

【Grant-in-Aid for Specially Promoted Research】

Biological Sciences



Title of Project : Elucidation of the link of the gene, neural circuit, and behavior in the mouse olfactory system

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Research Area : Neurophysiology

Keyword : neuron, synapse, and neural circuit

【Purpose and Background of the Research】

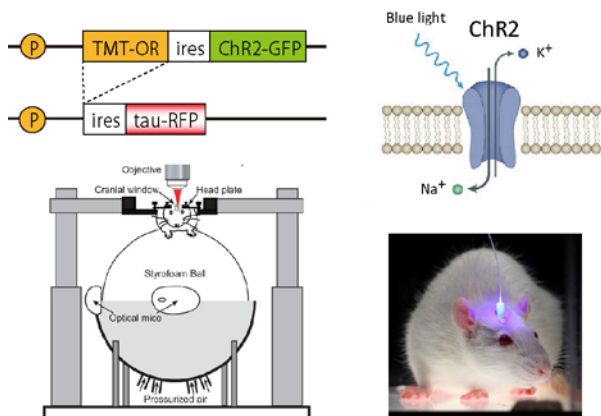
In the vertebrate nervous system, sensory information is spatially encoded in the brain, forming topographic maps that are fundamental for higher-order processing of sensory information. We will attempt to understand the link of the gene, neural circuit and behavior. Using the mouse olfactory system, we will try to understand how the two sensory decisions, one is by an innate hard-wired circuit and the other is by a memory-based learned circuit, are balanced and integrated in the central brain. This research will offer a new insight into the memory and consciousness of humans. Furthermore, it will shed light on the clinical application of mental disorders, such as autism and depression.

【Research Methods】

Specific aims and methods are as follows:

We will study the synapse formation of olfactory sensory neurons (OSNs) and mitral/tufted (M/T) cells, using various mutant mice in the lab, which affect glomerular formation and axonal projection of OSNs. We will also study how the M/T cells target to the olfactory cortex (OC). Axonal projection of M/T cells to the OC will be analyzed by injecting dye or trans-synaptic viruses. We will concentrate on the neural circuits for fox smell-induced fear responses. To analyze the neural circuits for fear responses,

Fig. 1 Genetic manipulations of olfactory neural circuits

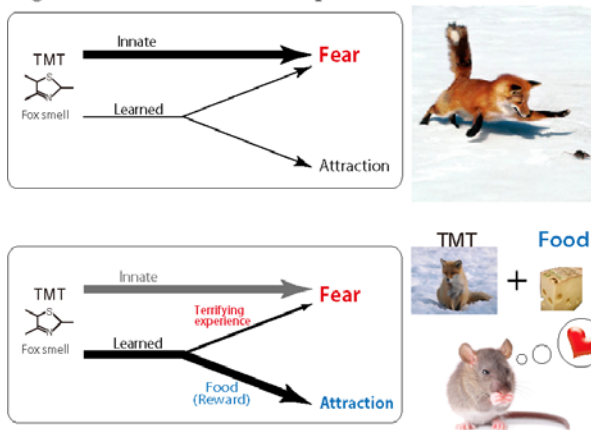


TMT-responsive OR genes will be cloned and then knocked-out or GFP-tagged. They will also be labeled with the channel-rhodopsin gene (ChR2) to perform the gain-of-function experiment for the TMT-responsive neural circuits.

【Expected Research Achievements and Scientific Significance】

The proposed research is expected to reveal how the M/T cells are instructed by OSNs, and how the axonal projection to the OC is regulated. This research will also clarify how the odor information is processed for a particular behavior in mammals. These studies will contribute to our understanding of axonal projection and neural circuit formation, not only in the olfactory system, but also in the mammalian brain in general.

Fig. 2 Innate vs. learned responses to fox smell, TMT



【Publication Relevant to the Project】

Mori, K. and Sakano, H.: How is the olfactory map formed and interpreted in the mammalian brain? *Ann. Rev. Neurosci.* **34**, 465-497 (2011).

【Term of Project】 FY2012-FY2016

【Budget Allocation】 385, 000 Thousand Yen

【Homepage Address and Other Contact Information】

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