Neurofeedback training effects on inhibitory brain activation in ADHD: a matter of learning?


Abstract

Neurofeedback training (NF) is a promising non-pharmacological treatment for ADHD that has been associated with improvement of ADHD-related symptoms as well as changes in electrophysiological measures. However, the functional localization of neural changes following NF compared to an active control condition, and of successful learning during training (considered to be the critical mechanism for improvement), remains largely unstudied. Children with ADHD (N=16, mean age: 11.81, SD: 1.47) were randomly assigned to either slow cortical potential (SCP, N=8) based NF or biofeedback control training (electromyogram feedback, N=8) and performed a combined Flanker/NoGo task pre- and post-training. Effects of NF, compared to the active control, and of learning in transfer trials (approximating successful transfer to everyday life) were examined with respect to clinical outcome and functional magnetic resonance imaging (fMRI) changes during inhibitory control. After 20 sessions of training, children in the NF group presented reduced ADHD symptoms and increased activation in areas associated with inhibitory control compared to baseline. Subjects who were successful learners (n=9) also showed increased activation in an extensive inhibitory network irrespective of the type of training. Activation increased in an extensive inhibitory network following NF training, and following successful learning through NF and control biofeedback. Although this study was only powered to detect large effects and clearly requires replication in larger samples, the results suggest a crucial role for learning effects in biofeedback trainings.