

## **Abstract**

### Learning to overcome BCI illiteracy

BCIs are devices that allow interaction between humans and artificial devices. Historically such interfaces have been largely dependent on human motor-control. New microchip design, microstimulation technology to interact with neuronal tissue, powerful computers, sophisticated signal detection algorithms and the rapidly growing field of neuroscience allow us to tap into a completely new application of interfaces, i.e. the restoration of lost motor or sensory function.

In recent years a lot of effort has been put into the development of training schedules for the target patient groups (human learning) and of sophisticated signal processing procedures (machine learning) leading to several prototype BCIs tested in clinical settings and some have even been used independently by patients. Despite this progress on human and machine learning a group of individuals – healthy participants and neurological patients – seem not to profit from training in BCI-use and from subsequent adaptation of signal processing to the individual EEG activation pattern.

In a combined effort of the unique expertise in patient training (Tübingen) and machine learning (Berlin) this proposal has three goals. Firstly, we wish to define physiological and psychological predictors of performance in BCI use. This is of particular importance, because training patients requires tremendous personal and financial effort and thus, a predictor of later outcome would help in the process of selecting and rejecting patients for training in BCI use: the BCI illiterates. On the basis of previous work on biofeedback learning, we wish, secondly, to define the most suitable learning paradigm and thus, help to elucidate the still unanswered question of how participants learn to regulate a brain response.

Finally, and most importantly, we will combine different learning paradigms with the machine learning approach and will thus, be able to define which learning strategy will profit most from a constant adaptation of the signal processing algorithms. Additionally, we aim at defining the best learning paradigm and the best signal processing procedure as a function of the psycho physiological predictors. This project will contribute to our understanding of how participants acquire the skill of BCI use, how much they can profit from machine learning, and which of the two – human or machine learning – contributes most to final performance.