

R&D Theme

## Constructing a Universal Emotional State Space

### Progress until FY2022

#### 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 wild-type mice and mice of disease models (mice with autism model 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 the psycho-physiological data obtained from both mice and humans, we aim to construct a universal emotional state that possesses biological validity. This project is comprised of 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 the 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 mice of disease models (mice with autism model 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 can be incorporated into the construction of emotion estimation models for humans.

Regarding the measurement of physiological signals in mice, we conducted the following tasks: 1) establishment of an experimental system dedicated to the measurement of physiological data in mice, 2) setup of an experimental environment for developing depressive mice models using social defeat stress (SDS), and 3) verification tests on a ring-type device aimed at measuring physiological data in mice.

In task 1), we evaluated the specifications of new measurement system capable of collecting physiological data, such as electrocardiogram, body temperature, blood pressure, and acceleration, in mice.

In setting up the experimental environment [task 2)], we allocated adequate space to conduct experiments such as the selection of highly aggressive ICR mice and the co-housing of ICR mice with stressed B6 mice. Given the need for space to conduct experiments involving the induction of social stress or post-stress social behavior tests, we made provisions for securing the necessary experimental space and installing the required equipment. Moreover, considering the need to use a large number of mice for social defeat stress experiments in this project, we also prepared separators to cohabitate ICR and B6 mice.

In task 3), we evaluated the feasibility of using a ring-type wearable device designed for humans to measure multiple physiological data in anesthetized mice. Based on the experimental results, we evaluated the optimal attachment

sites on the mouse's body, as well as the appropriate size and shape of the device for mice.

#### 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 by utilizing data from both mice and humans.
- We will collect physiological data from mice, including those with SDS-induced stress.

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