A Neural Substrate for Olfactory Scene Analysis in Lobster

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There is no understanding of what, if any, strategy might be utilized by the olfactory system to capture signal intermittency. We show through computational modeling that a bursting subset of primary olfactory receptor neurons (bORNs) have the unexpected capacity to encode the temporal properties of intermittent odor signals.Based on differences in their inherent rate of bursting discharge and the phase dependency of their response to odor stimulation, each bORN is tuned to a specific range of stimulus frequencies. Those bORNs that fall within a given range of inherent bursting frequency are synchronized by the odor intermittency. Collectively, bORNs can encode a wide spectrum of stimulus intermittency that can be decoded from the instantaneous response of the bORN population. Our model argues for the existence of a novel peripheral mechanism for encoding temporal pattern of odor signals that potentially serves as a neural substrate for olfactory scene analysis.