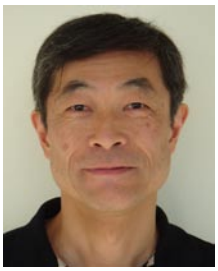
【Grant-in-Aid for Scientific Research(S)】
Integrated Science and Innovative Science (Comprehensive fields)



Title of Project : Exploring the genomic basis for the species difference in the neural circuitry for male courtship in *Drosophila*

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Research Area : Neuroscience in general
Keyword : Molecular and cellular neuroscience

【Purpose and Background of the Research】

We cloned the gene *fruitless (fru)*, whose loss-of-function mutations enhance male-to-male courtship in *Drosophila* males. The Fru protein masculinizes the nervous system because the ectopic expression of Fru in females results in the generation of male-specific muscle of Lawrence (MOL) and male-typical courtship behavior in such females. Some of the *fru*-expressing neurons exhibit conspicuous sexual dimorphism, which is indeed *fru*-dependent. One of the *fru*-expressing interneuron clusters, P1, is male-specific. Ectopic formation of a P1 MARCM clone in the female brain allows her to display male-typical courtship, indicating that P1 plays a role in triggering male-typical courtship behavior. These observations led to the hypothesis that *fru* orchestrates the transcriptional network of genes that function to form the male courtship circuit, just as a master control gene, *eyeless*, does in eye development.

In the proposed project, we endeavor to disclose the mechanism whereby the *fru* genes of different *Drosophila* species organize the neural circuitry in species-specific ways, thus, enabling males to perform behaviors with conspecific patterns. This study is expected to open up an avenue for the study of molecular and cellular bases for the divergence in behavioral patterns, which is probably not just a result of, but also a cause of, speciation.

【Research Methods】

1. Clone the genomic sequence 5' to the most distal promoter of *fru* for up to 30 kb in both *subobscura* and *melanogaster*, 2. Construct a series of transgenes, *sub-fru5'-Gal4* and *mel-fru5'-Gal4*, each carrying a *fru5'* fragment of different length, 3. Generate transgenic lines harboring these transgenes in *melanogaster*, 4. Identify exhaustively the Gal4 expressing neurons in all transgenic flies generated as above by MARCM, 5. Express dTrpA1 in all neurons composing the *mel-fru5'* and *sub-fru5'* circuitries, activate them with temperature increases and see if this forcible activation of each circuitry induces courtship behavior characteristic of respective species, 6. Determine which neurons are crucial for the determination of species-types of courtship behavior by restricting the number of cells to be activated by MARCM, and 7. Establish causality among the species differences at three levels; the *fru cis*-element, identified neuronal connections and courtship behavioral patterns.

【Expected Research Achievements and Scientific Significance】

Our proposed project will attempt to reconstitute the *subobscura* neural circuitry for courtship in the *melanogaster* brain by "transplanting" the *cis* element of *subobscura fru* into the *melanogaster* genome in the form of the Gal4 fusion transgene. This will allow us to visualize and genetically manipulate the neurons in which the *cis* element of *subobscura fru* (*sub-fru5*) is active.

This study will elucidate the hitherto unknown mechanism whereby genomic changes and the selective forces upon them shape the brain circuitry and therefore drive the evolution of behavior. The principles thus unveiled would help us to understand how the diversification in behavior took place, and possibly even help us to learn know how we acquired the uniquely human brain.

【Publications Relevant to the Project】

Goto, J., Mikawa, Y., Koganezawa, M., Ito, H. and Yamamoto, D. (2011) Sexually dimorphic shaping of interneuron dendrites involves the Hunchback transcription factor. J. Neurosci. 31, 5454-5459.

Kohatsu, S., Koganezawa, M. and Yamamoto, D. (2011) Female contact activates male-specific interneurons that trigger stereotypic courtship behavior in *Drosophila*. Neuron 69, 498-508.

【Term of Project】 FY2011-2015
【Budget Allocation】 165,200 Thousand Yen

【Homepage Address and Other Contact Information】

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