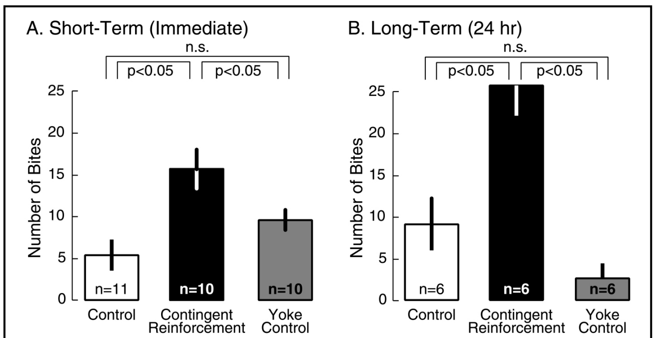

Fig. 1

At both time points, contingent reinforcement led to a significantly higher rate of biting. These results indicate that the operant conditioning was under the control of the contingency between the expression of the behavior and the reinforcement. This demonstration of operant conditioning in a behavioral system that is well suited for a cellular analysis provides an opportunity to both analyze mechanisms of operant conditioning and to examine the relationship between operant and classical conditioning on a mechanistic level (Lechner et al. 2000a,b; Nargeot et al. 1997, 1999a,b,c).