R&D Theme

Developing technology for inter-personal comparison of pleasure and aspiration by human brain indicators

Progress until FY2022

1. Outline of the project

We need to measure the "goodness" of each policy at the group and societal level to make our society free and fair. However, it is known that such an index cannot be successfully created without methods for comparing the well-being (or utility) of different people (Arrow's impossibility theorem; Arrow, 1963). It is also known that it is impossible to compare utility across individuals using classical methods based solely on behavioral data. In our project, we propose methods to measure well-being in an interpersonally comparable manner by combining various physiological indices (Plan 3-1).

In addition, we are strengthening our MEG research system to clarify the neural circuit dynamics of human pleasure and aspiration, and have human MEG and marmoset ECoG experiments on "sense of self of agency" and MEG experiments on "narrative self" underway (Issue 3-2).

Interpersonal comparison of utility

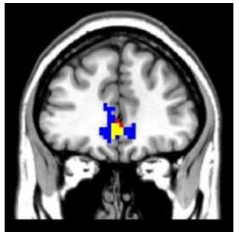
It is thought that the poorer a person is, the more pleased they will be when they receive 10,000 yen. However, there is no scientific method to compare the pleasure across individuals.

2. Outcome so far

(1) Quantification of the intensity of pleasure using brain indices

●We determined the direction for the development of a technique for reading utility with high accuracy (multi-echo fMRI imaging, analysis using generative models).

● We are using an independent database (ABCD study) to analyze the activity of brain regions that we have identified as correlated with utility prediction error (Matsumori et al., 2021).



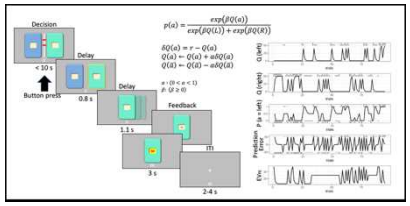
Neural representation of utility

● In order to reveal the dynamic process by which utility is computed in the brain at high temporal resolution, we determined the design of the utility task for the MEG experiment.

(2) Quantification of the aspiration using brain indices

●We determined the direction for the experimental task by focusing on "second-order desire (having the desire to have a certain desire)" (Frankfurt, 1971), which has been discussed in relation to free will.

●In order to clarify the neural dynamics of the process of constructing a model of the external world through interaction with the environment and the process of acquiring a "sense of agency," MEG measurements using an exploratory task were conducted on healthy subjects.



●To elucidate in detail the neural circuit dynamics of the "sense of agency" in vocalization, we analyzed cortical electroencephalography (ECoG) data acquired from electrodes (96 channels) covering the frontal and temporal lobes of a marmoset while the marmoset was required to vocalize with the voice of another individual. We observed suppression of activity in the auditory cortex and temporal changes in activity in the hemisphere during vocalization. The functional connectivity between the frontal and temporal lobes was investigated (presented at Japan Neuroscience Society and the Society for Neuroscience).

●In order to determine the neural circuit dynamics of autobiographical memory and its evaluation, which is at the core of the "narrative self," we determined the details of the autobiographical memory task for the MEG experiment in conjunction with R&D 2-1.

3. Future plans

We will try to develop utility estimation techniques using data that can be easily obtained from cameras. This will lead to applications in the evaluation of mobility policies in smart cities.

Using MEG with optically pumped atomic magnetometer (OPM), we will investigate brain activity during free and exploratory actions in a Virtual Reality (VR) space city (smart city, urban, rural, etc.), and reveal the neural circuit dynamics involved in the discovery of "pleasure" and "aspiration" associated with mobility.

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