COMPENSATIONAL RECOVERY OF THE ESCAPE DIRECTION AND THE FUNCTIONAL CHANGE OF CRICKET GIANT INTERNEURON

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Crickets have a pair of appendages called cerci at the end of abdomen. When one of a pair of cerci was removed, the response rate of the escape behavior to an air puff stimulus decreased and the escape direction became incorrect. However, the response rate and the escape direction showed compensational recoveries by 6 days and 14 days after the unilateral cercal ablation, respectively. Escape direction did not show any compensational recovery when a cricket was prohibited free walking during the recovery period. On the other hand, a cricket permitted a free walking showed a recovery in the escape direction. Such a recovery could be accelerated by increasing the walking distance during the recovery period. To explore how wind-sensitive giant interneurons (GIs 8-1, 9-1, 9-2 and 9-3) change their response properties during the recovery period, the response properties of the GIs were investigated in the crickets reared in a small glass vial to prohibit walking. The results were compared with those obtained from the crickets those were forced to walk by touch stimulation to increase walking distance. The response properties of each GI in such crickets showed characteristic differences.

A PERIOD IN WHICH THE AMOUNT OF LOCOMOTION CAN AFFECT THE RECOVERY OF THE ESCAPE DIRECTION IN UNILATERALLY CERCUS-ABLATED CRICKETS

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In our previous study, the degree of compensational recovery of the escape direction was investigated in unilaterally cercus-ablated crickets by changing the total distance walked by the crickets after the ablation. The result suggested that the degree of compensation of the escape direction clearly depended on the distance walked by the crickets, i.e., crickets with a greater distance walked showed a higher degree of compensational recovery of escape direction. In the present study, we investigated whether there is a sensitive period in which the walking can accelerate the compensational recovery of the escape direction effectively. During a certain period after a unilateral cercal ablation, crickets were forced to walk to increase the walking distance. During the rest of the recovery period, each cricket was reared in a small glass vial and a free walking was prohibited. The walking period started from different times in the recovery period and the degree of compensational recovery of the crickets those walked with different timing were compared. As a result, it was revealed that the walking experienced before the 10th day after the ablation accelerated the recovery effectively.

BRAIN MECHANISMS UNDERLYING SPONTANEOUS INITIATION OF WALKING IN CRAYFISH

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Crayfish can initiate walking spontaneously without any sensory stimulation. We investigated how the brain of crayfish is involved in the spontaneous initiation of walking applying intracellular recording and staining techniques for identification of brain neurons and current injection experiment. An ascending interneuron was identified that elicited walking leg movements upon depolarizing current injection (10nA, 2sec). This interneuron projected to the antenna II neuropil in the tritocerebrum. We also identified descending and local interneurons that showed changes in synaptic activity preceding to the initiation of walking. These interneurons projected to the protocerebral bridge, the central body, the anterior medial protocerebral neuropil and the posterior medial protocerebral neuropil in the protocerebrum. These cells, however, did not cause walking leg movements upon current injection. These results suggest that the motor command for walking is not necessarily conveyed by descending interneurons. It remains to be studied how the ascending interneuron is activated preceding to the spontaneous initiation of walking.

EFFECT OF SOCIAL STATUS ON ESCAPE BEHAVIOR OF THE CRAYFISH

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Crayfish shows age dependent avoidance response when light tactile stimulus is applied to its tail fan. Large crayfish (over 13 cm) turns to the stimulus source and assumes a threat posture (turn) while smaller crayfish (6-8 cm) darts forwards (dart). Two crayfishes interact agonistically to determine which animal is dominant and which is subordinate when paired in a small water tank. We have paired two small crayfishes and observed their avoidance responses upon tail fan stimulations. As the social status was determined, dominant crayfish changed its avoidance response from dart to turn immediately and started to chase the subordinate crayfish. When an intense stimulus is applied to tail fan, crayfish escapes by flipping its abdomen. This escape behavior is mediate by lateral giant interneurons (LGs) and habituates readily upon repetitive stimulation. To analyze the effect of social status on LG habituation, time courses of habituation were investigated electrophysiologically and compared between dominant, subordinate and socially isolated crayfishes. Results suggested that establishment of social status inhibits habituation and increases the stimulus number needed to habituate.

THRESHOLD TIME DISPARITY OF PYRAMIDAL CELLS IN THE ELECTROSENSORY LATERAL LINE LOBE OF *GYMNARCHUS NILOTICUS*

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Time disparity on the order of microseconds within electrosensory feedback signals is an essential cue for the behavior of 'jamming avoidance response' of a weakly electric fish *Gymnarchus*. The computation of time disparity occurs within the electrosensory lateral line lobe (ELL), where time disparity-sensitive pyramidal cells reside. We recorded extracellular single-unit responses of pyramidal cells to sinusoidally (2Hz) modulated time disparity with various depths (0 to 200 μs) to determine threshold time disparities of pyramidal cells. Of 123 units in total, 60% of the units showed statistically significant responses to 5 μ s, 25% responded to 1 μ s of time disparity. The most sensitive unit showed a threshold at 0.5 μ s (n=3). This high sensitivity was preserved even the center phase of modulation cycle was shifted over 250 μ s around 0 μ s, suggesting the neuron's adaptability to modulated time disparity under different center phase which is steady-state. On the other hand, firing timings of primary and secondary electrosensory afferent neurons changed in response to steady-state phase shift. This result suggests that adaptation occurs within the ELL.

NEURAL NETWORKS CONTROLLING SQUID CHROMATOPHORE ORGANS IN LOCAL SKIN AREA

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Expansion and retraction of numerous chromatophore organs cause color changes in the mantle skin of squid, and these chromatophore organs are directly innervated by motoneurons located in the brain. Although the mantle skin is separated from the brain, black and yellow chromatophores show spontaneous expansion and retraction. The timings of the expansion and retraction among black and yellow chromatophores were highly synchronized. Artificial seawater containing various kinds of neurotransmitters was applied for an *in vitro* chromatophore bioassay, and we monitored spatial and temporal pattern of individual black and yellow chromatophores in the mantle skin. FMRFamide at 10^{-5} M caused expansion of black chromatophores and retraction of yellow ones. By immunohistochemical staining, the FMRFamide-immunoreactive cell bodies were observed beneath the mantle skin, and indicate a possibility that FMRFamide modulates rhythmical motion of the chromatophores. These results suggest that there is a local neural network on the mantle skin, and the chromatophores are dually innervated by central and local neurons.

CONTROL MECHANISMS OF FEEDING BEHAVIOR IN HYDRA: INHIBITION OF FEEDING RESPONSES IN SATIATED HYDRA

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Hydra has the simplest nerve net among animals, diffuse nerve net without ganglia or brain. We have observed the rise of feeding threshold in satiated hydra. We suggested the central control mechanisms of feeding behavior in hydra. In the present study, we analyzed the inhibition of feeding responses of intact tentacles and isolated tentacles in satiated hydra. Results have shown that the receptor-effecter system for feeding responses is working completely in a isolated tentacle. Results also have shown that the control mechanisms of the inhibition of feeding response in a satiated hydra are working in isolated tentacles.

ANALYSIS OF SYNAPTIC CIRCUITS IN THE SUPERIOR PROTOCEREBRUM OF *DROSOPHILA MELANOGASTER* INVOLVING PDF-IMMUNOREACTIVE LATERAL NEURONS

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In *Drosophila melanogaster*, ventral lateral neurons (LN_vs) co-expressing pigment-dispersing-factor (PDF) and the product of the *period* gene are the master circadian pacemakers and send their main projections into the superior protocerebrum (sP). We investigated the synaptic connections of PDF-immunoreactive (PDF-ir) fibers in the sP by