Neuere Studien zur Behandlung mit EEG-Biofeedback/Neurofeedback

zusammengestellt vom Schoresch-Zentrum für klinisch angewandtes Neurofeedback

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EEG Biofeedback Treatment Improves Certain Attention and Somatic Symptoms in Fibromyalgia: A Pilot Study

Xavier J. Caro · Earl F. Winter

Abstract

Fibromyalgia (FMS) is a chronic, painful disorder often associated with measurable deficiencies in attention. Since EEG biofeedback (EEG-BF) has been used successfully to treat attention problems, we reasoned that this modality might be helpful in the treatment of attention problems in FMS. We also speculated that improvement in central nervous system (CNS) function might be accompanied by improvement in FMS somatic symptoms. We studied fifteen FMS patients with attention problems, demonstrated by visual and auditory continuous performance testing (CPT), while completing 40 or more EEG-BF sessions. Training consisted of a "SMR protocol" that augmented 12-15 Hz brainwaves (sensory motor rhythm; SMR), while simultaneously inhibiting 4-7 Hz brainwaves (theta) and 22-30 Hz brainwaves (high beta). Serial measurements of pain, fatigue, psychological distress, morning stiffness, and tenderness were also obtained. Sixty-three FMS patients who received standard medical care, but who did not receive EEG-BF, served as controls. Visual, but not auditory, attention improved significantly ($P < 0.008$). EEG-BF treated subjects also showed improvement in tenderness, pain and fatigue. Somatic symptoms did not change significantly in controls. Visual attention parameters and certain somatic features of FMS appear to improve with an EEG-BF SMR protocol. EEG-BF training in FMS deserves further study.

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Neurofeedback for Insomnia: A Pilot Study of Z-Score SMR and Individualized Protocols

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Abstract

Insomnia is an epidemic in the US. Neurofeedback (NFB) is a little used, psychophysiological treatment with demonstrated usefulness for treating insomnia. Our objective was to assess whether two distinct Z-Score NFB protocols, a modified sensorimotor (SMR) protocol and a sequential, quantitative EEG (sQEEG)-guided, individually designed (IND) protocol, would alleviate sleep and associated daytime dysfunctions of participants with insomnia. Both protocols used instantaneous Z scores to determine reward condition administered when awake. Twelve adults with insomnia, free of other mental and uncontrolled physical illnesses, were randomly assigned to the SMR or IND group. Eight completed this randomized, parallel group, single-blind study. Both groups received fifteen 20-min sessions of Z-Score NFB. Pre-post assessments included sQEEG, mental health, quality of life, and insomnia status. ANOVA yielded significant post-treatment improvement for the combined group on all primary insomnia scores: Insomnia Severity Index (ISI $p<.005$), Pittsburgh Sleep Quality Inventory (PSQI $p<.0001$), PSQI Sleep Efficiency ($p<.007$), and Quality of Life Inventory ($p<.02$). Binomial tests of baseline EEGs indicated a significant proportion of excessively high levels of Delta and Beta power ($p<.001$) which were lowered post-treatment (paired z-tests $p<.001$). Baseline EEGs showed excessive sleepiness and hyperarousal, which improved post-treatment. Both Z-Score NFB groups improved in sleep and daytime functioning. Post-treatment, all participants were normal sleepers. Because there were no significant differences in the findings between the two groups, our future large scale studies will utilize the less burdensome to administer Z-Score SMR protocol.

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J Rehabil Med 2011; 43: 951–957

ORIGINAL REPORT

EFFECTS OF NEUROFEEDBACK TRAINING WITH AN ELECTROENCEPHALOGRAM-BASED BRAIN–COMPUTER INTERFACE FOR HAND PARALYSIS IN PATIENTS WITH CHRONIC STROKE: A PRELIMINARY CASE SERIES STUDY

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Abstract

OBJECTIVE:
To explore the effectiveness of neurorehabilitative training using an electroencephalogram-based brain- computer interface for hand paralysis following stroke.

DESIGN:
A case series study.

SUBJECTS:
Eight outpatients with chronic stroke demonstrating moderate to severe hemiparesis.

METHODS:
Based on analysis of volitionally decreased amplitudes of sensory motor rhythm during motor imagery involving extending the affected fingers, real-time visual feedback was provided. After successful motor imagery, a mechanical orthosis partially extended the fingers. Brain-computer interface interventions were carried out once or twice a week for a period of 4-7 months, and clinical and neurophysiological examinations pre- and post-intervention were compared.

RESULTS:
New voluntary electromyographic activity was measured in the affected finger extensors in 4 cases who had little or no muscle activity before the training, and the other participants exhibited improvement in finger function. Significantly greater suppression of the sensory motor rhythm over both hemispheres was observed during motor imagery. Transcranial magnetic stimulation showed increased cortical excitability in the damaged hemisphere. Success rates of brain-computer interface training tended to increase as the session progressed in 4 cases.

CONCLUSION:
Brain-computer interface training appears to have yielded some improvement in motor function and brain plasticity. Further controlled research is needed to clarify the role of the brain-computer interface system.

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Effect of Neurofeedback on Motor Recovery of a Patient with Brain Injury: A Case Study and Its Implications for Stroke Rehabilitation

Kay Wing

TopStroke Rehabil. 2001 Autumn;8(3):45-53.

Abstract

This case study showed the effect of neurofeedback (NFB) training in a patient with a brain tumor and co-existing traumatic brain injury. The patient received 40 sessions of NFB intervention. Tests and videotaped recordings evaluated pre- and post-NFB intervention. This study demonstrated minimal to significant improvements in several functional tasks. The conclusion is that the use of NFB for a person with a head injury and brain tumor can be generalized to be used with stroke survivors.

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Neurofeedback for subjective tinnitus patients

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Abstract

Objective: Previous studies report that enhanced power in the delta range (1.5–4 Hz) and reduced power in the alpha frequency band (8–12 Hz) were most pronounced in the temporal regions. These studies referred to the 8–12 Hz activity as tau activity, and they created a new neurofeedback protocol to treat tinnitus using a temporally generated tau rhythm (8–12 Hz) and slow waves in the delta range (3–4 Hz) for feedback. This study aims to repeat this protocol and to evaluate its effect on tinnitus.

Methods: Fifteen normal-hearing patients with tinnitus were treated with the neurofeedback protocol. The Tinnitus Handicap Inventory and Visual Analogue Scales were administered before and after treatment and at 1, 3 and 6 months post-treatment.

Results: After therapy, all questionnaires scores were significant improved, and the improvements persisted throughout the followup period. Moreover, an increasing trend in the tau/delta ratio was observed; specifically, the trend was more stable respect of the pre-recording measure.
However, only in some subjects may the signal alone be enough to develop the correct behaviors.

Conclusion: Further studies are necessary to characterize the tinnitus subjects who recovered from and adapted to this psychophysical condition and, therefore, responded to neurofeedback therapy.

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ORIGINAL CONTRIBUTION

Neurofeedback in ADHD: a single-blind randomized controlled trial

Ali Reza Bakhshayesh · Sylvana Hänsch · Anne Wyschkon · Mohammad Javad Rezai · Günter Esser

Abstract

Neurofeedback treatment has been demonstrated to reduce inattention, impulsivity and hyperactivity in children with attention deficit/hyperactivity disorder (ADHD). However, previous studies did not adequately control confounding variables or did not employ a randomized reinforcer-controlled design. This study addresses those methodological shortcomings by comparing the effects of the following two matched biofeedback training variants on the primary symptoms of ADHD: EEG neurofeedback (NF) aiming at theta/beta ratio reduction and EMG biofeedback (BF) aiming at forehead muscle relaxation. Thirty-five children with ADHD (26 boys, 9 girls; 6-14 years old) were randomly assigned to either the therapy group (NF; n = 18) or the control group (BF; n = 17). Treatment for both groups consisted of 30 sessions. Pre- and post-treatment assessment consisted of psychophysiological measures, behavioural rating scales completed by parents and teachers, as well as psychometric measures. Training effectively reduced theta/beta ratios and EMG levels in the NF and BF groups, respectively. Parents reported significant reductions in primary ADHD symptoms, and inattention improvements in the NF group were higher compared to the control intervention (BF, d (corr) = -.94). NF training also improved attention and reaction times on the psychometric measures. The results indicate that NF effectively reduced inattention symptoms on parent rating scales and reaction time in neuropsychological tests. However, regarding hyperactivity and impulsivity symptoms, the results imply that non-specific factors, such as behavioural contingencies, self-efficacy, structured learning environment and feed-forward processes, may also contribute to the positive behavioural effects induced by neurofeedback training.

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BIOLOGICAL CHILD AND ADOLESCENT PSYCHIATRY - ORIGINAL ARTICLE

ADHD and EEG-neurofeedback: a double-blind randomized placebo-controlled feasibility study

M. M. Lansbergen · M. van Dongen-Boomsma · J. K. Buitelaar · D. Slaats-Willemse

Abstract

Electroencephalography (EEG)-neurofeedback has been shown to offer therapeutic benefits to patients with attention-deficit/hyperactivity disorder (ADHD) in several, mostly uncontrolled studies. This pilot study is designed to test the feasibility and safety of using a double-blind placebo feedback-controlled design and to explore the initial efficacy of individualized EEG-neurofeedback training in children with ADHD. Fourteen children (8-15 years) with ADHD defined according to the DSM-IV-TR criteria were randomly allocated to 30 sessions of EEG-neurofeedback (n = 8) or placebo feedback (n = 6). Safety measures (adverse events and sleep problems), ADHD symptoms and global improvement were monitored. With respect to feasibility, all children completed the study and attended all study visits and training sessions. No significant adverse effects or sleep problems were reported. Regarding the expectancy, 75% of children and their parent(s) in the active neurofeedback group and 50% of children and their parent(s) in the placebo feedback group thought they received placebo feedback training. Analyses revealed significant improvements of ADHD symptoms over time, but changes were similar for both groups. This pilot study shows that it is feasible to conduct a rigorous placebo-controlled trial to investigate the efficacy of neurofeedback training in children with ADHD. However, a double-blind design may not be feasible since using automatic adjusted reward thresholds may not work as effective as manually adjusted reward thresholds. Additionally, implementation of active learning strategies may be an important factor for the efficacy of EEG-neurofeedback training. Based on the results of this pilot study, changes are made in the design of the ongoing study.

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Neurofeedback bei Kindern mit ADHS – methodische Grundlagen und wissenschaftliche Evaluation

Holger Gevensleben, Gunther H. Moll, Aribert Rothenberger und Hartmut Heinrich

Neurofeedback bei Kindern mit ADHS
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Zusammenfassung

Neurofeedback stellt ein computergestütztes Verhaltenstraining dar, das in der Behandlung von Kindern mit Aufmerksamkeitsdefizit-/Hyperaktivitätsstörung (ADHS) zunehmend Beachtung findet. Der vorliegende Beitrag geht auf den aktuellen Stand der Forschung ein, insbesondere die methodischen Grundlagen und Aspekte der Evaluation. In den bislang durchgeführten Evaluationsstudien konnte die klinische Wirksamkeit nachgewiesen werden. So zeigte sich ein Neurofeedback-Trainingz. B. in einer randomisierten kontrollierten Studie einem herkömmlichen Computer-Aufmerksamkeitstraining überlegen (mittlere Effektstärke). Die Trainingseffekte erweisen sich auch längerfristig als stabil, wie Follow-up Untersuchungen (z. B. nach sechs Monaten) belegen. Auf klinischer Ebene scheinen mit den Neurofeedback-Protokollen Theta/Beta-Trainingund Training langsamer kortikaler Potentiale vergleichbare Effekte erzielt werden zu können. Untersuchungen auf neurophysiologischer Ebene weisen allerdings auf unterschiedliche Wirkmechanismen dieser Neurofeedback-Protokolle hin. Künftige Studien sollten die Spezifität der Trainingseffekteweiter beleuchten und sich der Optimierung und Individualisierung des Trainingswidmen.

Zeitschrift für Kinder- und Jugendpsychiatrie und Psychotherapie, 38 (6), 2010, 409–420

Übersichtsarbeit

Neurofeedback-Training bei Kindern mit Aufmerksamkeitsdefizit-/Hyperaktivitätsstörung (ADHS)

Effekte auf Verhaltens- und neurophysiologischer Ebene

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Zusammenfassung

Im Rahmen einer multizentrischen, randomisierten, kontrollierten Studie evaluierten wir die klinische Wirksamkeit eines Neurofeedback-Trainings (NF) bei Kindern mit einer Aufmerksamkeitsdefizit-/Hyperaktivitätsstörung (ADHS) und untersuchten die einem erfolgreichen Training zugrunde liegenden neurophysiologischen Wirkmechanismen. Als Vergleichstraining diente ein computergestütztes Aufmerksamkeitstraining, das dem Setting des Neurofeedback-Trainingsin den wesentlichen Anforderungen und Rahmenbedingungen angeglichen war. Auf Verhaltensebene (Eltern- und Lehrerbeurteilung) zeigte sich das NF-Trainingnach Trainingsende dem Kontrolltraining sowohl hinsichtlich der ADHS-Kernsymptomatik als auch in assoziierten Bereichen überlegen. Für das Hauptzielkriterium (Verbesserung im FBB-HKS Gesamtwert) ergab sich eine mittlere Effektstärke (von 0.6). Sechs Monate nach Trainingsende (follow-up) konnte das gleiche Ergebnismuster gefunden werden. Die Ergebnisse legen somit den Schluss nahe, dass NF einen klinisch wirksamen Therapiebaustein zur Behandlung von Kindern mit ADHS darstellt. Auf neurophysiologischer Ebene (EEG; ereignisbezogene Potentiale, EPs) konnten fur die beiden Neurofeedback-Protokolle Theta/Beta-Trainingund Training langsamer kortikaler Potentiale spezifische Effekte aufgezeigt werden. So war für das Theta/Beta-Training beispielsweise die Abnahme der Theta-Aktivität mit einer Reduzierung der ADHS-Symptomatik assoziiert. Fur das SCP-Trainingwurde u. a. im Attention Network Test eine Erhöhung der kontingenten negativen Variation beobachtet, die die mobilisierten Ressourcen bei Vorbereitungsprozessen widerspiegelt. EEG- und EP-basierte Prädiktorvariablen konnten ermittelt werden. Der vorliegende Artikel bietet einen Gesamtüberblick über die in verschiedenen Publikationen unserer Arbeitsgruppe beschriebenen Ergebnisse der Studie und zeigt zukünftige Fragestellungen auf.

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Is neurofeedback an efficacious treatment for ADHD? A randomised controlled clinical trial

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Abstract

BACKGROUND:

For children with attention deficit/hyperactivity disorder (ADHD), a reduction of inattention, impulsivity and hyperactivity by neurofeedback (NF) has been reported in several studies. But so far, unspecific training effects have not been adequately controlled for and/or studies do not provide sufficient statistical power. To overcome these methodological shortcomings we evaluated the clinical efficacy of neurofeedback in children with ADHD in a multisite randomised controlled study using a computerised attention skills training as a control condition.

METHODS:

102 children with ADHD, aged 8 to 12 years, participated in the study. Children performed either 36 sessions of NF training or a computerised attention skills training within two blocks of about four weeks each (randomised group assignment). The combined NF treatment consisted of one block of theta/beta training and one block of slow cortical potential (SCP) training. Pre-training, intermediate and post-training assessment encompassed several behaviour rating scales (e.g., the German ADHD rating scale, FBB-HKS) completed by parents and teachers. Evaluation ('placebo') scales were applied to control for parental expectations and satisfaction with the treatment.

RESULTS:

For parent and teacher ratings, improvements in the NF group were superior to those of the control group. For the parent-rated FBB-HKS total score (primary outcome measure), the effect size was .60. Comparable effects were obtained for the two NF protocols (theta/beta training, SCP training). Parental attitude towards the treatment did not differ between NF and control group.

CONCLUSIONS:

Superiority of the combined NF training indicates clinical efficacy of NF in children with ADHD. Future studies should further address the specificity of effects and how to optimise the benefit of NF as treatment module for ADHD.

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ORIGINAL CONTRIBUTION

Neurofeedback training in children with ADHD: 6-month follow-up of a randomised controlled trial

Holger Gevensleben · Birgit Holl · Björn Albrecht · Dieter Schlamp · Oliver Kratz · Petra Studer · Aribert Rothenberger · Gunther H. Moll · Hartmut Heinrich

Abstract

Neurofeedback (NF) could help to improve attentional and self-management capabilities in children with attention-deficit/hyperactivity disorder (ADHD). In a randomised controlled trial, NF training was found to be superior to a computerised attention skills training (AST) (Gevensleben et al. in J Child Psychol Psychiatry 50(7):780-789, 2009).

In the present paper, treatment effects at 6-month follow-up were studied. 94 children with ADHD, aged 8-12 years, completed either 36 sessions of NF training (n = 59) or a computerised AST (n = 35). Pre-training, post-training and follow-up assessment encompassed several behaviour rating scales (e.g., the German ADHD rating scale, FBB-HKS) completed by parents. Follow-up information was analysed in 61 children (ca. 65%) on a per-protocol basis. 17 children (of 33 dropouts) had started a medication after the end of the training or early in the follow-up period. Improvements in the NF group (n = 38) at follow-up were superior to those of the control group (n = 23) and comparable to the effects at the end of the training.

For the FBB-HKS total score (primary outcome measure), a medium effect size of 0.71 was obtained at follow-up. A reduction of at least 25% in the primary outcome measure (responder criterion) was observed in 50% of the children in the NF group. In conclusion, behavioural improvements induced by NF training in children with ADHD were maintained at a 6-month follow-up. Though treatment effects appear to be limited, the results confirm the notion that NF is a clinically efficacious module in the treatment of children with ADHD.

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Kindheit und Entwicklung 18 (2), 95–104 © Hogrefe Verlag, Göttingen 2009

Therapie

Spezifische Wirksamkeit von Neurofeedback auf die Impulsivität bei ADHS

Martin Holtmann[1], Dörte Grasmann[2], Ewa Cionek-Szpak[2], Viola Hager[2], Nicole Panzner[2], Anke Beyer[2], Fritz Poustka[2] und Christina Stadler[2]

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Zusammenfassung

Für das Neurofeedback (NF), ein verhaltenstherapeutisches Verfahren, das über die Modifikation von EEG-Parametern eine Verbesserung von ADHS-Kernsymptomen anstrebt, hat sich die Evidenzbasis in den vergangenen Jahren verbessert. Die Arbeit gibt einen Überblick über die vorliegenden Befunde. Die durch NF erreichten kurzfristigen Verbesserungen entsprachen in mehreren Studien denen einer pharmakotherapeutischen Stimulanzien-Behandlung. Untersuchungen zur Wirkdauer der Effekte sind ermutigend.

In einer eigenen Pilotstudie wurden 34 Kinder mit ADHS zufällig einer Neurofeedback-Behandlung oder einem computergestützten Aufmerksamkeitstraining zugeteilt. Die Zahl der Impulsivitätsfehler in einem Stopp-Signal-Paradigma reduzierte sich durch Neurofeedback signifikant, während sich im Elternurteil keine differenziellen Effekte fanden. Eine weitgehende Normalisierung hirnelektrischer Korrelate von Hemmungskontrolle fand sich nur in der NF-Gruppe. Neurofeedback ist ein vielversprechender Ansatz in der ADHS-Behandlung. Gleichwohl besteht Bedarf an weiteren kontrollierten Studien mit einheitlichen diagnostischen Kriterien, ausreichend großen Stichproben, geeigneten Veränderungsmaßen und Katamnese-Untersuchungen.

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Zeitschrift für Kinder- und Jugendpsychiatrie und Psychotherapie, 32 (3), 2004, 187–200

Übersichtsarbeit

Neurofeedback in der Behandlung der Aufmerksamkeitsdefizit-Hyperaktivitätsstörung (ADHS) im Kindes- und Jugendalter

Martin Holtmann[1], Christina Stadler[1], Ulrike Leins[2], Ute Strehl[2], Niels Birbaumer[2] und Fritz Poustka[1]

Zusammenfassung:

Einleitung: In der Therapie der Aufmerksamkeitsdefizit-Hyperaktivitätsstörung (ADHS) sind viele nicht-medikamentöse Behandlungsmethoden den Nachweis ihrer Wirksamkeit schuldig geblieben. Für das Neurofeedback (auch EEG-Biofeedback) hat sich die Evidenzbasis in den vergangenen Jahren verbessert. Neurofeedback bewirkt abhängig vom Trainings-Protokoll Veränderungen des EEG-Frequenzspektrums oder der ereigniskorrelierten Potentiale bei ADHS und strebt uüber die gelernte Modifikation dieser Parameter eine Verbesserung der ADHS-Kernsymptome an.

Methoden: In dieser Übersichtsarbeit werden die vorliegenden Forschungsbefunde detailliert dargelegt.

Ergebnisse: Die durch das Neurofeedback erreichten kurzfristigen Verbesserungen entsprachen in drei kontrollierten Studien denen einer pharmakotherapeutischen Stimulanzien-Behandlung. Neurofeedback führte zu einer signifikanten Reduktion von Unaufmerksamkeit, Impulsivität und Hyperaktivität. Darüber hinaus fand sich eine anhaltende Normalisierung des Spontan-EEGs, während eine Stimulanzientherapie keine vergleichbare Normalisierung bewirkte; es traten keine unerwünschten Wirkungen auf. Untersuchungen zur Wirkdauer der Neurofeedback-Effekte sind ermutigend, stützen sich aber auf kleine Patientenzahlen.

Schlussfolgerung: Neurofeedback ist ein viel versprechender Ansatz in der Behandlung aufmerksamkeitsgestörter, hyperaktiver Kinder. Gleichwohl besteht Bedarf an weiteren kontrollierten Studien mit einheitlichen diagnostischen Kriterien, ausreichend großen Stichproben, geeigneten Veränderungsmaßen und Katamnese-Untersuchungen.

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