Goal9 Realization of a mentally healthy and dynamic society by increasing peace of mind and vitality by 2050. Development of "*Jizai Hon-yaku-ki* (At-will Translator)" connecting various minds based on brain and body functions



R&D item

2. Interpreting mental states through exosomes

Progress until FY2023

1. Outline of the project

In R&D item 2, we develop **technologies to evaluate our mental states through exosomes in our body fluid**. Information of mental states will be provided to Jizai-honyaku-ki system, and used to optimize the quality of communication aids.



The endocrine and autonomic nerve systems link our physical and mental states. Exosomes are believed to play an additional role in this body–mind relationship.

Our body fluid (like saliva and blood) contains small particles, **exosomes**, produced in cells of various organs. One of their functions is to manage metabolic waste. But they also have another interesting role — intercellular communication. Increasing attention has been paid to this function of exosomes, as they might work as biomarkers of bodily and neurodegenerative diseases.

It is pointed out that the uptake of exosomes into the brain is connected to (changes in) the state of the brain. However, **little is known about the relationship between one's exosomes and mental state**.



Illustrative summary of exosomes

Source: https://www.rcast.u-tokyo.ac.jp/ja/research/people/staff-hoshino_ayuko.html

Our R&D item 2 aims to unravel the interactions of the brain and other organs mediated by exosomes through biochemical examinations and AI-based data analysis.

2. Outcome so far

- 1. Suggested the possibility of significant changes in exosome composition cue to social stress
- 2. Discovered differences in exosomes between individuals with ASD and Neurotypical Individuals
- 3. Successfully distinguished between individuals with ASD and neurotypical individuals based on exosome protein composition

Outcome 1: Using mice, we discovered that blood exosomes undergo dynamic changes in response to social stress. Particularly noteworthy is the increased production of exosomes from the brain. This finding holds significant promise as a clue to explore the relationship between exosomes and mental state.

Outcome 2: We compared the molecular (microRNA)



Outcome 1 — illustrative summary Image provided by Prof. Ayuko Hoshino (U Tokyo)

composition of plasma exosomes between individuals with ASD and neurotypical individuals. We identified eight significantly different molecules between the two groups, raising expectations for their potential use as biomarkers.

Outcome 3: We compared the protein composition of the exosomes from individuals with ASD and neurotypical individuals. We found differences in complement molecules related to the immune system, and through machine learning of the results, we could distinguish between the two groups.

We are advancing basic research to unravel the interactions between exosomes and brain function.

3. Future plans

Our R&D item 2 will further investigate the interactions of brain and other organs mediated by exosomes.

Furthermore, we aim to develop technology to interpret mental states multidimensionally by integrating information from exosomes with brain activity and othe physiological signals (R&D Item 1).

(U Tokyo: A. Hoshino, A. Nasiri Kenari)

