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Tracking a dynamic odor plume in a noisy chemical environment

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Natural, behaviorally significant olfactory stimuli typically are mixtures of volatiles whose concentrations co-vary dynamically in time and space. The olfactory world is also an arena of constant movement and flux. Once emitted by a source, volatiles are dispersed and mixed by the ambient motion of air to form a shifting and filamentous plume. How does the olfactory system quickly discriminate the fluctuating signal from a background? We examined this process using the moth, *Manduca sexta*, and the volatiles from its hostplant, *Datura wrightii*. Using proton-transfer-reaction mass spectrometry, the fluctuating odor plume from *D. wrightii* flowers were characterized in field sites near Tucson AZ USA. Results from these measurements demonstrated that, even within the headspace of the flower, the ion plume was highly dynamic in both time and space. Moreover, with increasing distance from the source, the chemical background became mixed with the flower plume. We examined the ability of the moths to encode the temporally dynamic signal by multi-channel recording in the moth's antennal (olfactory) lobe (AL). The neural ensemble could track the mixture of the flower odor at temporal frequencies up to 5 Hz. However, when an odor background was presented, the ensemble representation of the flower mixture decreased. The change in AL representation was due to the changing of the ratios in the presented stimulus, thereby altering the balance of excitation and inhibition in the system. Finally, behavioral experiments in a wind tunnel showed that the ability to track a plume significantly decreased when background odors of increasing similarity to the floral mixtures were presented. Together, these results provide new evidence that in moths, upwind orientation to mixtures is mediated by the precise integration of multiple glomerular pathways, and that alteration of the mixture input transforms the network representations.

Poster session II Poster #60

Brain-behavioural lateralization in honeybees: odour dependent asymmetry and a morphological comparison of the Antennal Lobes

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Recently, a lateralization in the recall of odour memories was revealed in the honeybee, *Apis mellifera,* showing a right dominance on short-term odour retention. In addition, it was demonstrated that odour detection in honeybees is not equal between the antennae, with the right one showing higher level of depolarization after odour presentations and higher number of olfactory sensilla. Here we want to present results on the anatomical measurements between the right and left side in the first olfactory centers of the honeybee brain, the Antennal Lobes (ALs). A subset of the ALs' functional units, the glomeruli, was imaged using two-photon microscopy, and volumetrical reconstructions were compared between sides. Furthermore, we performed single-antenna recall test conditioning bees to extend their proboscis (in the so-called PER paradigm) in association to those odours that more strongly activated functional responses in the selected glomerular subset. Anatomical analysis did not reveal significant differences between sides but the behavioural tests showed an odour dependence in the capacity of bees to recall compounds with the two antennae. These data provide new evidence on the odour effect on behavioural asymmetries in honeybees as well as on the quest for the anatomical differences beyond the lateralized behaviour.