Abstract of Presentation

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Research interest:

Martin Sommer: neuroplasticity, non-invasive brain stimulation in humans, TMS, movement disorders, speech disorders.

Michael Nitsche: neuroplasticity, neuropsychopharmacology, cognition, non-invasive brain stimulation in humans, TMS, tDCS, tACS, PAS

Abstract :

Transcranial stimulation by magnetic field and direct currents: Mechanisms of action, functional effects, and questions open for computational neuroscience

Neuroplastic cortical excitability alterations are the likely neurophysiological foundation of learning and memory processes. During the last years, non-invasive brain stimulation tools were developed, which are now able to induce long lasting changes of cortical excitability in humans. By aid of stimulation tools, important new insights about the physiological mechanisms, as well as the functional effects of plasticity in humans have been gained.

One of these stimulation tools is transcranial magnetic stimulation (TMS), bypassing the skull by magnetic fields to induce short-lasting currents in the living brain. Serial application of TMS allows induction of lasting cortical excitability changes, with a therapeutical perspective. Another stimulation tool is transcranial application of tonic direct currents (transcranial direct current stimulation, tDCS). Stimulation polarity-dependently, tDCS induces cortical excitability enhancements or reductions, which can last for over an hour after the end of stimulation. It has been shown that tDCS is able to improve learning and memory formation in humans, and might be effective in altering pathological cortical excitability enhancements, or reductions, in neuropsychiatric diseases.

However, many factors influence the changes of cortical excitability induced by external neurostimuation. These include cortical sites and topography as well as targeting corticocortical connections; orientation and type of induced currents; and pre-existing alterations of excitability from other interventions or pathology. Good recipes using all these ingredients appropriately for the patients' sake are still to be defined, and various approaches of computational neuroscience will be able to help achieving this goal.