Form 1-5-2

Japan-U.S. Brain Research Cooperation Program
Researchers Dispatched to the U.S. Program FY2014: Report

Field: Development/Plasticity/Repair

1. Researcher

Name: Hitoshi Shitara
Title: Assistant professor
Affiliation: Department of Orthopaedic Surgery, Gunma University Graduate School of Medicine

2. Research Title:

Motor learning enhancement by combining real-time functional MRI-guided neurofeedback with non-invasive brain stimulation

3. U.S. Joint Researchers/Institutes
Please give the name, title and affiliation.

Name: Dr. Mark Hallett
Title: Chief
Institution: Human Motor Control Section, National Institute of Neurological Disorders and Stroke

4. Research Period, from/to (mm/dd/yyyy):

From 6/23/2014 to 9/22/2014
From 9/27/2014 to 3/23/2015

5. Abstract, Results, and Research Significance (300 Words):

An emerging method in the field of functional MRI (fMRI) research is real-time fMRI-guided neurofeedback (rtfMRI-guided NF), which has been developed to modify the state of the brain and to treat mood, cognitive, and motor disorders. This technique may offer significant advantages over competing techniques in terms of engendering more persistent effects and minimizing adverse side effects. However, the use of this technique for clinical applications is limited by the capacity of subjects to quickly learn to modulate brain activity during task performance and the limited understanding of the neurophysiological mechanisms that mediate the beneficial effects of rtfMRI-guided NF on brain repair and plasticity. To develop an enhancement technique of motor learning to a practically useful degree with sufficient effect size, it will be ideal to combine two techniques: rtfMRI-based NF (from Dr Hallett's lab) and EEG-based NF (traditional biofeedback with a high temporal resolution). Here I propose the following research to be conducted in Dr Hallett's laboratory at National Institute of Neurological Disorders and Stroke.

Research Purpose

1. To decode a "Successful" brain state when participants were able to perform speedy and precisely. To determine optimal information and timing of the feedback
2. rtfMRI/EEG-guided NF training leading to a "Successful" brain state

We applied visuo-motor tracking task as a motor learning task. Subjects controlled a joystick by non-dominant hand, and tracked the randomly moving target by the subject's control signal. Healthy subjects participated in EEG or fMRI study, not combine both of them. We collected clean data before simultaneous fMRI/EEG study because this study is explorative. Brain states including activity and connectivity were extracted just before performing the task. I am working on the analysis to investigate the relationship between the brain states and high performance (speed and accuracy) of the motor learning task.

6. Other (Research concerns, particular points of note):
None

*Please attach any reference materials as necessary.