

# Evidence for Efficacy of Neurofeedback in ADHD?

Martijn Arns, Ph.D.; Ute Strehl, Ph.D., M.Sc.

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To the Editor: A recent article by Sonuga-Barke et al. (1) presented the results of separate meta-analyses for nonpharmacological interventions of attention deficit hyperactivity disorder (ADHD). The authors considered randomized controlled neurofeedback trials, and they evaluated “most proximal” and “probably blinded” ADHD assessments separately. For neurofeedback, they reported a significant standardized mean difference of 0.59 for most proximal assessment, but they reported only a trend for probably blinded assessment (standardized mean difference, 0.29; 95% CI=−0.02 to 0.61). The authors concluded that further neurofeedback trials with probably blinded assessments were necessary before this treatment can be recommended for core ADHD symptoms. We will not comment on this here, because we have queries to the authors regarding study selection and criteria adherence for analyses that have to be answered before any conclusions about most proximal and probably blinded assessments can be drawn (also see reference 2 for a review).

In one of the studies referenced in the analysis (Steiner et al. [3]), three conditions were evaluated: a neurofeedback group, a cognitive training group, and a waiting list group. Sonuga-Barke et al. (1) stated that they selected control conditions “in the following order: sham/placebo, attention/active control, treatment as usual, waiting list.” However, they calculated the standardized mean difference for the Steiner et al. study against the waiting list, whereas they should have calculated it against the cognitive training condition. The null hypothesis for such a meta-analysis should be that all conditions have no effect; thus, interpreting the cognitive training as an “active ADHD treatment” (E.J. Sonuga-Barke, personal communication, February 2013) for one study but not for another study is inconsistent. Furthermore, the Steiner et al. study reported that 30% of patients in the neurofeedback and cognitive training conditions reduced their medication, whereas none of the individuals in the waiting list did, making a comparison against the waiting list group even more problematic. Therefore, Sonuga-Barke et al. should have compared the neurofeedback group with the cognitive training group.

Slow cortical potential and theta-beta training are well-investigated neurofeedback protocols (2). However, other protocols that have not been systematically evaluated were also included. We therefore question the selection of studies and control conditions in this meta-analysis. We recalculated the

statistics (using the specifications provided in the article) by including only standard neurofeedback protocols (i.e., omitting the study by Lansbergen et al. [4]) and against stringent comparison groups (computerized attention training or electromyographic biofeedback; three studies). For parent ratings, we obtained a significant standardized mean difference of 0.58 (95% CI=0.12–0.94;  $Z=3.52$ ;  $p=0.0004$ ), and for teacher ratings we found a significant standardized mean difference of 0.39 (95% CI=0.07–0.70;  $Z=2.39$ ;  $p=0.02$ ). Therefore, based on standard neurofeedback protocols and strictly adhering to the criteria from Sonuga-Barke et al., the conclusion of the European Guidelines Group that neurofeedback cannot be supported as a treatment for core ADHD symptoms is not supported by the data.