

【Grant-in-Aid for Transformative Research Areas (B)】

Section I



Title of Project : Understanding the relationship between the structure of qualia and the structure of information processing extracted from brain activity

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(Advanced Telecommunications Research Institute International, Brain Information Communication Research Laboratory Group, Visiting Researcher)

Number of Research Area : 20B101 Researcher Number : 80517128

【Purpose of the Research Project】

Traditional neuroscience research has extensively investigated the relationship external stimuli (e.g., an apple in front of the eye) and the brain activity that occurs in response to the stimuli. Such studies have revealed a great deal about the mechanisms on how brains process information about external stimuli. On top of such information processing, however, our brains generate subjective conscious experience (e.g., "I see an apple!"). In this project, going beyond the traditional study on the relation between external stimuli and evoked brain activity, we aim to clarify the relationship between brain activity and consciousness.

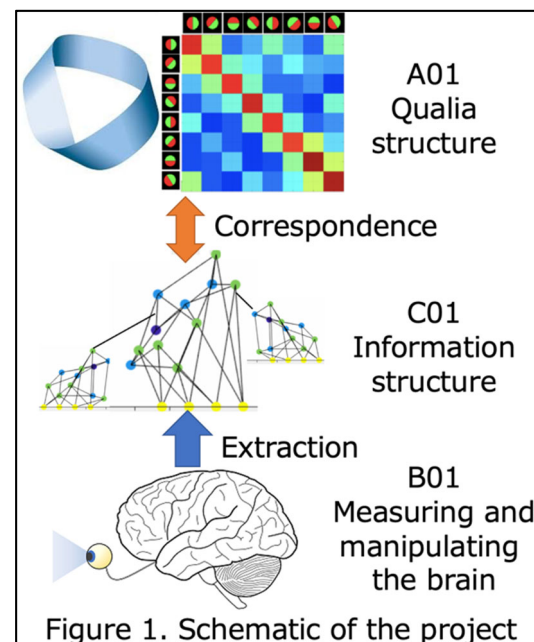
Previous studies that aimed to study the relationship between brain activity and consciousness focused on the situations, where the same physical stimuli can be perceived differently across trials. For example, by showing a stimulus for a very brief duration, researchers tried to identify what are the differences between brain activities when participants report that they “saw” vs. “did not see” the stimuli. While it simplified the logic of the research paradigm, these studies grossly categorised our conscious percept into binary categories. Far from such poor categorisation, at any moment, our contents of consciousness, or qualia, seem vastly richer and complex. In fact, qualia have been claimed to be too rich to characterise and quantify with any traditional methods.

Here, we propose a novel paradigm. We claim that we can characterise an object through its relationships with all other objects, even if the object itself is difficult to characterise. Based on this logic, rather than trying to characterize a particular quale (e.g., "red") itself, we will try to characterize the relationships between the quale and other qualia in all possible ways.

【Content of the Research Project】

Building on the above idea, this project will establish a new research method to address the problem of how the contents of consciousness, or qualia, relates to brain activity. We will form three research groups (Fig. 1). Group A01 will characterize visual qualia by exploring the relationship between qualia and other qualia, which we call “qualia structure” using psychophysics and mathematical phenomenology. Group B01 will clarify the brain activity which underlies the qualia structure by using functional brain imaging. B01 will further clarify how the qualia structure can be changed by pharmacological manipulation of the brain activity. Group C01 will examine the information structure extracted from the brain activity using information theory. C01 will also evaluate the degree

of correspondence between the information structure and the qualia structure. Jointly, we will establish an unprecedented research method of consciousness that connects the visual qualia structure and the information structure extracted from brain activity.



【Expected Research Achievements and Scientific Significance】

By characterizing the qualia structure, it may become possible to mathematically verify if I feel the red in the same way as you feel it. This logic may be applied, in principle, to animals, plants and man-made objects if established in the future.

【Key Words】

“Qualia” is quality, or contents, of consciousness. Not only visual consciousness, they can refer to audition, touch, taste and smell. They can also include thoughts and emotions. Everything that are subjectively experienced can qualify as qualia.

【Term of Project】 FY2020-2022

【Budget Allocation】 65,000 Thousand Yen

【Homepage Address and Other Contact Information】
<https://qualia-structure-en.labby.jp/>

【Grant-in-Aid for Transformative Research Areas (B)】

Section I



Title of Project : Understanding and breaking the limit of human minds and performance

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(RIKEN Center for Brain Science, Team leader)

Number of Research Area : 20B102 Researcher Number : 20505979

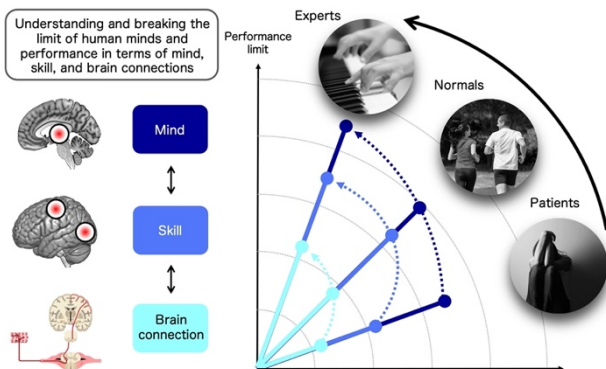
【Purpose of the Research Project】

Our research project aims to understand the mechanisms that underlie the limits of our performance and contribute to developments of new methods that enable to overcome the limits. As a patient with disease, normal person, or expert in a certain field, we all constantly make efforts to improve our own performance. However, such improvements typically end up reaching the ceiling. In most cases, this ceiling prevents us from breaking the limits of our performance. On the other hand, a handful of greats eventually break the limits and show outstanding performance and exceptional recovers from serious disorders. Understanding of how such break occurs should lead to the developments of the methods to overcome the limits.

Our research project focuses on our mind and brain that lead to the limits of our performance. We aim to understand the mechanisms by which our mind and brain control our performance, develop new methods to overcome the performance limitations, and consider how these methods will be assimilated with our society in the future through discussions about ethical and normative impacts that are expected in response to the developments of these methods. Our interdisciplinary framework likely contributes to various fields including cognitive science, brain science, engineering, medicine, arts, sports, pedagogy, philosophy, and ethics.

【Content of the Research Project】

Our project assumes that the limits of our performance are constrained by the following three mechanisms: mind, skill, and brain connections. This framework would allow us to comprehensively understand the performance limits of patients, normal persons, and experts (see below).



Three mechanisms that constrain the limits of our performance

Our research project will investigate these three mechanisms by using cutting-edge techniques. For example, we plan to utilize behavioral measurements, neuroimaging methods, computer simulations, robots, neurofeedback, brain prosthesis.

【Expected Research Achievements and Scientific Significance】

Findings from our research project will make better understanding of mechanisms that underlie the limits of our performance. Such understanding is expected to lead to new intervention and/or methods that allow us to overcome the limits.

In addition, our research project will consider what changes will occur once each of us has an access to the methods to overcome the limits of our performance. If everyone has a chance to benefit from such methods, it is likely that our ethics and morals will waver in a great degree; breaking the limits of performance will give a sense of superiority to beneficiaries, but a sense of unfairness and/or fear to the rest of people. It will be necessary to establish concrete public systems that accommodate possible advantages and disadvantages for our society. Indeed, it has been recently shown that our abilities can be enhanced by human augmentation technologies. At the same time, it is possible that understanding and breaking the limits of our performance will lead to reform of our view of humans in a positive manner. Thus, our research project will start discussing these issues ahead of the times and grope for the ways to assimilate our new methods with the society in the future.

【Key Words】

Neurofeedback:

A method to provide a user with his/her brain activations and allow the user to control the activations.

Brain prosthesis:

A method that connects distant brain regions by a computer.

【Term of Project】 FY2020-2022

【Budget Allocation】 97,500 Thousand Yen

【Homepage Address and Other Contact Information】

<https://sites.google.com/view/brainlimit/home>

Twitter: @nou_limit

【Grant-in-Aid for Transformative Research Areas (B)】

Section I



Title of Project : **Religious Movements and Communication Medium /Worldview/Social Integration: A Synthetic Approach of Historical Research**

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(Tokyo Metropolitan University, Graduate School of Humanities, Associate Professor)

Number of Research Area : 20B103 Researcher Number : 30708095

【Purpose of the Research Project】

This project conducts comparative research on the creation and use of various types of media by monks, focusing particularly on Christian monasticism in the Middle Ages and early modern period in Europe, America, and Japan on the one hand, and Buddhism and Shintoism in medieval Japan on the other. Research results from fields adjacent to historical studies indicate that monks disseminated their religious beliefs using a variety of media, which include literary works, illuminated manuscripts, church decorations, and even pilgrimage, in addition to written documents such as monastic rules and sermons. A more systematic approach is required, however, to understand how these initiatives brought discipline and order to society or how they helped sustain society and made it resilient.

Did Catholic monks, Buddhist monks, and Shinto priests, with their strong willpower and drive, contribute to the sustainable development of society and brought about innovative worldviews and institutional frameworks to transform society through pastoral/teaching activities as they sought religious transcendence. The dynamic ways in which religious movements and society influenced each other can be elucidated when these phenomena are compared synchronically and diachronically as they occurred in different religious cultures.

This perspective is shared between the four research teams which constitute the project, each seeking to achieve the following three objectives to systematically explain the significance of religious movements in the history of civilisation:

- (1) to identify the type of medium (texts, images, mechanisms, etc.) created and disseminated by those who led religious movements in medieval and early modern periods as they sought to promote communication inside and outside their religious community;
- (2) to explicate the message religious leaders disseminated to those inside and outside the religious community using the media identified in (1), and the values and worldviews they brought about; and finally
- (3) to find out how religious leaders pursued teaching, helped integrate their society, and brought changes to civilisation through the above (1 and 2).

【Content of the Research Project】

Four research teams have been established for this purpose:

A01 Contemplative Orders Team: Comprehensive research on the formation of a 'liturgical space' by contemplative monasteries

A02 Mendicant Orders Team: In-depth media research on the pastoral revolution by mendicant orders

A03 Society of Jesus Team: Broad-ranging historical research for critical examination of the modernity of the Society of Jesus

B01 Medieval Japanese Temple and Shrine Team: Fully interdisciplinary study of travels, pilgrimages, and shrine visits involving regional temples and shrines in medieval Japan

While each team holds its own study sessions, separate research units are established to bridge between the teams as they pursue international joint research. Three disciplines within the humanities – history, art history, and literature – collaborate to achieve comprehensive interpretation of texts and images, diachronically and synchronically compare the characteristics of the media created by religious leaders, and present a fresh view of history regarding the dynamic relationship between religious movements and society.

【Expected Research Achievements and Scientific Significance】

This research field is not simply an extension of comparative religious history. It deals with a larger issue of how religious movements impacted the long-term development of a secular society even while tension remained between the two. The goal of this endeavour is to redefine religious movements as a source of wisdom practiced and inherited in a society, and to pioneer a new research field to explain in a comprehensive manner the significance of religious movements in the history of civilisation.

【Key Words】

Christian monasticism: The lifestyle of the religious who follow Christ and leave the secular world behind to achieve total devotion to God.

Temples and shrines in medieval Japan: The major temples and shrines exercised great influence in various fields under the protection of the state and had their own branch temples and shrines throughout the country.

【Term of Project】 FY2020-2022

【Budget Allocation】 29,700 Thousand Yen

【Homepage Address and Other Contact Information】

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