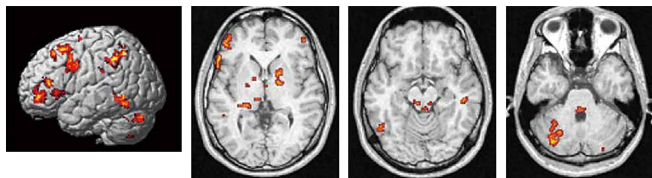# Diagnosis of psychiatric disorders using brain functional images and AI
～ paving the way for new treatment approaches

Functional magnetic resonance imaging (fMRI) is a noninvasive imaging technique for measuring brain activity using the blood-oxygen-level-dependent (BOLD) signal based on the principle of nuclear magnetic resonance (NMR).

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Major research fields
Psychiatry, Brain Sciences

Psychiatric diagnosis is based on doctor's observation of clinical symptoms and signs. Therefore, objectivity and reliability of such psychiatric diagnosis have been questioned. As other reasons of difficulty in diagnosis, there are wide variety of patients' clinical courses and treatment response patterns.

To overcome these challenges, it is important to develop brain biomarkers using simple measurements, in order to categorize psychiatric disorders and to evaluate treatment effects even when several disorders have similar symptoms. In addition, if psychiatric disorders may be caused by abnormal brain activity, it would be the most efficient treatment to modulate or change the brain activity directly towards that of healthy people.

As an example, we have shown for the first time that it would be possible to diagnose whether or not the patient is one major subtype of depression (with melancholic features) with high accuracy, based on specific abnormal brain activity using techniques of artificial intelligence (AI). It is expected that these results would make it possible to diagnose some depression subtypes with 10-minute fMRI assessment in the future.

Furthermore, we have been working on development of treatment methods using neuroimaging techniques. The
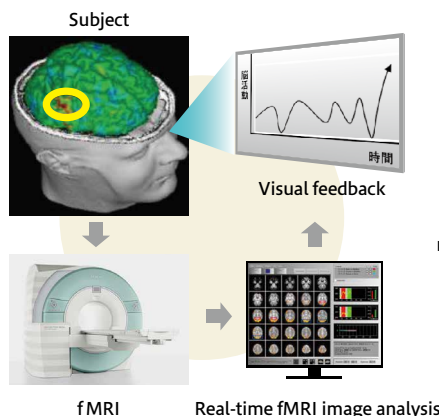
Participants learn self-regulation strategies by trial and error to modulate their own brain activity in the desired direction during real-time neurofeedback of visualized their own brain activity.

Ten brain functional connections that contribute to the diagnosis of major depressive disorder with melancholia were identified from about 10,000 connections.
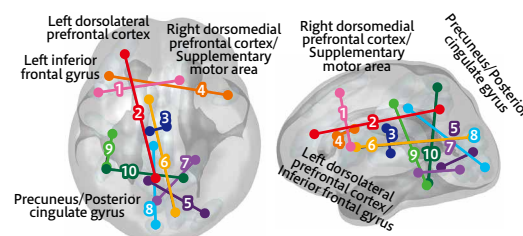
fMRI neurofeedback is a learning method for participants to monitor and learn how to modulate their own brain activity during real-time feedback of target brain activation patterns. Because of its usefulness as a self-regulation method, it has attracted increasing attention as a new treatment approach. Development of these approaches would make it possible to offer individually-optimized treatments based on individual brain activity.

Understanding brain functions, it is not enough to accumulate knowledge about

associated location and materials. More and more collaboration projects have become common among computational brain sciences and experimental brain sciences. The biomarker and neurofeedback studies mentioned above are also one of the results of those research projects. These days, many brain scientists and researchers are interested in higher brain functions including decision making, emotion, attention, and consciousness. It would be critically meaningful to take psychiatric disorders as disorder models to elucidate the mechanism of higher brain functions. We hope that such understanding would be a boon to people suffering from psychiatric and mental disorders.

Research Centers

Promising Research Initiatives

HU selects and provides priority support to promising research initiatives, which are researcher groups who have the potential to grow into independent world-class research centers (Centers of Excellence).

- International Network on Polyoxometalate Science
- Core of Research for Organelle Diseases
- Catchment Healthy Cycle between urban and rural in Setouchi to Asia, toward the creation (HURu-SATO)
- Center for Next Generation Photovoltaics
- Developing science and technology for diversity and inclusion
- Consolidated research for biogenic nanomaterials

- MBR Center
- Hiroshima Drug-Delivery Research Center Using Photoirradiation
- Educational Vision Research Institute
- The Research Core for Plant Science Innovation
- Integrated Research Center for Smart Biosensing
- The Research Center for Japanese Foods
- Center for Regenerative Therapy for Immediately Responsive to Radiation Emergency Medicine

Chirality Research Center to elucidate the mystery of right- and left-handedness

Your right and left hands are very similar, yet they are not identical. This property is called chirality. Our research has revealed that chiral magnets made only from right-handed materials are completely different from normal magnets. It is becoming clear that problems with chiral magnets have commonalities with problems in molecule biology and high energy physics. The Center is working to elucidate chirality-related problems from a basic science perspective.