Construction of an AIoT-based universal emotional state space and evaluation of well-/ill-being states

R&D item

2. Constructing a Universal Emotional State Space

Progress until FY2023

1. Outline of the project

This project aims to construct a 'universal' emotional state space that transcends animal species. To achieve this, we measure a variety of psycho-physiological data from both wildtype mice and disease model mice (e.g., autism model mice exhibiting increased anxiety and fear-related behavior, or mice with susceptibility or resilience to depression) under various conditions, including application of stimuli (Social Defeat Stress: SDS) or drug administrations that induce emotional responses. By combining psycho-physiological data obtained from both mice and humans, we aim to construct a universal emotional state space with biological validity. This project comprises the following two research topics.

1. Development of universal emotional state estimation technology

Summary: by combining IoT measurement data obtained from both mice and humans, we develop a universal emotional state space that transcends animal species and possesses biological validity.

2. Assessment of physiological data and emotional states in animals

Summary: to construct a universal emotional state space, it is essential to obtain psycho-physiological data from animals. Therefore, we will measure a variety of physiological signals from both wild-type mice and disease model mice (e.g., autism model mice exhibiting increased anxiety and fear-related behavior, or mice with susceptibility or resilience to depression) under various conditions, including application of stimuli (Social Defeat Stress : SDS) or drug administrations that induce emotional responses.

2. Outcome so far

To construct a universal emotional state space that transcends animal species, we investigated the application of transfer learning techniques to develop emotion estimation models for mice based on models originally developed for humans. Additionally, we examined how data from animals with specific conditions could be incorporated into the construction of emotion estimation models for humans. Furthermore, we collected foundational animal data for this study.

[Main Achievements by FY2022]

- An experimental protocol for the Social Defeat Stress (SDS) mouse model, a depression model was established.
- Surveyed a measurement system capable of continuously acquiring multiple physiological signals (e.g., electrocardiograms, body temperature, blood pressure, and acceleration) from mice over an extensive period, including the disease onset process.

[Main Achievements in FY2023]

We validated the protocol for SDS developed last year. Additionally, to evaluate the measurement system, we



measured physiological signal (body temperature and activity levels) responses before and after restraint stress, confirming that the measurement data contained information related to stress responses. Following this, we conducted long-term continuous measurements spanning from before to after the onset of depression (Figure 1).

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Furthermore, as a preliminary analysis, we analyzed alterations in the dynamical features of physiological signal fluctuations throughout the process from before to after the onset of the disease.

3. Future plans

- We will validate the applicability of the emotion estimation model developed for humans to mice.
- We will attempt to construct a new emotion estimation model utilizing data from both mice and humans.
- Physiological data will be collected from mice, including those subjected to SDS-induced stress.

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