Wissenschaftliche Veröffentlichungen
zusammengestellt von Dr. Gaston von Glutz

Neuere Publikationen zu Neurofeedback
1. ADS
2. Anxiety and PTSD
3. Autism
4. Depression
5. Head Injury
6. Chronic Pain

1. ADS

DeBeus R. et al. : Advanced Psychological Services, Riverside Health System, Newport News, Viginia
Presented at the Annual Conference of the International Society for Neuronal Regulation Houston: August 29, 2003
Attention training with ADHD children: preliminary findings in a double-blind placebo-controlled study.
A double-blind crossover design was used with 52 children age 7-10 diagnosed with ADHD (50% inattentive type, 50% combined); 46% had comorbid conduct disorder, depression, or anxiety disorders, typical of the ADHD population. All subjects received 20 neurofeedback and 20 sham feedback interventions in randomly assigned order, for a total of 40 treatments. deBeus and colleagues used the neurofeedback technology titled SMART Brain from CyberLearning Technology, LLC. The active treatment was theta suppression with enhancement of SMR or beta; the sham was random rewards from the same equipment. Neurofeedback resulted in significantly better hyperactivity ratings at home and school, attention ratings at home, ability to work with others, organization, study habits, attitude, internalizing symptoms, and computerized tests of attention. During biofeedback a third of the group was able to reduce medication dosage. During biofeedback, but not during sham, the subjects showed the expected power spectrum changes.

Monastra et al: FPI Attention Disorders Clinic, Endicott, New York 13760, USA. drmonastra@stny.rr.com
Appl. Psychophysiol Biofeedback 2005 Jun, 30(2): 95-114
Electroencephalographic biofeedback in the treatment of attention-deficit/hyperactivity disorder.

Historically, pharmacological treatments for attention-deficit/hyperactivity disorder (ADHD) have been considered to be the only type of interventions effective for reducing the core symptoms of this condition. However, during the past three decades, a series of case and controlled group studies examining the effects of EEG biofeedback have reported improved attention and behavioral control, increased cortical activation on quantitative electroencephalographic examination, and gains on tests of intelligence and academic achievement in response to this type of treatment. This review paper critically examines the empirical evidence, applying the efficacy guidelines jointly established by the Association for Applied Psychophysiology and Biofeedback (AAPB) and the International Society for Neuronal Regulation (ISNR). On the basis of these scientific principles, EEG biofeedback was determined to be "probably efficacious" for the treatment of ADHD. Although significant clinical improvement was reported in approximately 75% of the patients in each of the published research studies, additional randomized, controlled group studies are needed in order to provide a better estimate of the percentage of patients with ADHD who will demonstrate such gains in clinical practice.

Monastra VJ: FPI Attention Disorders Clinic, 2102 East Main Street, Endicott, NY 13760, USA.
Published 26 November 2004 in Child Adolesc Psychiatr Clin N Am, 14(1): 55-82
Electroencephalographic biofeedback (neurotherapy) as a treatment for attention deficit hyperactivity disorder:
rationale and empirical foundation.
During the past three decades,
electroencephalographic (EEG) biofeedback has emerged as a nonpharmacologic treatment for attention-deficit/hyperactivity disorder (ADHD). This intervention was derived from operant conditioning studies that demonstrated capacity for neurophysiologic training in humans and other mammals and targets atypical patterns of cortical activation that have been identified consistently in neuroimaging and quantitative EEG studies of patients diagnosed with ADHD. This article presents the rationale for EEG biofeedback and examines the empirical support for this treatment using efficacy guidelines established by the Association for Applied Psychophysiology and Biofeedback and the International Society for Neuronal Regulation. Based on these guidelines, EEG biofeedback is considered to be "probably efficacious" for the treatment of ADHD and merits consideration as a treatment for patients who are stimulant "nonresponders." Although research findings published to date indicate positive clinical response in approximately 75% of patients treated in controlled group studies, additional randomized, controlled trials are needed to provide a better estimate of the robustness of this treatment.

Friel PN: Washington State Toxicology Laboratory, Forensic Laboratory Services Bureau Suit 360, 2203 Airport Way South, Seattle, WA 98134, USA.
Pat.Friel@wsp.wa.gov
Alternative Medicine Review*, Volume 12, #2, June, 2007, pp146-151*
Review Article: Neurofeedback in ADHD
Electroencephalogram (EEG) biofeedback, also known as neurofeedback, is a promising alternative treatment for patients with attention deficit/hyperactivity disorder (AD/HD). EEG biofeedback therapy rewards scalp EEG frequencies that are associated with relaxed attention, and suppresses frequencies associated with under- or over-arousal. In large-scale clinical trials, the efficacy of EEG biofeedback for AD/HD is comparable to that of stimulant medications. Many different EEG

biofeedback protocols for AD/HD are available. Single-channel protocols developed by Lubar and interhemispheric protocols developed by the Othmers are widely practiced and supported by large-scale clinical studies.

Drechsler R, Straub M, Doehnert M, Heinrich H, Steinhausen HC, Brandeis D
Department of Child and Adolescent Psychiatry, University of Zurich, Switzerland.
renate.drechsler@kjpd.uzh.ch.
Behav Brain Funct. 2007, Jul 26; 3:35

Controlled evaluation of a neurofeedback training of slow cortical potentials in children with Attention Deficit/Hyperactivity Disorder (ADHD).

Although several promising studies on neurofeedback training in Attention Deficit/Hyperactivity Disorder (ADHD) have been performed in recent years, the specificity of positive treatment effects continues to be challenged. METHODS: To evaluate the specificity of a neurofeedback training of slow cortical potentials, a twofold strategy was pursued: First, the efficacy of neurofeedback training was compared to a group training program for children with ADHD. Secondly, the extent of improvements observed in the neurofeedback group in relation to successful regulation of cortical activation was examined. Parents and teachers rated children's behaviour and executive functions before and after treatment. In addition, children underwent neuropsychological testing before and after training. RESULTS: According to parents' and teachers' ratings, children of the neurofeedback training group improved more than children who had participated in a group therapy program, particularly in attention and cognition related domains. On neuropsychological measures children of both groups showed similar improvements. However, only about half of the neurofeedback group learned to regulate cortical activation during a transfer condition without direct feedback. Behavioural improvements of this subgroup were moderately related to neurofeedback training performance, whereas effective parental support accounted better for some advantages of neurofeedback training compared to group therapy according to parents' and teachers' ratings. CONCLUSION: There is a specific training effect of neurofeedback of slow cortical potentials due to enhanced cortical control. However, non-specific factors, such as parental support, may also contribute to the positive behavioural effects induced by the neurofeedback training.

Beauregard M et al: Centre de Recherche en Neuropsychologie et Cognition, Département de Psychologie, Université de Montréal, Montréal, Canada.
Appl Psychophysiol Biofeedback, 2006 Mar ; 31 (1) : 3-20

Functional magnetic resonance imaging investigation of the effects of neurofeedback training on the neural bases of selective attention and response inhibition in children with attention-deficit/hyperactivity disorder.

Two functional magnetic resonance imaging (fMRI) experiments were undertaken to measure the effect of neurofeedback training (NFT), in AD/HD children, on the neural substrates of selective attention and response inhibition. Twenty unmedicated AD/HD children participated to these experiments. Fifteen children were randomly assigned to the Experimental (EXP) group whereas the other five children were randomly assigned to the Control (CON) group. Only subjects in the EXP group underwent NFT. EXP subjects were trained to enhance the amplitude of the SMR (12-15 Hz) and beta 1 activity (15-18 Hz), and decrease the amplitude of theta activity (4-7 Hz). Subjects from both groups were scanned one week before the beginning of NFT (Time 1) and 1 week after the end of NFT (Time 2), while they

performed a "Counting Stroop" task (Experiment 1) and a Go/No-Go task (Experiment 2). At Time 1, in both groups, the Counting Stroop task was associated with significant activation in the left superior parietal lobule. For the Go/No-Go task, no significant activity was detected in the EXP and CON groups. At Time 2, in both groups, the Counting Stroop task was associated with significant activation of the left superior parietal lobule. This time, however, there were significant loci of activation, in the EXP group, in the right ACC, left caudate nucleus, and left substantia nigra. No such activation loci were seen in CON subjects. For the Go/No-Go task, significant loci of activation were noted, in the EXP group, in the right ventrolateral prefrontal cortex, right ACcd, left thalamus, left caudate nucleus, and left substantia nigra. No significant activation of these brain regions was measured in CON subjects. These results suggest that NFT has the capacity to functionally normalize the brain systems mediating selective attention and response inhibition in AD/HD children.

2. Anxiety + PTSD

D. Corydon Hammond: Physical Medicine and Rehabilitation, University of Utah School of Medicine, PM&R 30 No 1900 East, Salt Lake City, UT 84132-2119, USA
Child and Adolescent Psychiatric Clinics of North America , Jan 2005, Vol 14 (1), 105-123

Neurofeedback with anxiety and affective disorders

As reviewed in other articles, the neuroscience technology known as EEG biofeedback (or neurofeedback) has considerable research support in areas such as uncontrolled epilepsy and attention deficit disorder and ADHD. In evaluating the studies in the overall broad area of the neurofeedback treatment of anxiety disorders, EEG biofeedback qualifies for the evidence-based designation of being an efficacious treatment .When separate anxiety disorders are individually evaluated, the areas of phobic anxiety, generalized anxiety, and PTSD each qualify for designation as being a probably efficacious treatment. Currently there are only reports of cases and series of cases on the treatment of depression and OCD and no published reports thus far on treatment of bipolar disorder. Despite the lengthy follow-ups and use of objective measures, neurofeedback treatment for depression and OCD is not yet empirically supported.

EEG biofeedback is an exciting, cutting-edge technology that offers an additional treatment alternative for modifying dysfunctional, biologic brain patterns that are associated with various psychiatric conditions. It has the advantage of
118 D.C. Hammond / Child Adolesc Psychiatric Clin N Am 14 (2005) 105–123
not being as invasive as medication, transcranial magnetic stimulation, or electroconvulsive therapy, and it has been associated with few side effects or adverse reactions. Frank H. Duffy, a professor and pediatric neurologist at Harvard Medical School, said that scholarly literature suggests that neurofeedback ‘‘should play a major therapeutic role in many difficult areas. In my opinion, if any medication had demonstrated such a wide spectrum of efficacy it would be universally accepted and widely used.’’ ‘‘It is a field to be taken seriously by all’’.. Duffy further pointed out that the field of neurofeedback also must produce more randomized, controlled studies. The efficacy of other biologic treatments (eg, medication and transcranial magnetic stimulation) for anxiety and affective disorders in children is not fully established, and many parents and patients increasingly seek less invasive treatment alternatives. It is desirable that more funded research be directed to providing further research evaluation of the

potential of neurofeedback as a treatment with adults and children. Clinicians who are interested in learning more about neurofeedback training and qEEG may contact the International Society for Neuronal Regulation (www.isnr.org) or the Association for Applied Psychophysiology and Biofeedback (www.aapb.org).

Moore NC: Brain Research Center, Mercer University School of Medicine, Macon, GA 31207, USA.
Clin Encephalogr. 2000 Jan;31(1):1-6.
A review of EEG biofeedback treatment of anxiety disorders
Alpha, theta and alpha-theta enhancements are effective treatments of the anxiety disorders (Table 1). Alpha suppression is also effective, but less so (Table 2). Perceived success in carrying out the task plays an important role in clinical improvement. Research is needed to find out how much more effective they are than placebo, and which variables are important for efficacy. Variables needing study are: duration of treatment, type and severity of anxiety, number and type of EEG waveforms used, pretreatment with other kinds of feedback, position and number of electrodes, and presence of concomitant medication.

Ken Graap, M.Ed., David J. Ready, Ph.D., David Freides, Ph.D., Bob Danials, Ph.D., David Baltzell, M.D.: Emory University, Department of Psychology, Atlanta, GA.
1997 SNR (Society for Neuronal Regulation) Presented Paper Abstracts
EEG Biofeedback Treatment for Vietnam Veterans Suffering from Post Traumatic Stress Disorder
Peniston and Kulkosky (1991) reported outstanding results in relieving symptoms of PTSD with an EEG biofeedback based treatment. This study was undertaken in an attempt to replicate Peniston and Kulkosky findings in an outpatient setting. To this end, outpatient veterans who sought treatment for PTSD at the Atlanta, VA were screened for participation in a two group cross over design study. Ultimately, nineteen of the veterans participated in some part of the study and thirteen of them completed the EEG biofeedback training. Dependent measures including the Beck Depression Inventory (BDI), Minnesota Multi-phasic Personality Inventory (MMPI), Million Clinical Multi-Axial Inventory (MCMI), Clinician Administered Posttraumatic Stress Scale (CAPS), Mississippi Scale for Post Traumatic Stress (Miss) and 19 channel EEG recordings were collected on three separate occasions. Half of the sample was treated at Emory using the Lexicor Biolex system and half were seen at the VA using a Focus Technology system. All participants were also enrolled in therapy groups with their cohort. BDI and Mississippi Scale scores declined across the study interval while other variables did not systematically change.
Overall, the results indicated that applying the treatment described by Peniston and Kulkosky (1991) to the outpatient population did not lead to the same dramatic results as they reported. A discussion of the past research, the present study and the factors which may have lead to the failure to replicate is presented.

3. Autism

Robert Coben, Ilean Padolsky: Neurorehabilitation & Neuropsychological Services, 1035 Park Boulevard, Suite 2B, Massapequa Park, NY 11762 (E-mail: robcoben@optonline.net)
Journal of Neurotherapy, Vol. 11(1) 2007
Assessment-Guided Neurofeedback for Autistic Spectrum Disorder
Background. Research reviewing the epidemiology of Autism (Medical Research

Council, 2001) indicated that approximately 60 per 10,000 children (1/166) are diagnosed with Autistic Spectrum Disorder (ASD). Jarusiewicz (2002) published the only controlled study documenting the effectiveness of neurofeedback for Autism based on one outcome measure. The present study extended these findings with a larger sample size, broader range of assessments, and physiological measures of brain functioning.
Methods. Assessment-guided neurofeedback was conducted in 20 sessions for 37 patients with ASD. The experimental and control groups were matched for age, gender, race, handedness, other treatments, and severity of ASD.
Results. Improved ratings of ASD symptoms reflected an 89% success rate. Statistical analyses revealed significant improvement in Autistics who received Neurofeedback compared to a wait list control group. Other major findings included a 40% reduction in core ASD symptomatology (indicated by ATEC Total Scores), and 76% of the experimental group had decreased hyperconnectivity. Reduced cerebral hyperconnectivity was associated with positive clinical outcomes in this population. In all cases of reported improvement in ASD symptomatology, positive treatment outcomes were confirmed by neuropsychological and neurophysiological assessment.
Conclusions. Evidence from multiple measures has demonstrated that neurofeedback can be an effective treatment for ASD. In this population, a crucial factor in explaining improved clinical outcomes in the experimental group may be the use of assessment-guided neurofeedback to reduce cerebral hyperconnectivity. Implications of these findings are discussed.

Arthur G. Sichel, Lester G. Fehmi, and David M. Goldstein:
Journal of Neurotherapy1(1)60-64
Positive Outcome With Neurofeedback Treatment In a Case of Mild Autism
This article looks at the experience of Frankie, an autistic 8 and 1/2 year old boy. He was diagnosed mildly autistic by several specialists. One specialist claimed he was brain damaged and "autistic-like " and that there was no hope for improvement. At Frankie's mother's request, neurotherapy diagnosis and treatment was begun. After 31 sessions, Frankie showed Positive changes in all the diagnostic dimensions defining autism in DSM-111-P, This has profound implications for treatment in a field with few low-risk alternatives.

4. Depression

Rosenfeld JP, Cha G, Blair T, Gotlib IH: Department of Psychology, Northwestern University, Evanston, Illinois 60208, USA.
Biofeedback Self Regul. 1995 Sep;20(3):241-58.
Operant (biofeedback) control of left-right frontal alpha power differences: potential neurotherapy for affective disorders
Two experiments were done with subjects from a paid pool of undergraduates. In each study, there were five 1-hour sessions on each of 5 days: (1) Baseline: Rewards given for randomly selected 20% of the 700-ms sequential epochs; mean and SD of baseline power differences determined. 2) Exploration: Subjects were rewarded when right minus left alpha differences in an epoch were greater than the baseline mean plus about .85 SD ($p = .20$); subjects told to discover how to generate rewards. (3)-(5). Training: Subjects were paid (over and above the $8/h flat rate) in proportion to their hit rates. In the first study (in which active filters passed 8-12 Hz activity, and the rectified, integrated amplitude was utilized), 6 of 8 subjects met

learning criteria (a significant difference between baseline and training scores). In the second study (in which on-line FFTs were used to extract alpha power), 3 of 5 subjects met learning criteria.

Saxby E, Peniston EG: Biofeedback Center, Pacific Grove, CA 93950, USA.
J Clin Psychol, 1995 Sep;51(5):685-93.
Alpha-theta brainwave neurofeedback training: an effective treatment for male and female alcoholics with depressive symptoms
This was an experimental study of 14 alcoholic outpatients using the Peniston and Kulkosky (1989, 1991) brainwave treatment protocol for alcohol abuse. After temperature biofeedback pretraining, experimental subjects completed 20 40-minute sessions of alpha-theta brainwave neurofeedback training (BWNT). Experimentally treated alcoholics with depressive syndrome showed sharp reductions in self-assessed depression (Beck's Depression Inventory). On the Millon Clinical Multiaxial Inventory-I, the experimental subjects showed significant decreases on the BR scores: schizoid, avoidant, dependent, histrionic, passive-aggression, schizotypal, borderline, anxiety, somatoform, hypomanic, dysthmic, alcohol abuse, drug abuse, psychotic thinking, and psychotic depression. Twenty-one-month follow-up data indicated sustained prevention of relapse in alcoholics who completed BWNT.

Hardman E, Gruzelier J, Cheesman K, Jones C, Liddiard D, Schleichert H, Birnbaumer N: Laboratory of Neuro-Psychophysiology, Department of Psychiatry, Charing Cross and Westminster Medical School, London, UK
Neurosci Lett 1997 Jan 17;221(2-3):117-20.
Frontal interhemispheric asymmetry: self regulation and individual differences in humans.
Sixteen subjects naive to biofeedback learned lateralised interhemispheric control of slow cortical potentials (SCPs) across electrode sites F3-F4 during three sessions of visual electroencephalograph (EEG) biofeedback. Subjects were required to generate slow negativity shifts either towards the left or the right hemisphere in sixty pseudorandomly ordered trials per session. Group 1 ($n = 8$) were told to use emotional strategies in the task (positive emotions for left hemisphere activation, negative emotion for right hemisphere activation), group 2 received no guidance. Both groups received feedback in the form of an on-screen rocket-ship, initially centrally placed, which rose to indicate an increase in left hemisphere negativity (relative to the right hemisphere) and fell to indicate an increase in right hemisphere negativity (relative to the left hemisphere). A 2 x 3 x 3 x 2 ANOVA (group x session x block x trial) showed no performance differences between the strategy and no strategy groups. Both groups learned to produce correct direction shifts in the final third of each session during both trial types ($P < 0.001$). The no strategy group showed a particularly strong within session learning effect ($P < 0.0037$) with poor performance in the early part of the sessions, and strong shifts at the end. Subjects high on withdrawal showed stronger rightward shifts in keeping with right hemisphere involvement in behavioural withdrawal. This is the first demonstration of self regulation of interhemispheric frontal asymmetry.

5. Head Injury

Kirtley E. Thornton, , Dennis P. Carmody: Center for Health Psychology, Suite 2A, 2509 Park Avenue, South Plainfield, NJ 07080, USA and Institute for the Study of Child Development, Department of Pediatrics, Robert Wood Johnson Medical

School, University of Medicine and Dentistry of New Jersey, 97 Paterson Street, New Brunswick, NJ 08903, USA
Child Adolesc Psychiatric Clin N Am 14 (2005) 137– 162

Electroencephalogram biofeedback for reading disability and traumatic brain injury

Our society has spent billions of dollars on efforts to remediate the cognitive and behavioral dysfunction in individuals with learning disabilities and TBI through various cognitive-based strategies. The evidence accumulated to date indicates that few of these intervention efforts demonstrate efficacy. When change is measured for the more traditional approaches, the change scores typically result in improvements in the +0.00 SD to +0.50 SD range, often after lengthy intervention periods. Research completed to date and clinical reports show greater improvements with EEG biofeedback with these two groups. The application of neurofeedback with reading disability and TBI is relatively recent. Although no published studies have assessed the efficacy of neurofeedback for subjects specifically diagnosed with reading disability, many studies have assessed the effectiveness of qEEG with the ADHD population, which is known to have a high rate of comorbidity for learning disabilities. These findings suggest the possibility that neurofeedback specifically aimed at remediating reading disability would be effective. Clinical experience, as evidenced by the case examples, provides strong initial support for this suggestion. In particular,

there is reason to believe that assessment and training under task conditions are likely to be fruitful. Further research is required to confirm these initial findings. Given the significance of the problems and the absence of proven alternatives for remediating reading disability, efforts to complete the needed research seem warranted. Given the absence of proven alternatives, clinical use of this intervention also seems to be warranted with informed consent acknowledging the absence of empirical efficacy data.

More work has been reported on the assessment of the efficacy of neurofeedback for TBI. The results of these studies indicate that neurofeedback shows promise in this area. There is reason to believe that assessment and training under task conditions are likely to be fruitful. Further research replicating these findings with larger numbers of subjects and better controls is needed before strong claims can be made. Clinical work using neurofeedback with patients with TBI has been consistent with the indications of efficacy found in the research. Given the significance of the problems and the absence of proven alternatives for remediating the cognitive and behavioral effects of TBI, efforts to complete the needed research for clinical use seem warranted.

Thatcher RW: Bay Pines VA Medical Center, University of South Florida College of Medicine and Defense and Veterans Head Injury Program, Washington D.C., USA.
Clin Electroencephalog. 2000 Jan;31(1):38-44

EEG operant conditioning (biofeedback) and traumatic brain injury

A review is presented of the currently sparse literature about EEG operant conditioning or biofeedback as a treatment to reduce symptomology and patient complaints following a traumatic brain injury. The paper also evaluates the general use of quantitative EEG (QEEG) to assess traumatic brain injury and to facilitate EEG biofeedback treatment. The use of an age matched reference normative QEEG database and QEEG discriminant function are presented as a method to evaluate the nature or neurological basis of a patient's complaints as well as to individualize an efficient and optimal feedback protocol and to help evaluate the efficacy of the biofeedback therapy. Univariate and multivariate statistical issues are discussed, different classes of experimental designs are described and then a "double blind" research study is proposed in an effort to encourage future research in the area of EEG biofeedback for the treatment and rehabilitation of traumatic brain injury.

Jonathan E. Walker MD, Neuroscience Centers, Inc., Dallas, TX, neurotherapy@hotmail.com
Charles A. Norman, University of Alberta, Edmonton, Alberta, Canada
Ronald K. Weber, Neuroscience Centers, Inc.
Journal of Neurotherapy Vol 6(2) (2002)
Impact of qEEG-Guided Coherence Training for Patients with a Mild Closed Head Injury
Background. Mild closed head injury (50%) was noted in 88% of the patients (mean = 72.7%). All patients reported that they were able to return to work following the treatment, if they had been employed prior to the injury. On average, 19 sessions were required, less than the average of 38 sessions required using power training of Cz-Beta in our previous unpublished study. Conclusions. In this uncontrolled open trial of qEEG guided coherence training, the majority of patients with MHI experienced substantial and rapid symptomatic improvement, including return to work. Further study with controls and additional outcomes measures is warranted.

6. Chronic Pain

Mark P. Jensen PhD, Dept of Rehabilitation Medicine, University of Washington, Seattle, WA, 98195-6490, mjensen@u.washington.edu, Caroline Grierson RN, Train Your Brain, Los Angeles, CA, 90024-2941, USA Veronika Tracy-Smith PhD, California State University, Fullerton, CA, USA Stacy C. Bacigalupi MA, Mount San Antonio College, Walnut, CA, 91789, USA Siegfried F. Othmer BA, EEG Institute, Woodland Hills, CA, 91367, USA
Journal of Neurotherapy, Vol 11(1)2007
Neurofeedback Treatment for Pain Associated with Complex Regional Pain Syndrome Type I
Introduction. Complex Regional Pain Syndrome Type I (CRPS-I) is a devastating pain condition that is refractory to standard care. Preliminary evidence suggests the possibility that neurofeedback training might benefit patients with chronic pain, including patients with CRPS-I. The current study sought to address the need for more information about the effects of neurofeedback on pain in persons with chronic pain by (1) determining the average decrease in pain in patients with CRPS-I following neurofeedback training, (2) identifying the percent of patients reporting pain decreases that are clinically meaningful, and (3) documenting other benefits of neurofeedback training. Method. Eighteen individuals with CRPS-I participating in a multidisciplinary treatment program were administered 0-10 numerical rating scale measures of pain intensity at their primary pain site, as well as pain at other sites and other symptoms, before and after a 30 minute neurofeedback training session. A series of t-tests were performed to determine the significance of any changes in symptoms observed. We also computed the effect sizes and percent change associated with the observed changes in order to help interpret the magnitude of observed improvements in symptoms. Results. There was a substantial and statistically significant preto post-session decrease in pain intensity at the primary pain site on average, with half of the study participants reporting changes in pain intensity that were clinically meaningful. Five of seven secondary outcome measures also showed statistically significant improvements following neurofeedback

treatment. Conclusions. The findings suggest that many patients who receive neurofeedback training report significant and substantial short-term reductions in their experience of pain, as well as improvements in a number of other painand nonpain-specific symptoms. The findings support the need for additional research to further examine the long-term effects and mechanisms of neurofeedback training for patients with chronic pain.