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CIN
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Centrum für Integrative
Neurowissenschaften

Press Release

Fingerprints of higher brain functions

Neuroscientists uncover novel signatures of neuronal information processing in the brain.

Tübingen, den 01.03.2012

Every advanced high school student has to solve abstract and highly complex computational problems. For such tasks, he or she necessarily requires knowledge of the underlying basic calculations that is learned in elementary school. Our brain probably works according to a similar principle when it carries out perceptual and behavioural skills such as thinking, decision-making, and planning. When we read a menu and make up our mind about what to eat, our brains perform various basic calculations before we commit to a final choice and place our order. At the Centre for Integrative Neuroscience at the University of Tübingen, together with their collaborators, researchers have discovered that the oscillation patterns of brain waves, which are measured during information processing, may be 'fingerprints' of these basic calculations.

Such basic calculations, which manifest themselves in similar ways in completely different perceptual and behavioural processes, are termed 'canonical neuronal computations'. These canonical computations form the brain's set of 'standard calculations'. Markus Siegel from the Werner Reichardt Centre for Integrative Neuroscience at the University of Tübingen, together with partners Tobias Donner from Amsterdam and Andreas Engel from Hamburg, is investigating the relation between such canonical computations and the specific frequency patterns of brain waves that accompany information processing in the brain. The scientists assessed the results of recent research on this topic in the renowned journal 'Nature Reviews Neuroscience' (Nature Rev. Neuroscience Vol. 13 No. 2, February 2012.). In this article, they suggest that the specific frequency patterns of brainwaves, also known as oscillations, are 'spectral fingerprints' of canonical neuronal computations. The scientists have investigated this hypothesis with electroencephalography (EEG) and magnetoencephalography (MEG). As people make various decisions, their brain activity is measured using EEG or MEG. EEG measures electrical activity in the brain through voltage variations on the scalp, while MEG measures the brain's magnetic activity.

Comparison of their own data and of the results of numerous colleagues working on neuronal oscillations, led to the hypothesis of a correlation between the spectral fingerprints of neuronal activity and canonical computations. For example, in types of behaviour as different as switching on a light (motor activity) and noticing that the light has been turned on (visual activity), similar spectral fingerprints can be measured if these actions

Hochschulkommunikation

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Wir bitten um Zusendung von Belegexemplaren! Danke.

involve similar canonical computations in the brain.

Markus Siegel, who has been working at the CIN since 2010, is fascinated by the interplay of the complex brain processes that ultimately bring about our higher cognitive capacities such as reasoning and decision-making. Thus, in his research group at the CIN, he investigates the relation between higher brain functions, neuronal information processing, and patterns of oscillation. ‘For me, oscillations open up a fascinating, new approach to study the neuronal network mechanisms that underlie higher brain functions’, he says.

These results have important implications for research into neuropsychiatric disorders such as schizophrenia, autism and multiple sclerosis. Such disorders often involve the disruption of those neuronal networks that ultimately carry out ‘canonical neuronal computation’. Thus, this basic research may provide important insights into these kinds of neurobiological diseases and potential therapies.

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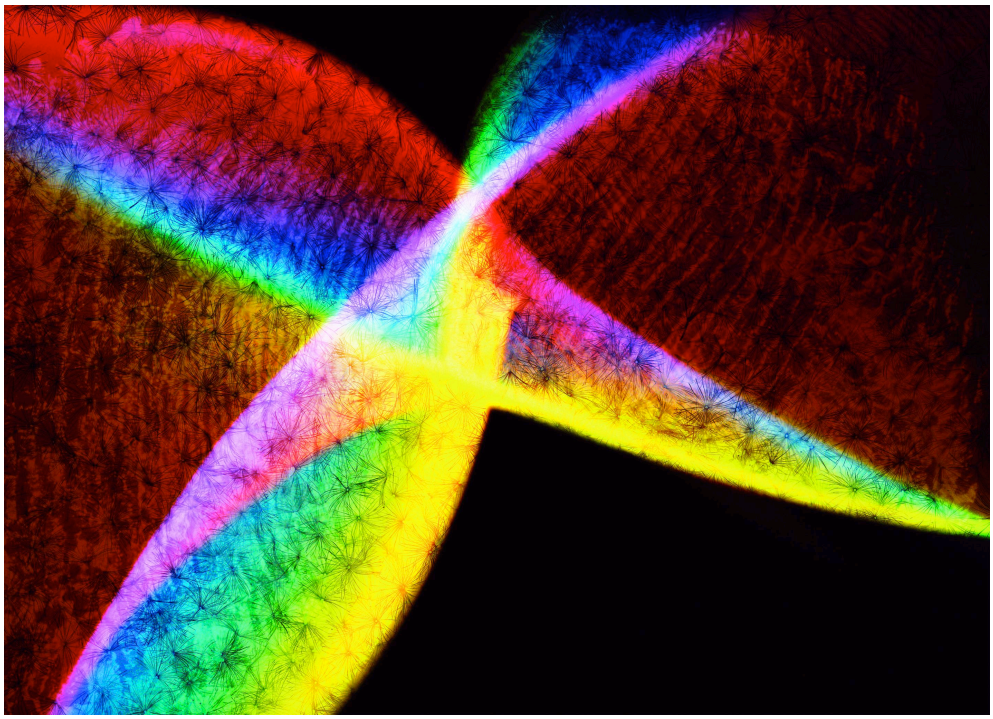

An illustration of a neuronal fingerprint