DOCTORAL THESIS

# Functional magnetic resonance imaging-based methods for translational research of psychiatric disorders

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## 要約

In the field of cognitive neuroscience, researchers have been studying to clarify the mechanism of the brain that causes various phenomena using functional magnetic resonance imaging (fMRI). With the development of new approaches have come attempts to apply fMRI to real-world problems, specifically in medical contexts. The approaches can be roughly divided into two types. One approach is prediction of outcomes (e.g. a diagnosis) from neuroimaging data. Growing studies of a data-driven approach point to the utility of resting-state fMRI can be used to interrogate a multitude of functional brain network (functional connectivity) simultaneously to discover the functional connectivity which associated with psychiatric disorder. This leads, for example, to assist in diagnosing whether participant is psychiatric disorder or not by observing functional connectivity pattern. The other approach is intervention for psychiatric disorders using fMRI neurofeedback in which real-time online fMRI signals are used to self-regulate brain function. FMRI neurofeedback is expected to become a next-generation therapy for psychiatric disorders, because this technique can non-invasively manipulate the brain activity. In the former, however, many previous studies have not been achieved to construct prediction model that can be truly useful for any imaging site because they used the dataset from few imaging sites and were mainly relying on the diagnosis which recently been known that the relationship with the neurobiological basis is weak. In the latter, since neurofeedback manipulating the local brain activity has not broad utility, improvement of technique is necessary to become a next-generation therapy for psychiatric disorders. In this thesis, we conducted three researches to solve these problems. In the first work, we developed a state-of-the-art harmonization method which enable us to analyze large-scale resting-state fMRI dataset from multiple imaging sites. In the second work, by using large-scale multi-site resting-state fMRI dataset we constructed a reliable prediction model of depressive symptoms which more directly related with biological basis than diagnosis. We found the functional connections which associated with major depressive disorder diagnosis and depressed symptoms simultaneously. These functional connections are likely to be a therapeutic target of intervention for psychiatric disorder. In the third work, we developed a connectivity neurofeedback which can induce an aimed direction of change in functional connectivity and a differential change in cognitive performance. This technique could be used for intervening the functional connectivity of therapeutic target. These works would provide possible framework of therapeutic intervention for psychiatric disorder using fMRI.