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Neural circuitry for detection of insect repellent DEET and attractive sugar in Drosophila

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Insects utilize sophisticated olfactory and gustatory systems to detect chemicals in the environment. These chemicals provide important attractive and aversive cues that insects use to feed and avoid toxins. The insect repellent DEET is detected by both the olfactory and gustatory system and has remained unimproved for more than six decades because the target receptors and neurons were unknown. In a recent study, we identified olfactory DEET-sensitive neurons in a pit-like structure in Drosophila antenna called the sacculus that express a highly conserved receptor, Ir40a. Flies in which these neurons are silenced or Ir40a is knocked down lose avoidance to DEET. DEET also evokes contact repellency and we have identified that Gr33a+ and Gr89a+ neurons of the labellum and labral sense organ (LSO) of the pharynx, which are bitter taste neurons, are activated by DEET. We have extended our analysis to trace DEET-activated neurons that convey information from the first gustatory center called the suboesophageal ganglion (SOG) to higher brain centers. In parallel experiments, we have also identified candidate projection neurons that make connections with primary sweet taste neurons in the SOG and project to higher brain areas. Behavioral analyses and calcium imaging experiments provide support for the idea that the identified neurons convey sweet taste information to higher brain centers. Current efforts are directed towards systematic neuroanatomical and functional analysis of the identified neurons in aversive (DEET) and attractive (sucrose)-evoked chemosensory behaviors. An understanding of the processing centers for repellency and ingestion may lead to novel tools for safe and affordable strategies for insect control.

Reference:

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