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**EDITORIALS**

Mechanism(s) of the Placebo Response and the Future of Neurofeedback Research  
Theodore J. La Vaque, PhD

**SCIENTIFIC ARTICLES**

**EEG NeuroBioFeedback Treatment of Patients with Brain Injury: Part 3: Cardiac Parameters and Finger Temperature Changes Associated with Rehabilitation**

Rima E. Laibow, MD, Albert N. Stubblebine, MSc, Henry Sandground, Michel Bounias, DSc

Background. Twenty-seven patients with brain injury were treated by computer-assisted electroencephalographic NeuroBioFeedback (EEG-NBF). All patients were medication-free during treatment.

Methods. Parallel to targeted changes in EEG power spectra, secondary effects were monitored for heart rate, systolic and diastolic pressures, pulse rate and fingertip temperature.

Results. Extreme blood pressure values generally responded by up- and down-regulation toward normal values. Fingertip temperature (FT°) increased in both kinetic movement and amplitude from the beginning to the end of treatment and correlated directly with the rate of the

**EEG NeuroBioFeedback Treatment of Patients with Brain Injury Part 4: Duration of Treatments as a Function of Both the Initial Load of Clinical Symptoms and the Rate of Rehabilitation**

Michel Bounias, DSc, Rima E. Laibow, MD, Albert N. Stubblebine, MSc, Henry Sandground, A. Bonaly, DSc

Background. Twenty-seven patients with brain injury, primarily from car accidents and stroke, were treated by computer-assisted electroencephalographic NeuroBioFeedback (EEG-NBF).

Methods. Patients were distributed into five clinical classes, for which changes in power spectra and in cardiovascular parameters were surveyed. A rationale was proposed for the calculation of the load of symptoms for each patient of each class, which in turn provided indices of rehabilitation rates.

Results. Statistically significant correlations were observed between the number of NeuroBioFeedback (NBF) treatment sessions (SN#) needed and both the initial load of symptoms (SL%) and the final rate of improvement of patient's clinical status (IMP%). When patients were considered in all five classes of defined SL%, the relationship exhibited a

<p>patient's rehabilitation, reflecting an improvement of blood circulation. Blood pressure, pulse and FT° ranks in numerical values were compared by rank correlations.</p> <p><u>Conclusions.</u> NBF in patients with brain injury results in beneficial physiological regulation in addition to initially targeted improvements in brain functions. Symptom associations versus the success or failure of EEG treatment and improvement rates reflected correction of symptoms as well as freedom from the bias of expectation in response to treatments.</p> <p>KEYWORDS. Clinical classes, fingertip temperature, heart rate, systolic/diastolic pressure and ratios, up/down regulation, EEG biofeedback</p> <p>Editorial Note: Introduction to Scientific Abstracts, SNR 2001Abstracts</p>	<p>hyperbolic shape, although linearity could not be totally rejected, due to the variability of data. The improvement rates could be subdivided into two major classes, in which number (SN#) was hyperbolically related to the improvement rates. In addition, finger temperature responsiveness exhibited a significant correlation with the number of NBF sessions.</p> <p><u>Conclusion.</u> The work suggests a rationale for the prediction of the duration of treatment, by considering the patients' initial clinical status and the levels of improvement and rehabilitation considered achievable.</p> <p>KEYWORDS. Brain injury, fingertip temperature, initial symptom loads, number of sessions, math models, targeted rehabilitation rates, EEG biofeedback</p> <p><b>SNR CONFERENCE</b></p> <p>Summaries and <u>Abstracts of Scientific Papers</u> Presented at the 2001 Society for Neuronal Regulation, 9th Annual Conference, Monterey, California</p>
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<p><b>EDITORIALS</b></p> <p>Welcome to New Editors Journal of Neurotherapy Online David L .Trudeau, MD</p> <p><b>SCIENTIFIC ARTICLES</b></p> <p><b>Quantitative Electroencephalographic Amplitude Measures In Young Adults during Reading Tasks and Rest</b> Efthymios Angelakis, MA, Joel F. Lubar, PhD</p> <p><u>Background.</u> Previous studies have</p>	<p><u>Results.</u> Significant improvement (&gt;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.</p> <p><u>Conclusions.</u> In this uncontrolled open</p>

observed differences in the quantitative electroencephalogram (qEEG) between individuals with reading difficulties and non-clinical controls during reading tasks. However, very little is reported about the qEEG effects of reading tasks as compared to rest within individuals across a wide range of EEG frequencies. The present study explored the qEEG differences between resting and reading states in a group of 19 non-clinical college students. The purpose was to investigate the amplitude changes across five frequency bands: 8 to 10, 10 to 12, 12 to 21, 21 to 32, and 38 to 42 Hz.

Methods. Nineteen channels of EEG were recorded at 256 samples per second during an initial resting baseline, during five different reading tasks while selectively engaging the visual, phonetic, and semantic modalities, and during a second resting baseline. Absolute EEG amplitude was measured as the dependent variable. Ninety ANOVAs (task x channel) were computed, comparing each reading task to each baseline, for each frequency band, for each of three cortical areas, frontal, centro-coronal, and posterior. Single-channel t-tests were computed for significant ANOVAs.

Results. ANOVA analyses revealed significantly less amplitude for the 10 to 12 Hz band during all three reading tasks as compared to the second baseline. Single-channel t-tests showed this phenomenon to be lateralized towards the left hemisphere.

Conclusions. Results are interpreted as a manifestation of language specific processing for the 10 to 12 Hz band. The absence of amplitude changes in the 12 to 21 Hz band was interpreted as motor inhibition. It is suggested that future studies employ a post-task baseline when

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 outcome measures is warranted.

KEYWORDS. Closed head injury, quantitative EEG, neurofeedback, outcome study, coherence training

## TECHNICAL NOTES

### **Application of Repetitive Visual Stimulation to EEG Neurofeedback Protocols**

Thomas F. Collura, PhD

Introduction. This report describes an approach for using repetitive visual stimulation in the context of electroencephalographic (EEG) neurofeedback protocols. The EEG response to repetitive stimulation can be described as a series of successive evoked potentials (EPs), giving rise to a periodic response in the cortex, the steady-state visual evoked potential (SSVEP). Experimental data and signal analyses are presented to support this view. This approach is useful because evoked potential signals reflect sensory and perceptual processes, are sensitive to short-term shifts in attention, and also show important differences between normal and ADD/ADHD groups, for example. Methods can be developed to provide real-time measurement and feedback of important variables related to the evoked response.

Method. Computerized averaged EP data are compared with filtered EEG "photic driving" responses measured in real time. Synchronous comb-filtering is used to

studying cognitive tasks.

KEYWORDS. EEG, reading, adults, delta, theta, alpha, beta, gamma

### **An Auditory Electrophysiological Intervention in Migraine: A Randomized Placebo Controlled Add-On Trial**

Eugen Trinka, MD, Josef Unterraine, PhD, Gernot Luthringshausen, MD, Bernhard Iglseder, MD, Gunther Ladurner, MD, Thomas Loew, MD, Hans Georg Trzopek, MD

Background. The aim of the study was to assess the efficacy and tolerability of a new electrophysiological intervention technique as add-on treatment in patients with migraine.

Methods. A randomized double-blind placebo- controlled study with a parallel group add-on design and a 12- week treatment phase was conducted in a large outpatient headache clinic in a neurological center. Thirty-two patients (mean age 42.6 years, SD 11.8; range 23 to 79) with migraine without any pharmacological migraine prophylaxis in the past three months were studied. The electrophysiological stimulation with sound therapy applied via headphones three times a day for 10 minutes was compared against a placebo audiotape. The main outcome measure was a change in the headache subtest of a self-report test instrument, Giessener Beschwerdebogen (GBB), after 12 weeks of treatment.

Results. Significant decreases in the scores of the GBB were found in the treatment group after 12 weeks of treatment in the subtests "headaches" ( $p < 0.05$ ), "stomach complaints," ( $p < 0.05$ ) as well as "general physical complaints" ( $p < 0.05$ ). In the placebo group only, the decreases in

extract real-time SSVEP data which are plotted along with conventional EPs and EEGs. Results are plotted as a time-series and short-term variations are visible.

Results. Results of pilot studies are shown, illustrating the ability to record real-time SSVEP's, and to provide information suitable for neurofeedback. The correspondence with averaged evoked potential traces is shown. These data support the concept that EEG responses to repetitive light flashes may be described as a superposition of successive evoked responses, and do not have to appeal to an "entrainment" model. Short-term variations in signal amplitude are shown to be sensitive to attentive state, and to reveal moment-to-moment changes in brain responsiveness.

Discussion. A basic understanding of the brain's response to repetitive stimuli can be used to develop a variety of feedback methods. Some of these are identified. The concept of entrainment is discussed and it is shown that neurofeedback with repetitive photic stimulation may be approached without appealing to the notion of a nonlinear response to repetitive stimulation. In our studies the EEG reveals only the expected periodic evoked responses, indicating that the brain is following the stimulus, but not that any lasting or "entrained" frequencies are introduced. Methods that do not rely on the concept of entrainment, but that depend solely on monitoring and feedback of the brain evoked response, provide promising avenues for neurofeedback.

Conclusions. This study provides experimental data and a supporting rationale for the use of photic stimulation in EEG neurofeedback. Our approach is

"fatigue proneness" and "general physical complaints" reached statistical significance ( $p < 0.05$ ) between the pre- and post-treatment scores. No adverse events occurred during the treatment period.

Conclusions. In the small sample studied here a proprietary method, Psychofonie®, is effective as an add-on treatment in reducing subjective pain in migraine patients, although some of the effect could be attributed to placebo.

KEYWORDS. Audio stimulation, electrophysiological stimulation, sound therapy, migraine

### **Impact of qEEG-Guided Coherence Training for Patients With a Mild Closed Head Injury**

Jonathan E. Walker, MD, Charles A. Norman, PhD, Ronald K. Weber, PhD

Background. Mild closed head injury (MHI) is a major problem in our society. Traditional methods of treatment such as cognitive rehabilitation or behavioral training are time consuming, expensive, and of questionable effectiveness. Anecdotal reports indicate that neurofeedback can remediate the symptoms of MHI in a rapid and cost effective way. The purpose of this study is to evaluate whether quantitative electroencephalography (qEEG) guided coherence training is effective in remediating residual symptoms of MHI.

Methods. Twenty-six patients with persistent post-traumatic symptoms (PTS) were seen by the first author 3 to 70 months after a MHI and had a quantitative EEG (qEEG). Neurofeedback therapy designed to normalize abnormal qEEG coherence scores was provided to determine the effectiveness of this approach. Five training sessions addressed

based upon an understanding and use of the fact that the EEG response is comprised of a succession of sensory evoked potentials. This is in contrast to methods and models based upon the concept of nonlinear entrainment. A variety of methods for creating neurofeedback protocols are presented and discussed.

KEYWORDS. EEG, photic stimulation, visual evoked potential, steady-state visual evoked potential, entrainment

### **NEWS FROM OTHER JOURNALS AND WEBSITES**

David Kaiser, PhD, Editor

#### **CLINICAL CORNER**

D. Corydon Hammond, PhD

Simultaneous Neurofeedback Training at Multiple Sites: Using Lexicor's LCC Montage

Joel F. Lubar, PhD

Marvin W. Sams, ND

#### **BOOK REVIEW**

*The Art of Artifacting*

By D. Corydon Hammond, PhD  
& Jay Gunkelman, QEEGT

Reviewed by John R. Hughes, MD, PhD

<p>each qEEG abnormality. Training continued until the patient, by self-report, indicated that significant improvement had occurred or until a total of 40 sessions were given.</p>	
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<p><b>EDITORIALS</b></p> <p>The Voice of Australia Tamara Lorensen, BSc Grad Dip</p> <p>European Chapter of the Society for Neuronal Regulation Juri D. Kropotov, PhD</p> <p><b>SCIENTIFIC ARTICLES</b></p> <p><b>Neurofeedback for AD/HD: A Ratio Feedback Case Study and Tutorial</b> Thomas Rossiter, PhD</p> <p><u>Introduction.</u> The case study of a 13-year-old AD/HD male treated with neurofeedback is the subject matter for a tutorial on Ratio feedback.</p> <p><u>Method.</u> Neurofeedback was conducted at C3 (increase 15 to 18 Hz, decrease 2 to 10 Hz) and C4 (increase 12 to 15 Hz, decrease 2 to 7 Hz). Protocols provided visual and auditory feedback based on the Ratio of slow wave activity to be suppressed divided by fast wave activity to be enhanced.</p> <p><u>Results.</u> The patient demonstrated marked improvement in processing speed and variability on the Test of Variables of Attention-Auditory, a 19-point increase in IQ on the Kaufman Brief Intelligence Test, significant behavioral improvement based on parental (Behavior Assessment System for Children) and patient (Brown ADD Scale) reports, and a 7.5 grade equivalent increase in reading scores (Kaufman Test</p>	<p>Generator patterns were determined as a set of significant phase or coherence relationships, which all emanate from one location. The concept of emanate is an assumption based, in part, on previous literature of generator patterns and on the statistical need to reduce the number of variables. Degrees of activation values were determined as the differences in QEEG variables between two conditions (a relevant condition and the task condition). For the reading condition, a visual attention task served as the relevant condition, while for the recall tasks, the eyes closed served as the relevant control condition.</p> <p><u>Results.</u> During the input (reading) condition absolute levels of F7 beta generator and T5 coherence alpha generator activity were associated with higher memory scores. Degree of activation (visual attention vs. reading) values indicated significant relationships (increased activation positively correlated with recall) between recall and eight generator patterns (coherence) in the alpha range.</p> <p>Immediate recall was positively associated with absolute levels of generator activity (coherence beta2, 32 to 64 Hz) from the F4 location and with the absolute level of activations in the theta frequency predominantly at frontal locations. Degree of activation (from eyes closed) analysis indicated that increased memory scores were associated with activations in the theta frequency range in diffuse locations, activations of beta frequencies at posterior locations and generator activity predominantly in the beta2 frequency from right hemisphere locations.</p> <p>Higher long-term recall was associated with higher absolute levels of generator activity (alpha set at .10) from right frontal locations and frontal theta activity. The higher the degree of activation (from eyes closed) of posterior beta activity and beta generator activity from several sites, the higher the</p>

of Educational Achievement-Brief Form). At the 17-month follow-up parent questionnaires indicated that the patient's behavioral gains had been maintained or were slightly improved. EEG data showed significant declines in the C4/SMR Ratio ( $10^*2$  to 7 Hz/12 to 15 Hz) and 2 to 7 Hz amplitude, a tendency toward an increase in 12 to 15 Hz amplitude, a significant increase in 8 to 11 Hz amplitude, and a decline in 22 to 30 Hz amplitude. Beta activity (15 to 18 Hz) was unchanged. An unexpected finding was that C3/Beta ( $10^*2$  to 10 Hz/15 to 18 Hz) and C4/SMR protocols had similar effects on the EEG even though they targeted different bands to enhance and suppress. It appears that suppression of slow wave activity (2 to 7 Hz) may be the active component in both Ratio protocols and that fast wave enhancement either plays a minor (12 to 15 Hz) or no role (15 to 18 Hz).

Discussion. The findings cast doubt on the assumption that the C3/Beta and C4/SMR protocols have unique effects on EEG activity. Nevertheless, they may have differential effects on brain functions related to the training sites employed. It would be useful to analyze EEG changes in successfully treated individual AD/HD patients as a first step toward understanding the effects of various treatment protocols. What the protocols are intended to do, and the actual effects on the EEG may be different. If there are active components common to the various AD/HD treatment protocols reported in the literature, this is one way of beginning to recognize them. Brain maps collected before, during, and at the conclusion of treatment would enhance our understanding of treatment effects of various neurofeedback protocols, lead to more focused and productive research, and ultimately facilitate the development of

long-term memory score.

Discussion. The results provide a new perspective on brain functioning, which cannot be accounted for by any present day theories of brain functioning.

KEYWORDS: Reading, memory, dyslexia, memory, cognition, QEEG, neurotherapy

## **CURRENT CONCEPTS IN NEUROTHERAPY**

### **Behaviorism and Neurofeedback: Still Married**

Dwight E. Fultz, PhD

Many behavioral science practitioners do not appear to understand basic behavioral concepts and may easily misuse and misunderstand behavioral language. The notion that the non-linear nature of the neural system requires a perspective based on either general systems theory or chaos theory in order to describe EEG training, and that a behavioral conceptualization is inadequate, is unjustified. All aspects of effective EEG training programs can be described in behavioral terms. Behavioral language is particularly useful for identifying and describing important components of the training procedure.

KEYWORDS: Behavioral, behaviorism, non-linear, equilibrium, neurofeedback, neurotherapy

## **TECHNICAL NOTES**

### **Bispectral Analysis of the EEG: A Brief Technical Note**

Jack Johnstone, PhD

## **NEWS FROM OTHER JOURNALS AND WEBSITES**

David Kaiser, PhD, Editor

## **CLINICAL CORNER**

<p>more efficient treatment paradigms.</p> <p>Keywords. AD/HD, neurofeedback, ratio feedback, tutorial</p> <p><b>Electrophysiological (QEEG) Correlates of Effective Reading: Towards a Generator/Activation Theory of the Mind</b> Kirtley E. Thornton, PhD</p> <p><u>Introduction.</u> An investigation into the relationships between Quantitative EEG (QEEG) and memory scores for reading material was conducted employing 38 normal subjects.</p> <p><u>Method.</u> There were three conditions during which QEEG data was collected: (a) subject reading a story silently (b) subject engaging in an immediate recall period, followed by subject's oral recall, and (c) delayed recall assessment, followed by the same methodology of quiet recall and subsequent oral recall. The reading and recall performances were correlated with QEEG variables.</p>	<p>The Alpha Rhythm in EEG D. Corydon Hammond, PhD</p>
<p style="text-align: center;"><b>NUMBER 4</b></p>	
<p><b>EDITORIAL</b></p> <p>Science, Pseudoscience and Politics D. Corydon Hammond, PhD</p> <p><b>TASK FORCE REPORT ON METHODOLOGY AND EMPIRICALLY SUPPORTED TREATMENTS: INTRODUCTION</b> Donald Moss, PhD Jay Gunkelman, QEEG-D</p> <p><b>TEMPLATE FOR DEVELOPING GUIDELINES FOR THE EVALUATION OF THE CLINICAL EFFICACY OF PSYCHOPHYSIOLOGICAL INTERVENTIONS</b> Efficacy Template Taskforce</p>	<p><b>Biofeedback for Movement Disorders (Dystonia with Parkinson's Disease): Theory and Preliminary Results</b> Michael Thompson, MD Lynda Thompson, PhD</p> <p>Background. This paper presents a theoretical framework for using a combination of EEG biofeedback plus regular biofeedback with clients who have movement disorders.</p> <p>Method. A case study is included that describes intervention and results with a 47-year-old woman with the dual diagnosis of Parkinson's disease and dystonia. The rationale for adding biofeedback interventions to traditional medical treatment hinges on the fact that muscle spindles, which are involved in muscle movement and tone, have double innervations, cholinergic and sympathetic (Passatore, Grassi, &amp; Filippi, 1985). Both of these</p>

## SCIENTIFIC ARTICLES

### **Neurofeedback Training: Integration with Diet and Detoxification Programs**

Victoria L. Ibric, MD, PhD  
James E. McCourt, PhD

**Introduction.** This is a single case-study of the evaluation and training with neurofeedback of a 51-year-old male presenting multiple insults: (a) stress-related disorders: high blood pressure (180/105 mmHg, medicated), arrhythmia, anxiety disorder (Beck-anxiety scale) and overlapping ADD symptomatology (based on DSM-IV questionnaire for ADD); (b) chronic toxic exposure to mercury; and (c) Verapamil, the calcium channel blocker, used for over two years significantly imbalanced the tissue content of calcium and magnesium.

**Methods.** Treatment design consisted of a diet and detoxification program in parallel with the neurofeedback training.

**Results and Discussion.** Preliminary data suggest that: (a) biofeedback/ neurofeedback is a positive factor in decreasing reliance on medications, (b) detoxification is a cofactor in helping rebuild neural networks that have been affected by chemical and/or trauma insults, and (c) the recovery has a long-term positive outcome and the peak performance achieved was an added benefit.

**KEYWORDS.** Neurofeedback protocols, high blood pressure, arrhythmia, anxiety disorder, attention deficit disorder, peak performance, diet/detoxification program, trace mineral analysis, mercury toxicity

### **Efficacy of Neurofeedback for Children in the Autistic Spectrum: A Pilot Study**

Betty Jarusiewicz, PhD

**Background.** The efficacy of neurofeedback training was evaluated in 12 children in the autistic spectrum with matched controls, based on established training protocols for other conditions with similar symptoms.

**Method.** Twenty-four autistic children were divided into two groups, matched by sex, age, and disorder severity. One group received neurofeedback training and the second acted as a control group.

systems can be operantly conditioned using biofeedback. There were two learning goals: (1) increase the production of 12 to 15 Hz activity since this sensor motor rhythm (SMR) is associated with decreased firing of the red nucleus and the red nucleus, in turn, has links to the muscle spindles (Serman, 2000); (2) train for calm, relaxed autonomic nervous system functioning (decreased sympathetic drive and parasympathetic ascendance) because this may also have a beneficial effect on muscle tone by means of influencing muscle spindle activity (Banks, Jacobs, Gevirtz, & Hubbard, 1998). Training for balanced autonomic system functioning is facilitated by diaphragmatic breathing at a rate of about six breaths per minute. Diaphragmatic breathing results in respiration and heart rate variability, presented as a line graph, following the same sinusoidal pattern when viewed on a biofeedback screen, a pattern termed respiratory sinus arrhythmia (RSA, Budzynski, 1989). This dual training of neurofeedback to enhance SMR activity and RSA biofeedback for relaxed autonomic nervous system (ANS) functioning was done for 30 sessions over a six-month period.

**Results.** Training was associated with significant reduction in dystonic movements. Additionally, the client became able to use diaphragmatic breathing to cue herself to turn on a mental state associated with increased SMR production and thus control incidents of freezing, a common problem in advanced Parkinson's disease. With twelve more sessions over the next 18 months, the improved quality of life has been maintained.

**Discussion.** This work is reported to put forth a theoretical model of why neurofeedback plus biofeedback is helpful in movement disorders and to encourage research in this area.

**KEYWORDS.** Biofeedback, neurofeedback, dystonia, Parkinson's disease, movement disorders, respiratory sinus arrhythmia (RSA), breathing, muscle spindles.

## TECHNICAL NOTES

### **Notes on EEG Resampling by Natural Cubic Spline Interpolation**

Marco Congedo, MA  
Cem Özen, MS

Responses to the Autism Treatment Evaluation Checklists (ATEC) and parental assessments of problem behaviors were analyzed to evaluate the effectiveness of neurofeedback training for this condition.

**Results.** Neurofeedback training resulted in a 26% average reduction in total ATEC rated autism symptoms, compared to 3% for the control group. Parental assessments reported improvement in all behavioral categories: socialization, vocalization, anxiety, schoolwork, tantrums, and sleep, compared with minimal changes in the control group.

**Discussion.** Autistic spectrum children who underwent neurofeedback training showed significant improvements in autism symptoms and behaviors. The magnitude of improvement was independent of initial severity or age.

**KEYWORDS.** autism, Autistic Spectrum, neurofeedback, control group, Autism Treatment Evaluation Checklist (ATEC), EEG biofeedback

Leslie Sherlin, BA

Resampling of digitized electroencephalographic data allows changing the sampling rate with minimal distortion of the signal. Useful applications of the procedure include compatibility among diverse hardware and software and the customization of data analysis. The natural cubic spline interpolation procedure is introduced in a discursive fashion. A formal presentation is provided in the appendix.

**KEYWORDS.** spline interpolation, cubic spline, natural spline, sample rate, EEG

#### **NEWS FROM OTHER JOURNALS AND WEBSITES**

David Kaiser, PhD, Editor

#### **CLINICAL CORNER**

Are There Indications or Contraindications in Using and Doing Neurofeedback Under Task Conditions?

Judith Lubar, LCSW  
Lynda Thompson, PhD