【Grant-in-Aid for Transformative Research Areas（A）】

Deciphering and Manipulating Brain Dynamics for Emergence of Behavior Change in Multidimensional Biology（Biology of Behavior Change）

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Research Area Information	Number of Research Area : 22A301　Project Period (FY) : 2022-2026 Keywords : Behavior change, Neuronal activity, Standardization, Brain circuit

Purpose and Background of the Research

●Outline of the Research

In the process of human behavior change, multidimensional behavior changes, i.e., not only changes of the goal-directed behavior, but also changes such as facial movements that may be related to internal states such as motivation, conflict, and joy of success, often appear. This should be common not only to humans but also to many animal species, but it is difficult to measure detailed behavior changes in small animals such as mice, and has been overlooked in many studies. However, with the rapid progress of AI technology in the past few years, it has become possible to extract with high precision the movements of a mouse's entire body, including its eyes, whiskers, tongue, jaw, and other facial features, from video data alone. In this Research area, we aim to "quantitatively" elucidate the relationship between multidimensional behavior change and brain dynamics (brain information dynamics, which is neural activity that encodes information at a given moment, the dynamics of synaptic connections and molecular expression that define the neural activity, metacognition, and meta-learning). We will also investigate the principles by which the dynamics of related circuits operate to generate behavior change, how this relationship differs between individuals and between healthy and diseased individuals, and whether direct manipulation of the dynamics of related circuits or behavioral interventions can promote the desired behavior change.

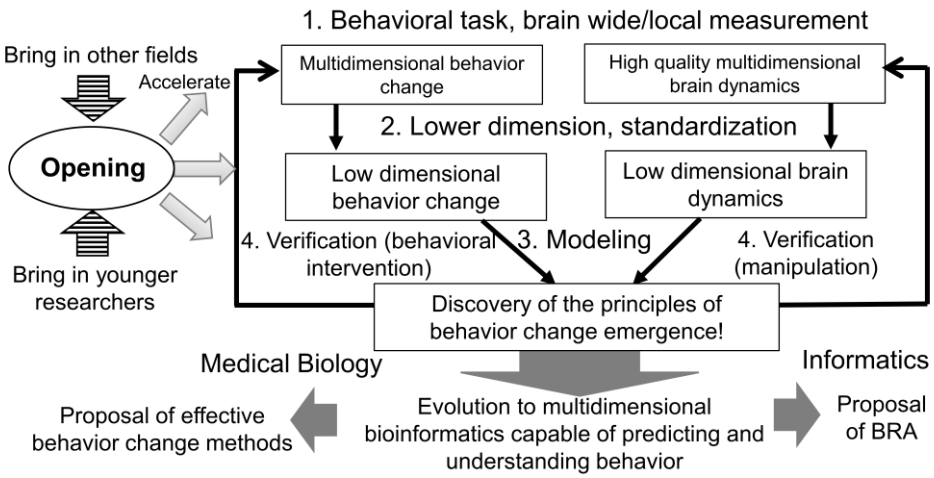

Figure 1. Diagram of the research cycle

●Research Group A01, "Wide Brain Dynamics of Behavior Change"

We will measure or manipulate brain dynamics of behavior change, including social behavior change, metacognition that unconsciously defines behavior change, developmental and aging-related behavior change, and disease models. We will develop computational models, simulations, and robotics that relate these studies. We will also attempt to clarify the relationship between behavior change and brain dynamics through behavioral interventions.

● **Research Group A02, "Interactions between Wide and Local Brain Dynamics",**
We will relate not only local brain activity but also dynamics at the single cell level and single synapse level to multidimensional behavior change based on rigorous cytoarchitecture, and model brain circuits. We will also perform dimensional reduction of multidimensional data and extract behavior changes common to the task.

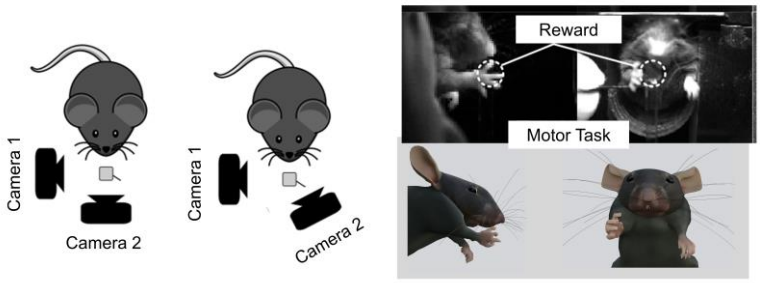

Figure 2. Diagram of measurement and standardization of multidimensional behavior change

Expected Research Achievements

We will measure multidimensional data of rodents, monkeys, and humans as comprehensively as possible, and clarify the functional cytoarchitecture and information processing principles that generate behavior change through innovative methods to standardize and analyze the acquired data. This will bring about a new revolution and shift in neurobiology (including physiology, biochemistry, molecular biology, morphology, mathematical biology, etc.) and create biology of behavior change integrated with animal behavior and behavioral science. We will also lay the foundation for multidisciplinary bioinformatics and AI based on brain reference architecture (BRA) for the further future.

This fundamental research is expected to lead to the development of methods to "promote desired behavior change" based on biological understanding, which is the theme of health behavior change in healthy individuals and patients. We will also build an innovative platform that can be accessed by researchers and young students in biology, medicine, physics, and information science by opening and standardizing behavior change data, and dramatically expand it to next-generation research.

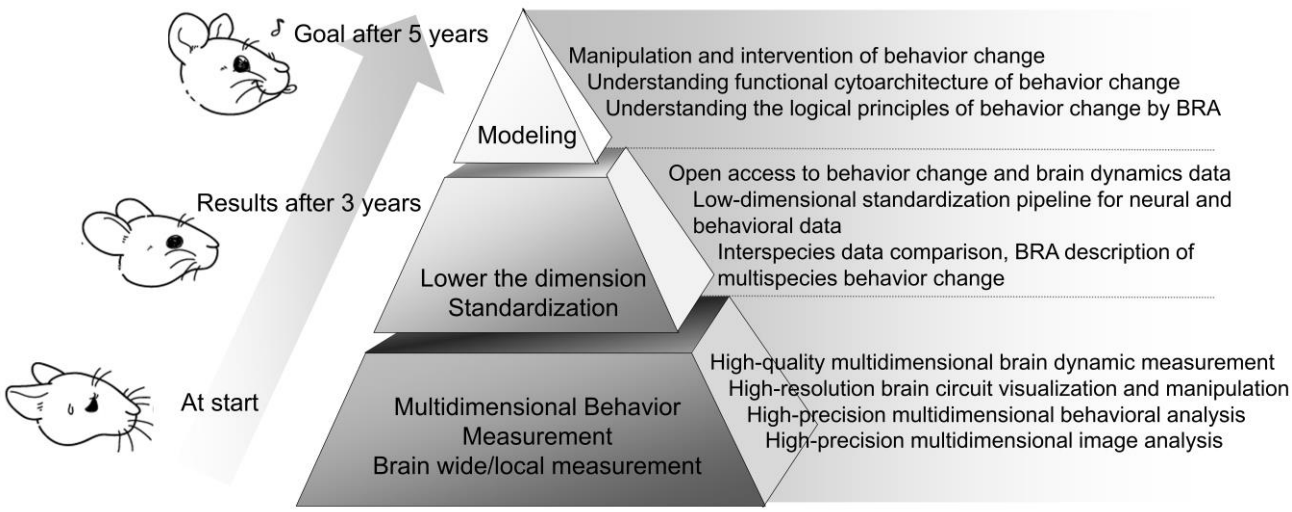

Figure 3. Roadmap for Area Research

Homepage Address, etc.	Research HP https://braidyn-bc.jp Research Twitter https://twitter.com/BraiDynBC Research database HP https://boatneck-weeder-7b7.notion.site/BraiDyn-BC-Database-1e972fb17ad1470b911aa108fb8c0713