RESPONSES OF TERMINAL ABDOMINAL GANGLION NEURONS TO MECHANICAL STIMULATION OF THE GENITALIA IN THE MALE CRICKET

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The male cricket switches behavior from courtship to aggression as soon as it extrudes the spermatophore during copulation. This change does not depend upon feedback from the periphery as a result of copulatory acts but upon the activation of the neural circuit in the terminal abdominal ganglion (TAG) responsible for dorsal pouch contraction underlying spermatophore extrusion. Intracellular recording from TAG neurons indicated that many neurons including ascending, efferent and local ones responded to mechanical stimulation of sensilla on the epiphallus, pouch and/or cercus, while some neurons specifically responded to that of sensilla inside the epiphallus with the model of the female copulatory papilla. The latter group was found to have dendritic arborizations in the lateralmost region of the TAG where the axons of afferent neurons innervating the epiphallic sensilla terminate.

GENITALIA CLEANING BEHAVIOR IN THE MALE CRICKET

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The genitalia of the male cricket Gryllus bimaculatus is housed in the subgental plate. The dorsal pouch and ventral lobes serving as a mould for the spermatophore in the subgenital plate are to be stained with foreign substances such as debris of the spermatophore material, feces, dusts and so on, particularly while it is opened during copulation and spermatophore preparation. Experiments were conducted on males with the inside of the subgenital plate (median pouch) soiled with a small debris. Video recording indicated that it was moved to the peripheral part of the median pouch by the characteristic movement of the median pouch to be taken into a small pocket located in the antero-lateral corner of the median pouch (Kumashiro and Sakai 2001) within 20 min. The surgical removal of the media pouch caused defects in the shape of the spermatophore. These results suggest that the median pouch plays a role in forming the normal shape of the spermatophore via keeping the median pouch clean.

COLLISION SENSITIVE NEURONS CODE A THRESHOLD SIZE OF RETINAL IMAGE IN THE OPTIC TECTUM OF THE BULLFROGS (*RANA CATESBEIANA*)

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The optic tectum (OT) of the frog provides the main interface for afferent retinal messages and efferent motor commands. In the present study, we focused on whether there is a specific class of tectal cells which respond selectively to objects moving on a direct collision course towards the frogs. With multi-electrode and single-electrode methods, collision sensitive neurons were found in OT ($n=56$), and the response characteristics were further examined using computer graphics to model looming stimuli. These collision sensitive neurons possessed smaller receptive field (RF) than those reported in pigeon and locust, and they can not be triggered with a looming object unless the focus of expansion of the image is located at the center of RF. Maximum response activity occurred when the approaching object had reached a specific visual angle ($\theta = 14.6° \pm 3.4°$, $n=16$), which is identical with the behavior data. Thus, we propose that these neurons compute the time at which visual angle of an approaching object reaches a specific value. This information may be used to initiate an avoidance behavior when the frog is facing to approaching looming objects.

COURTSHIP, AVOIDANCE AND AGGRESSIVE BEHAVIORS WERE INTRODUCED BY DIFFERENT COMPONENTS OF CUTICULAR PHEROMONES IN MALE CRICKET *GRYLLUS BIMACULATUS*

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Male crickets contact other crickets with their antenna and recognize the distinction of sexes by chemical substances called cuticular pheromones on the surface of the cricket body. Male crickets respond courtship behavior to female pheromones and avoidance or aggressive behaviors to male pheromones. Here we investigated to identify the components of cuticular pheromones using gas-liquid chromatography. Male cuticular pheromone contained unsaturated hydrocarbons more than female pheromones. Behavioral observation revealed that saturated hydrocarbons from both sexes introduced courtship behavior in male crickets and unsaturated hydrocarbons introduced avoidance behavior. Aggressive behavior was not evoked by the hydrocarbons. The volatile substances from male crickets were collected by absorption on Porapak-Q and recovered from the absorbent using ether. The volatile substances introduced aggressive behavior in male crickets. Our results indicate that cuticular pheromone in cricket consist of 3 components that are saturated hydrocarbons, unsaturated hydrocarbons and volatile substances that introduce courtship, avoidance and aggressive behaviors respectively.

ATTEMPT TO MAP THE HONEYBEE BRAIN REGIONS INVOLVED IN THE DANCE LANGUAGE BY USING THE IMMEDIATE EARLY GENE

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The honeybee can transmit the location of food to their nest mates by using the dance language. To identify the brain regions involved in the dance language, we have been trying to develop an experimental system to map the active regions in the honeybee brain, using an immediate early gene, which is expressed in response to neural excitation. In the present study, we will report the structural and expression analysis of a novel immediate early gene, termed *kakusei*. cDNA cloning suggested that *kakusei* may function as a non-coding RNA. *In situ* hybridization revealed that the expression of *kakusei* was induced in the mushroom boies and optic lobes of the honeybee brain after awaking from the anesthetization, suggesting that *kakusei* can be used as a neural excitation maker in the honeybee brain.

CONSOLIDATION OF LONG-TERM MEMORY BY ONE-TRIAL CTA LEARNING IN *LYMNAEA*

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The pond snail *Lymnaea stagnalis* acquires conditioned taste aversion (CTA) and maintains the long-term memory. In the typical laboratory situation, CTA requires 10 pairings of an appetitive conditional stimulus (CS, e.g. sucrose) with an aversive unconditional stimulus (US, e.g. potassium chloride). In the present study, we examined whether CTA can be formed by one-trial learning in snails. We show that a single pairing of the CS and US results in CTA that persists for one week in more than 30% of snails studied. This may be a more behaviorally relevant finding; as in the snails' natural environment they would not likely encounter 10 well timed pairings.

MORPHOLOGICAL AND PHYSIOLOGICAL CHARACTERISTICS OF PRE-NGI INTERNEURON INVOLVED IN CENTRAL COMPENSATION OF EYESTALK POSTURE OF CRAYFISH

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When a statolith is removed unilaterally in crayfish, the eyestalk posture becomes bilaterally asymmetrical in the upright body position, but restores the bilateral symmetry in several weeks. This central compensation process involves changes in both the passive membrane properties of and synaptic input to the nonspiking giant interneurons (NGIs) that are presynaptic to eyestalk motoneurons. Using simultaneous intracellular recording and staining techniques, we identified spiking and nonspiking interneurons that are presynaptic to NGIs. The I neuron, one of nonspiking local interneurons, had its soma in the dorsal anterior cluster in the protocerebrum, and extended its neurites onto the NGI cluster. It made graded synaptic transmittion to the NGI. The T neuron had its soma in the anterior cluster in the protocerebrum, and extended its neurites to the anterior medial protocerebral neuropile and parolfactory lobe in the deutocerebrum on both sides. It generated spikes and made polysynaptic excitatory connection with NGIs. The result suggests that these interneurons are involved in the central compensation of eyestalk posture.

WHERE IS RESPONSIBLE FOR THE ALARM PHEROMONE PROCESSING IN THE ANT BRAIN?

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Pheromones are critical to colonial behaviors in social insects. Alarm pheromones, for example, allow colony members to increase alertness of individuals and evoke defensive behavior toward possible source of danger. Therefore, analysis of brain mechanisms of such pheromone processing will provide cues for better understanding about social behaviors.In this study, we found that two kinds of alarm pheromones, formic acid and undecane, evoke different behavioral responses, elusion and attraction, respectively, in the ant Camponotus obscuripes. We made successful intracellular recordings and subsequent Lucifer yellow fills from 160 neurons in the brains of ants. We found many neurons in the protocerebrum, including the mushroom bodies, respond to alarm pheromones. In the antennal lobe, we identified