

FUNDING PROGRAM FOR NEXT GENERATION WORLD-LEADING RESEARCHERS

Project Title: Understanding the mechanisms of cognitive control by measuring synaptic functions in the human brain

Name: Katsuyuki SAKAI

Institution: The University of Tokyo

1. Background of research

The brain is not just a collection of specialized brain regions or neurons, but rather a multi-layered large-scale network. Our mental activity is a result of neural impulse transmission within this network. Its remarkable property is the ability to flexibly change the pattern of impulse transmission according to our behavioral goal. We now know that synaptic plasticity is the key mechanism for the network flexibility. However, we do not have methods to examine synaptic functions in the human brain.

2. Research objectives

Previously we have developed concurrent brain stimulation and recording technique and demonstrated task-dependent changes in the pattern of neural impulse transmission across brain regions. In this project, we develop the technique further and establish methods to measure synaptic functions in the human brain. Our goal is to clarify the synaptic mechanisms underlying human thought and behavioral control. Also we aim to establish methods to investigate the impairment of synaptic mechanisms in neuro-psychiatric disorders.

3. Research characteristics (incl. originality and creativity)

Synaptic functions have been examined using brain slices or invertebrate nervous system. The originality of this project lies in its technological development to examine synaptic functions in the living human brain. In contrast to the traditional brain mapping approach, the technique will allow us to examine the flow of neural impulse within the brain network and deepen our understanding of the neural mechanisms of human thought and behavior.

4. Anticipated effects and future applications of research

The techniques developed in this project can be extended to clinical fields: We will be able to detect impairments of synaptic functions in neuro-psychiatric disorders such as schizophrenia and Alzheimer disease. It is thought that synaptic functions are affected first in these disorders. Hopefully this project will make early diagnosis possible and provide clues to develop new treatment strategies.