Functionally disconnected: A look at how study design influences neurofeedback data and mechanisms in attention-deficit/hyperactivity disorder

Hudak J, Rosenbaum D, Barth B, Fallgatter AJ, Ehlis AC.


Abstract

Neurofeedback (NF) is a form of behavioral therapy used to treat e.g. attention-deficit/hyperactivity disorder (ADHD). Briefly, subjects are fed-back a putatively dysfunctional parameter of their brain activity in real time and must learn to control it in a suggested direction. NF protocols for ADHD have been used in practice for decades, though no clear standards on NF design have been implemented. Furthermore, studies often present only data from the general outcome of the NF treatment and do not look at how exactly the NF paradigm affects brain functionality, or what exactly the NF is training. The current study is two-fold: firstly, we look at how the functional connectivity (FC) patterns within key networks associated with ADHD differ between rests, feedback trials, success and failure in a complete functional near-infrared spectroscopy-based NF experiment on adults with ADHD. Secondly, due to methodological concerns discovered during the analysis of our data, we address important considerations in the design of NF that are often ignored in protocols being used widely in therapy and research today. In particular, we examine the common average reference and its impact on network activity as well as the importance of balancing the randomization in a design. Finally, we discuss how these methodological considerations may have influenced our FC results.