# THE RECENT SCIENTIFIC STUDIES PUBLISHED IN INTERNATIONAL PEER-REVIEWED JOURNALS ON NEUROFEEDBACK BENEFITS FOR INDIVIDUALS WITH ADHD

Among the clinical applications of neurofeedback, most research has been conducted in the field of ADHD over the world and in the last ten years.

In the last twelve months alone, over a dozen studies have been published in the relevant peer-reviewed journals. Nine of them confirmed neurofeedback as a possible effective treatment for individuals with ADHD.

They are listed below (in chronological order).

**NORWAY**

## 1. Self-reported efficacy of neurofeedback treatment in a clinical randomized controlled study of ADHD children and adolescents.

Published by: Neuropsychiatric Disease Treatment (a peer-reviewed journal of clinical therapeutics and pharmacology focusing on concise rapid reporting of clinical or pre-clinical studies on a range of neuropsychiatric and neurological disorders.)

Date: September 2014

Author information: Duric NS[1], Aßmus J[2], Elgen IB[3].

[1]Department of Clinical Medicine, University of Bergen, Bergen, Norway Center for Child and Adolescent Mental Health, University of Bergen, Bergen
Department of Child and Adolescent Psychiatry, Helse Fonna Haugesund Hospital, Haugesund, Norway.

[2]Center for Clinical Research, Haukeland University Hospital, Bergen, Norway.

[3]Department of Clinical Medicine, University of Bergen, Bergen, Norway Department of Child and Adolescent Psychiatry, Haukeland University Hospital, Bergen, Norway.

Objective: To report the self-evaluations of Neurofeedback treatment by children and adolescents with ADHD.

Conclusion: **The self-reported improvements in ADHD core symptoms and school performance shortly after treatment indicate Neurofeedback treatment being promising in comparison with medication, suggesting NF as an alternative treatment for children and adolescents who do not respond to MPH, or who suffer side effects. Further long-term follow-up is needed.**

Source:

http://www.ncbi.nlm.nih.gov/pubmed/25214789

Free PMC article: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4159126/

**SPAIN**

## 2. The Effects of Individual Upper Alpha Neurofeedback in ADHD: An Open-Label Pilot Study.

Published by: Applied Psychophysiology and Biofeedback Journal (an interdisciplinary journal devoted to the study of the interrelationship of physiological systems, cognition, social and environmental parameters, and health.)

Date: September 2014

Author information: Escolano C[1], Navarro-Gil M, Garcia-Campayo J, Congedo M, Minguez J.

[1]Aragon Institute of Engineering Research (I3A), Zaragoza, Spain,

Abstract: Standardized neurofeedback (NF) protocols have been extensively evaluated in attention-deficit/hyperactivity disorder (ADHD). However, such protocols do not account for the large EEG heterogeneity in ADHD. Thus, individualized approaches have been suggested to improve the clinical outcome. In this direction, an open-label pilot study was designed to evaluate a NF protocol of relative upper alpha power enhancement in fronto-central sites. Upper alpha band was individually determined using the alpha peak frequency as an anchor point. 20 ADHD children underwent 18 training sessions. Clinical and neurophysiological variables were measured pre- and post-training. EEG was recorded pre- and post-training, and pre- and post-training trials within each session, in both eyes closed resting state and eyes open task-related activity. A power EEG analysis assessed long-term and within-session effects, in the trained parameter and in all the sensors in the (1-30) Hz spectral range. Learning curves over sessions were assessed as well. Parents rated a clinical improvement in children regarding inattention and hyperactivity/impulsivity. Neurophysiological tests showed an improvement in working memory, concentration and impulsivity (decreased number of commission errors in a continuous performance test). Relative and absolute upper alpha power showed long-term enhancement in task-related activity, and a positive learning curve over sessions. The analysis of within-session effects showed a power decrease ("rebound" effect) in task-related activity, with no significant effects during training trials. **We conclude that the enhancement of the individual upper alpha power is effective in improving several measures of clinical outcome and cognitive performance in ADHD. This is the first NF study evaluating such a protocol in ADHD. A controlled evaluation seems warranted due to the positive results obtained in the current study.**

Source:

http://www.ncbi.nlm.nih.gov/pubmed/?term=The+effects+of+individual+Upper+Alpha+Neurofeedback+in+ADHD

**AUSTRALIA**

### 3. Non-pharmacological treatments for ADHD: a meta-analytic review.

Published by: Journal of Attention Disorders (a peer-reviewed academic journal that publishes papers in the field of Psychiatry.)

Date: May 2014

Author information: Hodgson K1, Hutchinson AD, Denson L.

1University of Adelaide, Australia.

Objective: The authors replicated and expanded on Fabiano et al.'s meta-analysis of behavioral treatments for ADHD, systematically comparing the efficacy of 7 nonpharmacological interventions.

Results: **Behavior modification and neurofeedback treatments were most supported by this evidence.** Interventions were generally more efficacious for girls, and least efficacious for the "combined" ADHD subtype. The authors found no dose or age effects.

Conclusion: Based on the small, published literature, this study supports some non-pharmacological interventions for ADHD, and indicates directions for more evaluation research into psychological treatments.

Source:

http://www.ncbi.nlm.nih.gov/pubmed/?term=nonpharmacological+treatments+for+ADHD%3A+a+meta-analytic+review

**USA**

### 4. In-school neurofeedback training for ADHD: sustained improvements from a randomized control trial.

Published by: Pediatrics (a peer-reviewed medical journal published by the American Academy of Pediatrics.)

Date: March 2014

Author information: Steiner NJ1, Frenette EC, Rene KM, Brennan RT, Perrin EC.

1The Floating Hospital for Children at Tufts Medical Center, Department of Pediatrics, Boston, Massachusetts.

Objective: To evaluate sustained improvements 6 months after a 40-session, in-school computer attention training intervention using neurofeedback or cognitive training (CT) administered to 7- to 11-year-olds with attention-deficit/hyperactivity disorder (ADHD).

Conclusion: **Neurofeedback participants made more prompt and greater improvements in ADHD symptoms, which were sustained at the 6-month follow-up, than did CT participants or those in the control group. This finding suggests that neurofeedback is a promising attention training treatment for children with ADHD.**

Source:

http://pediatrics.aappublications.org/content/early/2014/02/11/peds.2013-2059

5. **Neurofeedback and cognitive attention training for children with attention-deficit hyperactivity disorder in schools.**

Published by: Journal of Developmental Behavorial Pediatrics (a peer-reviewed medical journal covering developmental behavioral pediatrics.)

Date: January 2014

Author information: Steiner NJ1, Frenette EC, Rene KM, Brennan RT, Perrin EC.

1The Floating Hospital for Children at Tufts Medical Center, Department of Pediatrics, Boston, MA; †Harvard School of Public Health, Boston, MA.
J Dev Behav Pediatr. 2014 Jan;35(1):18-27. doi: 10.1097/DBP.0000000000000009.

Objective: To evaluate the efficacy of 2 computer attention training systems administered in school for children with attention-deficit hyperactivity disorder (ADHD).

Conclusion: Neurofeedback made greater improvements in ADHD symptoms compared to both the control and CT conditions. Thus, NF is a promising attention training treatment intervention for children with ADHD.

Source:

http://www.ncbi.nlm.nih.gov/pubmed/24399101

**THE NETHERLANDS**

## 6. Evaluation of neurofeedback in ADHD: the long and winding road.

Published by: Biological Psychology (a peer-reviewed academic journal covering biological psychology published by Elsevier.)

Date : January 2014

Author information: Arns M1, Heinrich H2, Strehl U3.

1Research Institute Brainclinics, Nijmegen, The Netherlands; Utrecht University, Dept. Experimental Psychology, Utrecht, The Netherlands.

2Dept. of Child and Adolescent Mental Health, University Hospital of Erlangen, Erlangen, Germany; Heckscher-Klinikum, München, Germany.

3University of Tuebingen, Tuebingen, Germany.

Abstract: Among the clinical applications of neurofeedback, most research has been conducted in ADHD. As an introduction a short overview of the general history of neurofeedback will be given, while the main part of the paper deals with a review of the current state of neurofeedback in ADHD. A meta-analysis on neurofeedback from 2009 found large effect sizes for inattention and impulsivity and medium effects sizes for hyperactivity. Since 2009 several new studies, including 4 placebo-controlled studies, have been published. These latest studies are reviewed and discussed in more detail. The review focuses on studies employing (1) semi-active, (2) active, and (3) placebo-control groups. The assessment of specificity of neurofeedback treatment in ADHD is discussed and **it is concluded that standard protocols such as theta/beta, SMR and slow cortical potentials neurofeedback are well investigated and have demonstrated specificity**. The paper ends with an outlook on future questions and tasks. It is concluded that future controlled clinical trials should, in a next step, focus on such known protocols, and be designed along the lines of learning theory.

Source:

http://www.ncbi.nlm.nih.gov/pubmed/?term=Evaluation+of+neurofeedback+in+ADHD%3A+the+long+and+winding+road.

**GERMANY**

## 7. Neurofeedback in ADHD: further pieces of the puzzle.

Published by: Brain Topography (a journal of Functional Neurophysiology which features original papers and review articles that apply topographic techniques to clinical neurophysiology and functional localization

Date: January 2014

Author information: Gevensleben H1, Kleemeyer M, Rothenberger LG, Studer P, Flaig-Röhr A, Moll GH, Rothenberger A, Heinrich H.

1Child & Adolescent Psychiatry, University Medicine Göttingen, Göttingen, Germany.

Abstract: Among the different neuromodulation techniques, neurofeedback (NF) is gaining increasing interest in the treatment of children with attention-deficit/hyperactivity disorder (ADHD). In this article, a methodological framework is summarised considering the training as a

neuro-behavioural treatment. Randomised controlled trials are selectively reviewed. Results from two smaller-scale studies are presented with the first study comprising a tomographic analysis over the course of a slow cortical potential (SCP) training and a correlational analysis of regulation skills and clinical outcome in children with ADHD. In the second study, ADHD-related behaviour was studied in children with tic disorder who either conducted a SCP training or a theta/low-beta (12-15 Hz) training (single-blind, randomised design). **Both studies provide further evidence for the specificity of NF effects in ADHD. Based on these findings, a refined model of the mechanisms contributing to the efficacy of SCP training is developed. Despite a number of open questions concerning core mechanisms, moderators and mediators, NF (theta/beta and SCP) training seems to be on its way to become a valuable and ethically acceptable module in the treatment of children with ADHD.**

Source:

http://www.ncbi.nlm.nih.gov/pubmed/?term=Neurofeedback+in+ADHD%3A+further+pieces+of+the+puzzle

**SPAIN**

## 8. Neurofeedback and standard pharmacological intervention in ADHD: a randomized controlled trial with six-month follow-up.

Published by: Biological Psychology (a peer-reviewed academic journal covering biological psychology published by Elsevier.)

Date: September 2013

Author information: Meisel V[1], Servera M, Garcia-Banda G, Cardo E, Moreno I.

[1]Research Institute on Health Sciences (IUNICS), University of Balearic Islands (UIBBiol Psychol. 2013 Sep;94(1):12-21. doi: 10.1016/j.biopsycho.2013.04.015. Epub 2013 May 9.

Abstract: The present study is a randomized controlled trial that aims to evaluate the efficacy of Neurofeedback compared to standard pharmacological intervention in the treatment of attention deficit/hyperactivity disorder (ADHD). The final sample consisted of 23 children with ADHD (11 boys and 12 girls, 7-14 years old). Participants carried out 40 theta/beta training sessions or received methylphenidate. Behavioral rating scales were completed by fathers, mothers, and teachers at pre-, post-treatment, two-, and six-month naturalistic follow-up. In both groups, similar significant reductions were reported in ADHD functional impairment by parents; and in primary ADHD symptoms by parents and teachers. **However, significant academic performance improvements were only detected in the Neurofeedback group. Our findings provide new evidence for the efficacy of Neurofeedback, and contribute to enlarge the range of non-pharmacological ADHD intervention choices. To our knowledge.**

Source:

http://www.ncbi.nlm.nih.gov/pubmed/23665196

**CHINA**

## 9. A randomised controlled trial of combined EEG feedback and methylphenidate therapy for the treatment of ADHD.

Published by: The Swiss Medical Weekly (a peer-reviewed medical journal published by EMH Swiss Medical Publishers.)

Date: August 2013

Author information: Li L[1], Yang L, Zhuo CJ, Wang YF.

[1]Institute of Mental Health, Peking University, Beijing, China

Objective: To evaluate the efficacy of combined methylphenidate and EEG feedback (neurofeedback) treatment for children with ADHD.

Results: Compared to the control group, patients in the combination group had reduced ADHD symptoms and improved in related behavioural and brain functions.

Conclusion: **The combination of EEG feedback (neurofeedback) and methylphenidate treatment is more effective than methylphenidate alone. The combined therapy is especially suitable for children and adolescents with ADHD who insufficiently respond to single drug treatment or experience drug side effects.**

Source:

http://www.ncbi.nlm.nih.gov/pubmed/23986461

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