Modulation of olfactory and gustatory sensitivity mediated by sensory experience in moths : a simple form of social learning ?

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Résumé en anglais	As do vertebrates, insects show a high degree of phenotypic plasticity, which enables them to adapt their behavioural responses to their surrounding world. For example, social insects such as honeybees are able to perform complex learning tasks, similar to vertebrates. Non-social insects such as flies or moths can also associate sensory information with rewards or punishment. Non-associative forms of learning include sensitization and habituation to sensory cues originating from conspecifics or the biotic or abiotic environment. Often sensitization and habituation are the result of multiple exposures to sensory stimuli, but we have evidence in moths that a single exposure can also elicit long-lasting sensitization. The capacity to use sensory experience to adapt responses to social contexts by developing increased sensitivity to salient sensory cues from conspecifics and heterospecifics can be interpreted as a simple form of social learning. We summarize here intra- and cross-modal effects of brief pre-exposure to different stimuli on the behaviour and underlying neural mechanisms in male moths. Moths are an ideal model for this type of approach because different sensory stimuli are well known to trigger a number of well-defined behaviours in different contexts and their nervous system is relatively simple, well-described and accessible. Adult males respond to low doses of highly specific female-produced sex pheromones to find a mating partner and to flower odours to find food sources. Host plant odours can also complement the sex pheromone for a better localization of conspecific females. For feeding, the quality of a food source is evaluated upon contact, where sucrose concentration indicates nutritional value and bitter substances indicate non-palatability or toxicity. Male moths also detect ultrasound emitted by bats, their natural enemies. Behavioural analyses have shown that a brief exposure to any of the mentioned sensory stimuli increases responses to the sex pheromone after 24 hr. In addition, responses to gustatory stimuli are increased by brief pre-exposure to gustatory and pheromone stimuli. These reciprocal effects indicate that the described phenomena represent a form of general sensitization or maturation of the sensory systems, rather than selective attention. Attempts to localize modifications within the nervous system after brief pre-exposure indicate no or rather small changes in peripheral sensory systems caused by intra-modal exposure. In the primary olfactory centre, the antennal lobe, response thresholds of projection neurons to the sex pheromone and plant odours decreased after pre-exposure to the sex pheromone, to a bat-mimicking sound, but not to sucrose. In addition, the part of the antennal lobe processing information on the major sex pheromone compound increased in size after pre-exposure to the sex pheromone, probably indicating an increase in synaptic connections. These neurobiological approaches indicate that intra- and cross-modal effects of sensory pre-exposure might originate from modality-dependent changes at multiple levels within the nervous system.
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