

# Sustained effects of neurofeedback in ADHD: a systematic review and meta-analysis

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Eur Child Adolesc Psychiatry (2018).

DOI: <https://doi.org/10.1007/s00787-018-1121-4>

## Abstract

Neurofeedback (NF) has gained increasing interest in the treatment of attention-deficit/hyperactivity disorder (ADHD). Given learning principles underlie NF, lasting clinical treatment effects may be expected. This systematic review and meta-analysis addresses the sustainability of neurofeedback and control treatment effects by considering randomized controlled studies that conducted follow-up (FU; 2–12 months) assessments among children with ADHD. PubMed and Scopus databases were searched through November 2017. Within-group and between-group standardized mean differences (SMD) of parent behavior ratings were calculated and analyzed. Ten studies met inclusion criteria (NF: ten studies, N = 256; control: nine studies, N = 250). Within-group NF effects on inattention were of medium effect size (ES) (SMD = 0.64) at post-treatment and increased to a large ES (SMD = 0.80) at FU. Regarding hyperactivity/impulsivity, NF ES were medium at post-treatment (SMD = 0.50) and FU (SMD = 0.61). Non-active control conditions yielded a small significant ES on inattention at post-treatment (SMD = 0.28) but no significant ES at FU. Active treatments (mainly methylphenidate), had large ES for inattention (post: SMD = 1.08; FU: SMD = 1.06) and medium ES for hyperactivity/impulsivity (post: SMD = 0.74; FU: SMD = 0.67). Between-group analyses also revealed an advantage of NF over non-active controls [inattention (post: SMD = 0.38; FU: SMD = 0.57); hyperactivity–impulsivity (post: SMD = 0.25; FU: SMD = 0.39)], and favored active controls for inattention only at pre-post (SMD = - 0.44). Compared to non-active control treatments, NF appears to have more durable treatment effects, for at least 6 months following treatment. More studies are needed for a properly powered comparison of follow-up effects between NF and active treatments and to further control for non-specific effects.