CDB SEMINAR

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16:00~17:00 Seminar Room A7F

Cortical representation of olfactory bulb input revealed by retrograde mono-transsynaptic labeling

Summary

In the mouse, each class of olfactory sensory neurons expressing a given odorant receptor converges their axons onto two specific glomeruli in the olfactory bulb (OB), thereby creating an odor map. An important unresolved question is how the spatial odor map in the olfactory bulb is represented in the olfactory cortex. Here we combine rabies virus-dependent retrograde mono-transsynaptic labeling with mouse genetics to control the location, number and type of 'starter' cortical neurons, from which we trace their presynaptic neurons. Our study revealed general principles that define cortical representations of the OB input. First, we find that individual cortical neurons receive direct convergent input from mitral cells representing multiple glomeruli. Layer I inhibitory neurons have a ~6 fold higher mitral cell convergence ratio compared to the one for excitatory pyramidal neurons, a result matching very well with recent slice physiology studies. Second, we find that cortical neurons within a small area (as few as 2-3 neurons less than 100 microns apart) receive input from glomeruli distributed widely across the OB, suggesting that the olfactory information from individual glomeruli is widely distributed in the cortex. Indeed, statistical analysis allows us to conclude that individual mitral cells representing the same glomerulus connect with their cortical partners independently. Third, we demonstrate that different cortical areas represent the OB input differently. For example, the cortical amygdala preferentially receives dorsal OB input, whereas the piriform cortex samples the whole OB without any obvious spatial bias. These differences likely reflect different functions of these cortical areas in mediating innate odor preference or associative memory. Finally, our study provides a new general strategy for mapping long-distance synaptic connections in the mammalian brain starting from genetically defined neurons in a particular region of the brain.

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