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Olfactory coding and plasticity in parallel olfactory pathways of the honeybee

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Honeybees are a traditional model for addressing the neural basis of olfactory perception and learning, as olfaction is a crucial sensory modality used within the colony for intraspecific communication but also outside the colony during foraging. In honeybees, odors are detected by sensory neurons on the antennae, which project to a primary processing centre, the antennal lobe (AL). Then two main tracts of projection neurons convey odor information to higher-order brain centers, the mushroom bodies (MB) and the lateral horn (LH). Strikingly, the honeybee brain contains a dual olfactory system, with a clear dichotomy from the periphery up to higher-order centres, subtended by two main neuronal tracts (median and lateral Antenno-Protocerebral Tract, m-APT and l-APT). Such dual system may be the basis for parallel processing of olfactory stimuli, but the exact function of this system is still unclear. We are thus performing a functional study of olfactory coding and plasticity in both subsystems, using in vivo calcium imaging to reveal neuronal activity. Olfactory coding of general odorants appears mostly redundant in both subsystems, but still shows some specificities according to the odorants' chain length and/or functional group information. Concerning pheromonal odorants, a dissociation between queen and brood pheromones was found. Here, we addressed possible differences in learning-induced plasticity and in olfactory mixture processing in both subsystems. Honeybees were first subjected to a differential conditioning procedure (A+B-) using the appetitive conditioning of the proboscis extension response (PER). Then they were subjected to in vivo calcium imaging recordings, either in the standard preparation to record l-APT projection neurons, or in the inverted preparation to record m-APT neurons (Carcaud et al. 2012). In these tests, a range of AB mixtures with gradual changes in component ratios was presented. Analysis of the data is currently under way.