Identifying electrophysiological correlates of visual awareness by a single-trial EEG analysis

GOAL OF THE PROJECT

Understanding how consciousness of our surrounding and ourselves is generated through the activity of our brains is one of the toughest mysteries of science. Through the last thirty years, we have learnt a lot about how consciousness works and how it benefits our functioning, yet we are still far from a complete scientific explanation. The complex and multidimensional nature of consciousness, which does not stem from activity of one brain region nor is a consequence of one particular mode of cortical processing, remains the most difficult obstacle to overcome. Our research project will approach this problem following a well-established research line searching for neural correlates of consciousness through combining cognitive science and neuroimaging methods. However, it differs and expands the field in three key aspects. Firstly, we plan to perform a thorough examination of basic properties of conscious visual perception with diverse set of experimental tasks (to better capture the mentioned complex nature of consciousness). Secondly, our project involves much bigger number of participants than is usually tested (to increase the precision of our measurements and reliability of results). Lastly, our studies will be a part of a much bigger international research endeavour aiming at capturing the phenomenon of consciousness with various paradigms, neuroimaging methods and state-of-the-art analyses. As a part of this consortium, our work will benefit from additional data and we will be able to support others' research with our studies. Therefore the uniqueness of this project lays in a complex, large-scale and widely cooperative approach that highly increases the chance to acquire new and reliable insight into neuronal basis of consciousness.

DESCRIPTION OF RESEARCH

Our project is comprised of three cognitive experiments with simultaneous EEG recording of the activity of cerebral cortex. All of the experiments will investigate conscious visual perception, although different aspects of this mental process will be manipulated in each. First one will aim at replicating classical perceptual effects observed by so-called evoked potentials, where we want to precisely trace how brain's activity change depending on whether (and how vividly) a person saw the stimuli. Second experiment will test to what extent attention modulates the neural correlates of conscious visual perception established from the first study. Last experiment will investigate how the requirement of performing a certain task influences the way the brain processes visual information. To achieve this goal, we will show participants stimuli without any explicit task and only after some time we will instruct them to perform some actions with the stimuli. Although such experiments were already performed, our project expands those paradigms, testing the results of other studies on a much bigger sample of participants - each of the tasks will be performed by at least 100 people. Additionally, our participants will take part in a complementary research project, giving us the opportunity to combine the acquired data (e.g. behavioral data and fMRI scans) and increase possible analyses exponentially.

WHY CONSCIOUSNESS

The scientific study of consciousness, while being a fascinating question for a scientist on it's own, tries to answer fundamental questions about the nature and behaviour of human beings. Although considering consciousness as a solely human characteristic is becoming obsolete, understanding its functioning and identifying its neural basis will allow us to better comprehend who we are as a species. Consciousness studies also have many practical consequences, disorders of consciousness being the most apparent. The more we know about the neural mechanisms of consciousness, the more possible it becomes to help people struggling with those disorders.

EXPECTED RESULTS

We are expecting to achieve three key scientific goals. Firstly, we hope to thoroughly replicate effects from classical studies on neuronal correlates of consciousness in a large-scale study (which had not been done to date and is an important aspect of reliability of modern science). Secondly, we hope to better understand neuronal mechanisms of consciousness through combination of different paradigms and data from many complementary sources. Lastly, we want to lay ground for more open science practices in the study of consciousness through making large amounts of high-quality data available to all other researchers. We believe this will not only help them in their research but also will accelerate consciousness science, despite any possible outcomes of this project alone.