

Interpreting mental states through brain and autonomic nerves

Progress until FY2022

1. Outline of the project

In our R&D Theme 1, we develop **technologies to interpret our mental states through brain and autonomic nervous activities**. That will broaden our ways of non-verbal communication.

The primary task of our R&D Theme 1 is to instantiate **sensing technologies worthy of use in everyday communication**. For instance, fMRI offers rich information yet is costly and time-consuming; polygraphs are handy yet are far from precise in decoding one's mental state. Interpretation of one's mental state through electroencephalography (EEG) has yet to be established.



Rich, but expensive

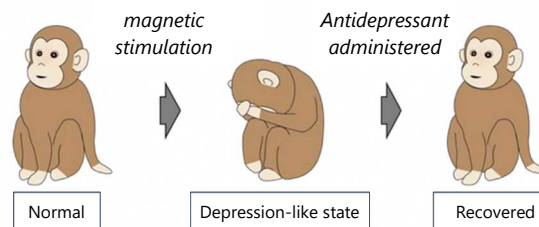
Handy, but inaccurate

Here, our R&D Theme 1 aims to develop **precise and multi-dimensional mind sensing based on brain and autonomic nervous activities** combined with behavioral data. Our goal is to offer a reliable mind-interpretation method suitable for everyday use.

2. Outcome so far

1. *Established a non-human primate model of depression;*
2. *Identified brain regions related to mood regulation;*
3. *Identified the pattern of brain waves related to stress susceptibility;*
4. *Designed a simultaneous recording method of depth and scalp EEG in rodents and monkeys;*
5. *Designed a high-precision, simultaneous recording method of the human brain and autonomic nervous activities.*

Outcome 1: We succeeded in **the artificial induction of depression in monkeys** by transcranial magnetic stimulation.

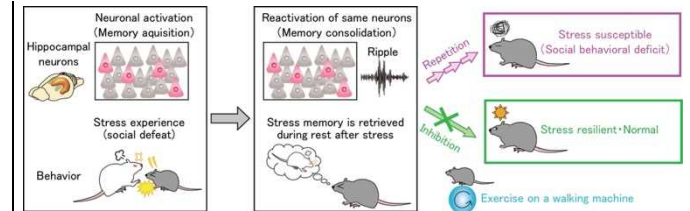


Outcome 1 — illustrative summary

Source: <https://www.tohoku.ac.jp/japanese/2022/08/press20220804-02-brain.html>

Outcome 2: We identified **brain regions related to mood regulation based on this model**.

Outcome 3: We found **a connection between a particular form of brain waves and the onset of depression** by recording and analyzing the neuronal activities of socially stressed mice.



Outcome 3 — illustrative summary

Source: <https://www.tohoku.ac.jp/japanese/2023/04/press20230421-01-stress.html>

Outcome 4: We established **a method to simultaneously record and compare rodent brains' depth and scalp EEG**. It will enable us to estimate one's depth EEG from scalp EEG, bypassing highly invasive process of direct recording of depth EEG.

Outcome 5: We established **a method to simultaneously record human EEG and autonomic nervous activities** (e.g., respiration, pulse, eye movements) with high precision.

So far, we are conducting researches to unravel the relationship between neuronal activities and one's mental state by combining animal and human experiments.

3. Future plans

Based on these animal/human researches, our R&D Theme 1 will further develop sensing technologies to interpret human mental states reliably. We also plan to combine these findings with our R&D Theme 2 (exosomes) to offer a multi-dimensional interpretation of one's mental state. (Tohoku U: K. Tsutsui, T. Sasaki & NIPS: K. Kitajo)