DIVISION OF SPECIATION MECHANISMS I

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Our research goal is to understand mechanisms underlying evolution of the nervous system. In order to approach this question, we are studying the genes that are expressed in the specific areas of the primate neocortex. Using differential display method, we have obtained genes that showed marked differences within the primate neocortex.

Our second approach is to understand informational processing in the brain underlying learning behaviors with gene expression techniques. Here, we report our findings in the year of 2000.

I. Genes expressed in specific areas of the neocortex

The neocortex is most evolved in mammals, particularly in primates, and thought to play the major role in higher functions of the brain. It is known to be divided into distinct functional and anatomical areas and has been a matter of debate what extent the areas of the neocortex are genetically and environmentally determined. It is also puzzling why, during the evolution of mammals, the neocortex was most markedly expanded while the number of the genes in the mammal was little changed. To access these questions, we studied gene expression within different areas of the neocortex.

1) In collaboration with Professor Hiroyuki Nawa (Nigata university), we used DNA macroarray technique to examine gene expression in the areas of human prefrontal, motor and visual cortexes. We found almost all the genes among 1088 genes examined showed only less than a factor of two in the difference of their expressions. Only one gene showed more than three fold difference and another one was between two and three fold difference within the three areas. These results suggest that the genes that are expressed among the different areas of the human neocortex are very similar. However, the question remained whether there are any genes that show marked difference within areas of neocortex.

2) In order to answer this question, we employed differential display methods and found at least two genes that indicated the area specific expression.

i) One, designated *occ1* is specifically expressed in the occipital cortex, particularly in V1 area, in the primate brain. Furthermore, the expression of occ1 turned out to be activity dependent, because, in the monocularly deprive–monkeys with being injected TTX into one of eyes, the expression of occ1 is markedly decreased in the ocular dominance columns of the primary visual cortex (V1).

ii) The other gene that showed marked difference within the neocortex, is gdf7, a member of BMP/TGF-β family, which is specifically expressed in the motor cortex of the African green monkey. We are currently examining the detailed expression pattern of the both genes.

3) We have also further isolatied several area specific genes with RLCS (Restriction Landmark cDNA Scanning).

II. Gene expression under audio-visual discrimination task

We are studying gene expression of c-Fos under audio-visual discrimination tasks in collaboration with professor Yoshio Sakurai (Kyoto University). We found that the visual and audio tasks enhanced the specific expression of c-Fos in the visual and audio cortex, respectively. Among the early visual and auditory pathways examined, c-Fos was specifically induced in the cortexes but not in the earlier pathways, suggesting the neural modulation of the neocortex depending on the types of the tasks. We are currently identifying the neuronal cell types in the cortical area that induced c-Fos depending on the relevant task.

Publication list:

Original Articles

Watakabe, A., Sugai, T., Nakaya, N., Wakabayashi, K., Takahashi, H., Yamamori, T. and Nawa, H. Similarity and variation in gene expression among human

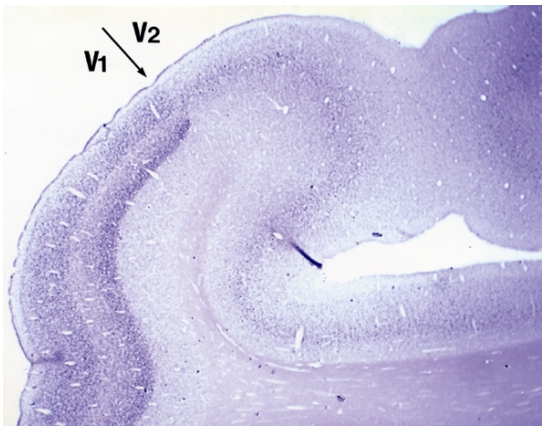

Fig. 1 Expression pattern of occ1 in the visual cortex.
In situ hybridization pattern of *occ1* in the primate visual cortex. Occ1 is markedly expressed in the layer IVcβ and moderately in the layers of II, III and IVa in area V1. The boundary between V1 and V2 is shown by an arrow.

cereberal cortical subregions: an mRNA expression profiling study using DNA macroarrays. *Molec. Brain Res*. (in press)

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Watakabe, A., Fujita, H., Hayashi, M., and Yamamori, T. GDF7, a BMP/TGF beta family member, is enriched in the primary motor area of monkey neocortex. *J. Neurochem.* (in press).

Karachot, L., Shirai, Y., Vigot, R., Yamamori, T. and Ito, M . Rapidly turned over protein maintains metabotropic synaptic transmission. *NeuroReport* **11**, 2903-2906, 2000

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Abstracts

Watakabe, A., Komatsu Y., Fujita, H., Hayashi, M., Yamamori, T. GDF7, a BMP/TGFβ family member, is enriched in the primary motor area of monkey neocortex. In the abstracts of the 30th Society for Neuroscience of North America. pp609, 2000

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Sakata, S., Kitsukawa, T., Sakurai, Y., Yamamori, T. Attention modulates fos expression in rat auditory cortex. In the abstracts of the 30th Society for Neuroscience of North America. pp2230, 2000

Vigot, R., Batini, C., Kado, R.T., Yamamori, T. Long lasting LTD recorded in the unanesthetized rat cerebellum. In the abstracts of the 30th Society for Neuroscience of North America. pp1394, 2000