Form 2-4-2

Japan-U.S. Brain Research Cooperation Program
Group Joint Study Project Program FY2015- FY2017: Report

Field: ③

1. Principal Researcher
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   Title; Professor
   Affiliation; Tamagawa University Brain Science Institute

2. Project Title:
   Contribution of functional connectivity within the prefrontal network to higher cognitive decision-making

3. Japanese Group
   Names, Titles and Affiliations of Principal Researcher and Collaborating Research Members
   Masamichi Sakagami (Brain Science Institute, Tamagawa University・Professor)
   Mineki Oguchi (Brain Science Institute, Tamagawa University・Research Assistant Professor)
   Shingo Tanaka (Niigata University, Medical School・Assistant Professor)

4. U.S. Group
   Names, Titles and Affiliations of Principal Researcher and Collaborating Research Members
   Suzanne N. Haber (Rochester University & Harvard University・Professor)
   John P. O' Doherty (California Institute of Technology・Professor)
   Julia F. Lehman (Rochester University・Research Assistant Professor)
   Eun Young Choi (Rochester University・Postdoctoral Research Associate)
   Anna Borkowska-Belanger (Rochester University・Senior Technical Associate)

5. ResearchPeriod, from/to (mm/dd/yyyy) and total number of years.
   From April 17, 2015 To March 31, 2018 (3Years)

6. Abstract, Results, and Research Significance (300 words):

Animals with well-developed prefrontal cortex (PFC) such as primates are enable to execute complex decision-making processes. A lot of studies have shown that subareas in the PFC play different but essential roles for value calculation and comparison. However, few studies directly examined the functional difference among subareas in the PFC and their interaction. The aim of this joint research was to clarify the exact mechanisms through which the prefrontal network contributes to higher-level decision making.

To examine dynamic signal processing related to value-based decision-making in the PFC, we recorded LFPs (local field potentials) from 256 ECoG (ElectroCorticoGram) electrodes implanted in the LPFC (lateral prefrontal cortex), the OFC (orbitofrontal cortex) and the MPFC (medial prefrontal cortex), while two monkeys performed a free-choice task with 6 different juices. In this task, two reward cues which indicated the kinds of juices were presented sequentially with a short blank. Then, two cues were presented simultaneously and the monkeys touched one of them to obtain juice reward. From the choice behavior the task, the values of the rewards could be estimated. Then we decoded the values of juices from the ECoG signals during 1st reward cue presentation. We used the wavelet power and phase in five frequency domains as features and decoded values of the rewards with Sparse Linear Regression (SLiR) algorithm. Decoded values from 3 areas were significantly correlated with the behaviorally estimated values. Also, we could show the information flow from visual process (posterior LPFC) to value process (anterior LPFC, then OFC and MPFC) in the prefrontal circuit from the decoding analysis by the collaboration with Professor O'Doherty. And these findings on the information flow were further confirmed by the anatomical studies (tracer injection study and electrical stimulation study) with Professor Haber.

7. Other (Research-related concerns, particular points of note):
   In this joint project, we performed electrophysiological experiments in Japan and neuroanatomical experiments in USA. Then, not only we had to visit USA but also researchers in USA had to visit Japan. The program could well support our visits to USA but couldn't support our collaborators' visits

to Japan. For more efficient collaboration, I hope the program can support mutual visit.

*Please attach any reference materials as necessary.