

【Grant-in-Aid for Scientific Research (S)】
Integrated Disciplines (Informatics)



Title of Project : Neural Basis of Mental Images

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Research Project Number : 15H05710 Researcher Number : 50418513

Research Area : Informatics

Keyword : Cognitive Neuroscience

【Purpose and Background of the Research】

Mental images constitute an essential part of our experience. Images are not only induced by external stimulation but are also internally generated as volitional imagery or dreaming. Although the phenomenal similarity between these types of images suggests a common neural basis, it remains elusive. In this project, we aim to reveal common neural representations for these images using machine learning-based pattern analysis of brain activity data.

Our group have developed methods for “brain decoding” for the last decade. Brain decoding predicts detailed mental contents from brain activity patterns using machine learning algorithms. We have shown that visual features such as orientation and motion direction can be reliably decoded from visual cortical activity, and that even the reconstruction of seen images (Figure 1, left) and the decoding of dreamed visual objects (Figure 1, right) are possible.

【Research Methods】

In this project, we collect brain activity data using functional MRI (fMRI) while participants are seeing images (Perception), having mental imagery (Imagery), or having dreams (Dreaming) (Figure 2). In addition to decoding analyses within each dataset, we perform generalization analyses in which a decoder trained on a dataset is tested on another dataset. Using the generalization performance as an index for the similarity of neural representation, we systematically and exhaustively



Figure 1 Neural decoding of visual information

quantify the similarity across image features and

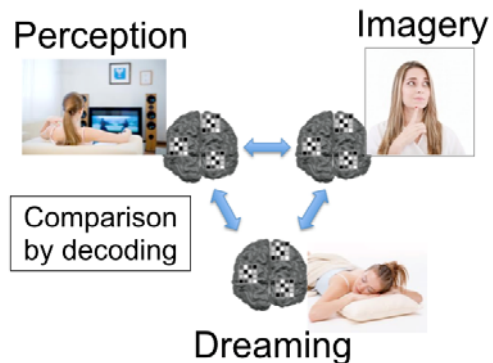


Figure 2 Our approach

brain regions.

【Expected Research Achievements and Scientific Significance】

This project will reveal the common neural basis for the different types of images, and provide insights into the mechanisms that generate mental experiences.

【Publications Relevant to the Project】

- Horikawa, T., Tamaki, M., Miyawaki, Y., and Kamitani, Y. (2013). Neural decoding of visual imagery during sleep. *Science* 340, 639-642.
- Miyawaki, Y., Uchida, H., Yamashita, O., Sato, M. A., Morito, Y., Tanabe, H. C., Sadato, N., and Kamitani, Y. (2008). Visual image reconstruction from human brain activity using a combination of multiscale local image decoders. *Neuron* 60, 915-929.

【Term of Project】 FY2015-2019

【Budget Allocation】 153,700 Thousand Yen

【Homepage Address and Other Contact Information】

<http://www.cns.atr.jp/dni/>