



## WORKSHOP: LEARNING CURVES IN EEG NEUROFEEDBACK

### Organizers

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### Introduction

In the literature on EEG neurofeedback, much recent research have taken on board the recommendations that when presenting findings of neurofeedback experiments, there should be data presenting the power of the EEG frequency bands over sessions. The assumption is that in order to demonstrate that neurofeedback training has had an impact on cognitive performance or symptomology, evidence is needed to show that the target frequency changed. This change could be within-sessions or between-sessions. However, this demonstration is not sufficient to conclude that neurofeedback training intervention impacted on the outcome variables. In this workshop, I will go over the various assumptions underlying the recommendations and challenge them. In particular, the lack of a learning curve for a target frequency does not necessarily mean that no learning has taken place. This draws the attention to identifying the correct outcome measure for creating the learning curves. In addition, frequency specificity is key in the interpretation, as focusing on the target frequency might lead to ignoring changes in frequencies that are more closely linked with the cognitive performance or symptoms under investigation.

Finally, demonstrating a change in some frequency range needs to be associated with change in the outcome measure to be of relevance. Examples from the literature and unpublished work will be shown that addresses these points. In order to make statistical inference researchers need to go beyond simple linear regression analyses and adopt parametric techniques used in prospective studies and bootstrap approaches (to control for inflated type-I error) when exploring the data. In discussing these statistical issues, the experimental design used in neurofeedback (baseline recording followed by training blocks) will be criticized for not providing the essential data to make unbiased inferences about learning. Alternative designs will be reviewed and their ability to address the points raised evaluated.

## **Keywords**

Learning curves, EEG neurofeedback, Statistics