

Neural Mechanisms of Higher Thought Processes in Human

Katsuyuki Sakai

(The University of Tokyo, Graduate School of Medicine, Associate Professor)

【Outline of survey】

Higher thought processes in humans such as language and arithmetic are based on the ability of cognitive manipulation, with which we transform external information according to the behavioral goals. My hypothesis is that each type of cognitive manipulations is represented as a discrete functional module in a local brain region and that complex thought processes are mediated by its interaction with external information. Thus the present research project is aimed at understanding the mechanisms of higher thought processes in the human brain by decomposing them into the constituent building blocks. The project is also aimed at identifying the neural correlates of intention for thought. I strongly believe that the workings of the brain are determined by the quantity of information represented in local brain regions and also by the efficiency in the transfer of the information across brain regions. Therefore the research involves development of novel techniques to visualize in the human brain the spatial pattern of neural activation with an order of a millimeter and the temporal dynamics of neural signal transmission with an order of ten milliseconds. The ultimate goal is to determine the causal relationship between the brain and thought.

【Expected results】

A patient who is thought to be unconscious may actually be fully aware of the environment but is unable to express his inner thoughts. The present research project opens up a possibility to read hidden intentions of such patients. This technique of mind reading can also be applied to normal people and this may lead to the development of novel media technologies. Since the project deals with fundamental issues of the causal relationships between the brain and mind, it will lead to various forms of inter-disciplinary research involving computational science, philosophy and law.

【References】

- Haynes JD, Sakai K, Rees G, Gilbert S, Frith C, Passingham RE. Reading hidden intentions in the human brain. *Current Biology* **17**: 323-328, 2007
- Sakai K. Task set and prefrontal cortex. *Annual Review Neuroscience*, in press

【 Term of project 】 FY2007 - 2011

【Budget allocation】 23,200,000 yen

(2007 direct cost)

【Homepage address】

<http://square.umin.ac.jp/dcntky/>