

# Journal of Neurotherapy: Investigations in Neuromodulation, Neurofeedback and Applied Neuroscience

## Abstracts of General Conference Presentations Presented at the 2003 International Society for Neuronal Regulation (ISNR) 11th Annual Conference, Houston, Texas

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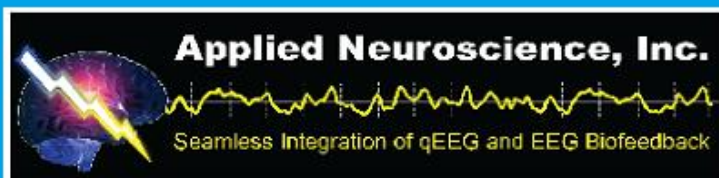
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## 2003 ISNR CONFERENCE

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### Abstracts of General Conference Presentations Presented at the 2003 International Society for Neuronal Regulation (ISNR) 11th Annual Conference, Houston, Texas

#### ***EDITORIAL NOTE: INTRODUCTION TO THE BALANCE OF THE 2003 ISNR CONFERENCE ABSTRACTS***

The most recent and exciting scientific information is often presented at conferences long before it makes its way through the peer review process into print. As a compromise between timeliness and thorough review, we once again print the abstracts of scientific papers presented at the annual conference of the International Society for Neuronal Regulation, ISNR.

In full form these papers were presented in twenty-, forty-, and sixty-minute time slots, and contained much more detail than their abstracts would indicate. Although the abstracts presented in this issue of the *Journal of Neurotherapy* have not undergone the rigorous peer review process the *Journal* routinely applies to scientific papers, nevertheless they are reviewed carefully.

The papers presented at the ISNR conference are first reviewed by the conference committee headed by Roger deBeus and including Joe

Horvat, David Kaiser, and Darlene Nelson. These papers are screened for accuracy and standards of scientific reporting by the committee. Tim Tinius reviewed papers that were submitted by students. I then screened all papers for content and accuracy.

Authors who prepare their work for presentation at the conference are often summarizing their most recent research. It is hoped these presenters will develop their topics into full manuscripts, submitted to the rigors of peer review in this or other journals.

Due to the increasing volume of quality abstracts presented at meetings that the *Journal of Neurotherapy* supports (ISNR-Australian Chapter, ISNR-European Chapter, and International Society for Neuronal Regulation annual conferences), abstracts will now be appearing in each regular issue of the *Journal of Neurotherapy*. This will become one of our regular features that we offer to readers along with Clinical Corner and News from other Journals and Websites, as well as the occasional Technical Notes and Current Concepts features. To that end, in this issue we conclude the ISNR 2003 general conference presentation abstracts. The first portion of the conference abstracts (student scholarships, poster presentations, and some of the general conference presentations) appeared in Volume 8, Number 2, pages 105 to 147.

*David L. Trudeau, MD*  
*Editor*

## General Conference Presentation Abstracts

### **Advanced Buddhist Meditation: Multiple States and Their Neurophysiological Correlates**

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#### ***Introduction***

Although the term “meditation” has become a common word in our culture denoting a method for engendering a state of inner peace or tranquility, there are many forms of meditation, some of which engage very different mental states and processes (DeLuca & Daly, 2003). Many of these states have not been differentiated on a neurophysiological basis. We discuss the nature of these different practices and present QEEG and LORETA findings of two Tibetans, one Buddhist monk and one ex-monk during such conditions. We compare differences between concentration and analytical meditation as well as between meditation on emptiness and compassion.

#### ***Method***

All QEEGs were recorded using a Lexicor NeuroSearch-24 and appropriate size Electrocap. EEG activity was sampled in the standard International 10-20 montage. The sampling rate was 128 Hz with 32K gain, high-pass filter on. Several meditation conditions were investigated: (a) concentration, or single-pointed meditation employing mantra repetition; (b) visualization, or the visualization of a Buddhist protector deity in front of oneself; (c) self-generation, or the visualization of oneself manifesting as the deity; (d) dissolving, an experiential state involving the experience of dissolving into emptiness; (e) analyti-

cal, or in this instance, the contemplation of the notion of the preciousness of human life; (f) emptiness, analytical meditation on the nature of emptiness or innate wisdom mind; and (g) compassion, an experiential state involving the generation of a state of great love and compassion.

### ***Results and Conclusion***

Findings suggest subtle differences in broad and single band activity between meditation conditions in terms of both location and power. Differences are subtle as all of the meditation conditions rest upon the practice of concentration meditation. Analytical meditation evidenced a greater area of posterior alpha absolute power as compared to concentration meditation. Meditation on emptiness evidenced greater right temporal absolute power as compared to meditation on compassion. Additional subtraction analyses and LORETA findings are also presented. These findings support the notion that these meditative states involve different brain states and neurophysiological correlates.

### REFERENCE

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### **Treating Fungal Sinusitis**

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### ***Introduction***

More than 37,000,000 Americans suffer from chronic sinusitis (CRS). The incidence is increasing. Previously, it was thought that fungus allergy was involved in less than ten percent of these cases, with other causes unknown. Mayo Clinic researchers (Ponikau et al., 1999) have now identified the cause of most chronic sinus infections—mold. Precisely, Allergic Fungal Sinusitis (AFS) is a delayed immune reaction to mold.

### ***Method***

Six hundred twenty-four (624) patients were treated over 14 years. Patients treated had diagnoses of arthritis, Chronic Fatigue Syndrome (CFS), Fibromyalgia, and other immune diseases.

The treatment approach included environment testing for colonies of fungus, environmental cleanup, surgery where needed, and medications. When the environment was improved to a standard of four fungal colonies or fewer identified per hour, the medical conditions improved significantly. Endoscopic photography and CAT scans identified abnormalities. Neurofeedback was attempted without success before environmental cleanup was accomplished.

### ***Results***

The key questions to identify environmental conditions are:

- Is the heater location damp or wet?
- Is there a humidifier on the furnace?
- Has there ever been a leak anywhere in the house structure?
- Do co-workers feel bad at the office?
- Does the person with CRS feel better away from home, or office?

### ***Conclusion***

The majority of CRS patients can experience long-term wellness and effective neurotherapy by applying these principles:

- Treat CRS as always with medications, surgery when needed, and allergy treatment
- When the disease persists, obtain sinus and environmental mold cultures
- Use environmental treatment pack (ETP) to reduce mold count
- Use saline nose irrigation and antimicrobial sprays
- Boost the immune system

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**Fear and FPO2: The Implications of a New Protocol***Sebern F. Fisher, MA*Private Practice, EEG Spectrum International, Northampton, MA  
<sebern.fisher@verizon.net>***Introduction***

Although it is increasingly apparent that many psychopathologies are driven by fear, there is no direct reference to fear in the DSM-IV. Fear or fear-based memory, however, is a common factor in most serious psychological disorders including PTSD, anxiety disorders, Reactive Attachment Disorder, Borderline Personality, Dissociative Identity Disorder, Asperger's and most addictions. The amygdala is responsible for generating fear. LeDoux (1996) postulates that the amygdala plays a central role in fear-based memory. Employing neurofeedback specifically targeting the amygdala, suggests a mechanism to address fear-based disorders.

***Method***

There are significant efferent pathways from the amygdala to the pre-frontal cortex. Schore (1994) and Siegel (1999) both speak about the pre-frontal orbital cortex as part of the amygdaloid system. The hypothesis tested was the value of training on the pre-frontal cortex, at a site off the 10/20 system designated as FPO2. Data is drawn from the training of 28 individuals at this site, in a clinical setting with a range of reward frequencies.

***Results***

Patients reported a reduction in fear as well as a sense of calm and well-being after training at FPO2. This change in affect appears to persist over time. In addition to the positive outcomes of the 28 patients treated at FPO2 by the author, there is a substantial body of anecdotal experience provided by other practitioners confirming the efficacy of training at this site, particularly in fear-related disorders.

### ***Conclusion***

Neurofeedback training at the FPO2 site provides a new protocol for significantly reducing fear level, as well as reducing the negative affect associated with fear-based memory.

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Schoore, A. (1994). *Affect regulation and the origin of self*. Hillsdale, NJ: Erlbaum.  
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### **Forehead Infrared Emissions: Feedback Training for Migraine Headache and Observations About the Signal**

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### ***Introduction***

The question addressed in this study was whether the training protocol and equipment designed by Jeffrey Carmen (Toomim & Carmen, 1999) using infrared feedback from the center of the forehead to ameliorate migraine pain can be replicated.

### ***Method***

Severe migraineurs (at least three per month) were recruited by flyer for an IRB approved eight 45-minute session, non-blinded, study in which the dependent variable was self report of migraine severity. With Carmen's method, infrared emissions are displayed in units of .01 degree F on a visible bank of LEDs. Participants also watched a videotape of a film of their choice and were encouraged to raise the intensity of their infra red emissions. A threshold was set and the videotape was paused if emissions fell below threshold. The video resumed when emissions exceeded the threshold.



### **Results**

The study was ongoing and this report was about the first 12 participants to complete the protocol. All participants learned how to raise their emissions in the first session. All but two reported decreased or no headaches for a period of two to five months. Two participants were migraine free at follow-up six months after their last session.

### **Discussion**

Within the limitations of a non-blinded study there was evidence that increased infrared emissions from the forehead often inhibit migraine pain. Because of the position of the sensor, it appears that the orbital-frontal cortex is being affected by the feedback loop. It is not known why the effects are more enduring in some cases and less enduring or non-existent in others. Progress in increasing efficacy will depend on research which clarifies the underlying function tapped by the infrared signal. Toward this end, a study will be reviewed which suggests that the signal studied is part of a frontal lobe attention-arousal system.

### REFERENCE

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### **Memory, Music and Attention: Validating Neurofeedback**

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In contrast to peripheral biofeedback, electroencephalographic (EEG) self-regulation is an under-valued application of psychophysiology in mainstream science and medicine. One reason for failure to meet acceptance and realize potential is the lack of formal validation of efficacy. While this has been demonstrated assiduously for slow cortical potentials over the years by Birbaumer and colleagues, and is well established in the case of peripheral biofeedback applications, it remains much of

an open book for EEG frequency spectrum training, though widely applied for clinical and optimal performance purposes. In this presentation some attempts in my department will be reviewed. These focus on controlled studies evaluating conventional protocols designed to elevate theta, alpha, 'SMR' and beta frequencies. Outcome measures consisted of: cognitive measures including attention, memory, mental rotation and cognitive cortical evoked potentials; psychometry including anxiety and activation questionnaires; music performance; phenomenological report (Egner & Gruzelier, 2001, 2003 a, b, c; Egner, Strawson, & Gruzelier, 2002; Gruzelier Egner, Valentine, & Williamson, 2002; Vernon et al., 2003).

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### **Central 12-15 Hz Activity in ADHD**

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#### ***Introduction***

Twelve to fifteen Hz increase training is a common practice in the neurofeedback treatment of ADHD. This study was undertaken to determine the percentage of patients in a private clinic practice exhibiting elevated, normal, and decreased relative power in the 12-15 Hz range over the motor strip: C3, CZ, C4.

#### ***Method***

The charts of 50 unmedicated, randomly chosen ADHD diagnosed patients were reviewed using the Thatcher NeuroGuide relative power 1 Hz bin maps, eyes-open and eyes-closed. Patients were male and female, child and adult, with the majority having comorbidities. Only 12-15 Hz at C3, CZ, and C4 were examined for elevations (1 SD or more) or deficits ( $-1$  SD or less), or normal (within  $+1$  to  $-1$  SD).

#### ***Results***

Of the 50 cases selected for this review 56% had one SD or more of 12-15 Hz activity at C3, CZ or C4 in either the eyes-open or eyes-closed condition. Twenty-four percent were less than  $+1$  SD or  $-1$  SD; 16% were equal to or greater than  $-1$  SD; and 4% were mixed.

#### ***Conclusion***

A majority (56%) of the ADHD subjects exhibited elevated 12-15 Hz relative power over the motor strip. These findings would suggest that up training these frequencies further may be contraindicated. This may also be the case for a subset of individuals with normal levels. If normalizing of QEEG abnormalities is part of what guides treatment, then one might theorize that down training 12-15 Hz may contribute to a reduction in symptoms and this is what has been observed from this clinician's experience. Further research is needed in this area.

## **Eyes-Closed and Eyes-Open QEEG Data: Similarities and Differences**

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### ***Introduction***

Many QEEG-based neurofeedback therapists possess only eyes-closed (EC) databases and do most of their training in the eyes-open condition (EO). In this study 50 ADHD patients were evaluated for relative power EC and EO similarities and differences in these two conditions of relative power Z scores.

### ***Method***

Fifty cases were randomly selected at an ADHD private outpatient clinic who met the criteria for a diagnosis of ADHD and no current medication. EC and EO linked-ear, 1-Hz bin, relative power maps utilizing the Thatcher NeuroGuide database were obtained and reviewed for similarities or differences. A difference was defined as the need to train different frequency bands by a 2 Hz or greater increment and/or different locations by more than two locations (e.g., FZ to PZ, but not FZ to CZ). The Hudspeth NeuroRep database was used for corroboration with adults.

### ***Results***

Sixty-six percent of the patients were found to be “different” so that training for EC and/or EO would require different frequency bands and/or different locations.

### ***Conclusion***

The difference between EC and EO QEEG topographic maps of 66% in this sample suggests the possibility that different frequency bands and locations for intervention for EC and EO training may be indicated. It is this clinician’s experience that training in both conditions, in only the bands and locations that are deviant, leads to improved treatment response.

**Neurofeedback for Balance & Incontinence: Three Case Reports**

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***Introduction***

Margaret Ayers discovered a neurofeedback protocol that assists in the rehabilitation of centrally mediated problems with physical balance and incontinence. This protocol, utilizing Ayers' Neuropathways digital equipment, places electrodes just barely above the inion ridge, directly below electrode sites O1 and O2.

***Method***

The protocol consists of inhibiting 4-7 Hz while rewarding 15-18 Hz. The amplitudes of the EEG are very small at this location, and thus the thresholds need to be adjusted accordingly. The use of this protocol with three cases was described. All the cases involved problems with physical balance associated with stroke or head injuries.

***Results***

In addition to problems of balance, one of the cases also involved problems with urinary incontinence, but the author kept the treatment partially blinded by only telling the patient that this protocol was designed to improve physical balance. Nonetheless, improvements occurred in this case not only with balance, but the frequency of incontinence went from three to four accidents daily to only an infrequent accident as confirmed by both the patient and her mother. Balance improved in all cases and objective pre- and post-measures were collected in one of the cases.

***Conclusion***

The Ayers protocol for balance/incontinence appears promising and warrants further research. It was particularly impressive that patients commonly noted improvements within three sessions and total treatment may often be in the range of 10 to 15 sessions.

**In Support of Neuroplasticity: All Digital Real Time EEG Biofeedback with Coma**

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***Introduction***

Currently there is very little if any effective treatment available, other than palliative care, for patients that remain in a coma for an extended period of time. This paper presented an overview of coma with an emphasis on the Glasgow Coma Scale (GCS) commonly used to measure depth of coma. On this scale three is the lowest ranking with the least chance of recovery and 15 is the highest level. This was followed by data from three patients in comatose states subsequent to injuries received in motor vehicle accidents (MVA) and one with injuries from a subdural hematoma. Data presented using All Digital Real Time EEG Biofeedback (BFB) tracings included changes in patterns of EEG activity, changes in ratings on the GCS, changes in levels of functioning, and discussion of implications for further research into coma recovery.

***Method***

All Digital Real Time EEG BFB (Neuropathways) was used to assess and train three coma patients over two or three weekends and another in the office on a weekly basis. Initial assessment was at C4T4, F4T4, C3T3, F3T3, O1O2, F4O2 and F3O1. Training consisted of numerous sessions over three days each weekend or for an hour in the office. Session length was determined by the brainwave pattern. Each session was terminated when there was a drop in Beta at 15-18 Hz. Session times ranged from forty seconds to ten minutes. Training involved inhibition of Theta (4-7 Hz) while monitoring Beta (15-18 Hz). Feedback to the patient consisted of verbal from the therapist and their families, audio from the BFB equipment, and vibrations from two speakers placed on their clavicles.

***Results***

Patient 1 was assessed by a physician at the start of training as GCS 5-6. EEG BFB training resulted in observable behavioral changes as

well as changes in the EEG tracings. After two weekends of training the patient was able to stand with assistance, push a cart, to say “Hello” and to swallow level 2 baby foods. This was one-year post MVA. Patient 2 was assessed by the physician at GCS 3-4 initially and at GCS 8-9 several months after training. This was one-year post MVA. Patient 3 (GCS 7) and six years post MVA, demonstrated an increase in control of head and eyes as well as an increased ability to swallow. Patient 4 (GCS 6) moved to GCS 11, responded to verbal commands and reported the ability to see. All patients demonstrated an increase in the amplitude of beta and a decrease in the amplitude of theta, as well as an increase in the overall brainwave pattern.

### ***Conclusion***

This exploratory treatment resulted in decreases in the depth of coma and was accompanied by apparently long-lasting positive changes in the EEG activity and patient functioning. The apparently lasting shifts in EEG amplitude and frequency strongly suggest that the changes in brain function may be the result of changes in brain structure (neuroplasticity) that have been documented to occur as a direct result of the brain’s on-going experience. If the brain can be taught to change with EEG BFB and the changes can result in such functioning changes as decreases in depth of coma, then the implications for future work with EEG BFB with this population in hospitals and long-term care facilities are almost unlimited. It should be remembered that at this time there are no known effective treatments available for this population.

### **Coherence Training**

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### ***Introduction***

This presentation gave an overview of coherence and the advantages of its use. It also discussed the effects of coherence training on follow-up quantitative electroencephalograms (QEEGs) and the changes produced by neurofeedback in the QEEG.

### ***Method***

QEEG follow-up studies were analyzed using change scores and t-tests to show the changes brought about by coherence training in follow-up QEEGs.

### ***Results***

Follow-up QEEG studies show that coherence training significantly changes several measures on the QEEG and, to a lesser degree this research shows that non-coherence protocols are able to produce changes in coherence measures in QEEG.

### ***Conclusion***

Coherence training is a viable alternative to other forms of neurotherapy. Follow-up QEEGs must be interpreted cautiously due to probable artifactual changes that are brought about by neurotherapy.

## **Controversial EEG Patterns that Correlate with Behavioral and Neuro-Vegetative Symptoms**

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The first of the controversial EEG patterns to be reviewed was the positive spike pattern at 6-7 and 14/sec. The history started with the Gibbsses presenting this pattern in 1951 at the American EEG Society, followed by hundreds of papers, demonstrating that its appearance is mainly in teenagers with neuro-vegetative symptoms like headaches, dizzy spells, blackouts, etc., and behavioral disorders, especially impulsive acting-out behavior. The pattern became controversial for many reasons, especially from one study by an eminent pediatric neurologist who reported on a relatively small number of boys at a well-known New England private school. The most recent studies, mainly from the Orient, were reviewed.

Next was the pattern of small sharp spikes, also called benign epileptiform transients of sleep (BETS). Studies have shown that the younger the patient and the larger the number of these spikes, the more likely the patient will have clinical seizures.



The third pattern was the 6/sec spike and wave. The review showed that there are two forms. One is called WHAM, referring to the pattern seen in the waking record: high in amplitude, anterior in location, and seen mainly in males. This form is clearly associated with seizures. The second form is called FOLD, referring to the high prevalence of females, occipital in location, low in amplitude, and seen in the drowsy state. The FOLD form is usually seen in patients with neuro-vegetative and psychiatric complaints.

Finally, the Rhythmic Mid-Temporal Discharge (RMTD) pattern was reviewed, appearing in young adults with neuro-vegetative symptoms, often with bizarre behavior, and at times, with complex partial seizures.

### **To Seam or Not to Seam: Evaluating Two Techniques for Eliminating Artifact**

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#### ***Introduction***

Artifact undermines the validity and reliability of quantitative EEG analysis. How we identify, minimize, and eliminate artifact in an EEG record can alter our findings and interpretations. Artifact in spectral analysis can be handled in the temporal or spectral domain (e.g., Croft & Barry, 2000; Janacek & Swift, 1993). In zero-crossing seaming, a popular temporal domain technique for handling artifact, contaminated data are eliminated from a time series and the time series is revised or re-fashioned by juxtaposing (connecting) uncorrupted data segments from either side of the artifact, often at the nearest zero-crossings. This technique was evaluated against a spectral domain technique based on averaging and multiple overlapping windows known in our lab as clipping. In clipping, the time series remains intact and the temporal positions of contaminated data are noted. Spectral analysis is performed across the unaltered time series, ignoring spectral contributions of any period judged to contain significant amounts of artifact. This technique assumes that neighboring segments of artifact-free data represent the corrupted data to some reasonable degree.

### **Method**

Seaming and clipping techniques were compared using pure sine waves and a variety of EEG records. One file of 5- and 10-Hz sine waves was used to evaluate techniques. Also, 17 data segments of increasing lengths in three EEG files were analyzed using multiple overlapping windows (98% overlap) for 19 channels and 24 single Hz bins (1-24 Hz). Finally, five randomly selected data segments in a 60-second file were designated artifact and analyzed using the approaches above. This process was repeated 16 times.

### **Results**

In the pure sine wave analysis, spurious spectral components emerged as a result of seaming but not with clipping (as would be expected, as clipping does not alter the time series). Seaming-based spectral estimates were 20 to 40% less accurate than clipping-based estimates. Empirical evaluations revealed that both techniques were less accurate when artifact lengths grew large, as should be expected (e.g., averages are always less accurate the more the data are lacking). Nevertheless, clipping provided better spectral estimates than seaming in every record investigated. On average, clipping distorted magnitude estimates about 1 to 3%, seaming 3 to 5%. Seaming was even less favorable when calculating spectral variability, distorting standard deviations 40 to 100% more than clipping. Neither technique interacted with the frequency band.

### **Conclusion**

Artifact will always be with us. Clipping and seaming are both reasonable techniques, and each has its disadvantages. Although seaming is less accurate and prone to generating spurious frequency components, clipping requires a minimum of uncorrupted contiguous data (e.g., one-half to one second). When using either technique, signal stationarity should always be considered. Finally, the seaming technique has the additional burden of matching phase between two artificially-juxtaposed signals.

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## **The Functional Meaning and Possible Physiological Basis of Theta and Alpha Oscillations for Cognitive Performance**

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### ***Introduction***

Studies from our laboratory and other investigators indicate that different frequency bands in the theta and alpha range are associated with different types of cognitive processes. Whereas event-related changes in the theta band appear to be related to encoding and retrieval processes of a complex working memory system, the upper alpha frequency range responds selectively to sensory-semantic memory processes of a complex long-term memory system and the lower alpha band attentional processes.

### ***Method***

In a series of memory experiments spectral estimates for a resting period (resting power) and ERD/ERS during task performance were calculated. In addition, phase locking and evoked oscillations were measured by wavelet analyses.

### ***Results***

Findings from several experiments indicate that cognitive performance is superior when alpha ERD and resting power is large, but when theta ERS is large and resting power is small. Most interestingly, we have found a similar relationship for evoked oscillations and ERP components. In addition, recent results indicate that increased theta and alpha phase-locking is related to improved cognitive performance.

### ***Discussion***

The reported findings suggest that cognitive performance may be based at least in part by an interplay between the synchronous activation of three neuronal network systems: a working memory, attentional, and semantic memory system, each operating with a different frequency, the first in the theta (about 6 Hz), the second in the lower alpha (about 8

Hz), and the third in the upper alpha (about 12 Hz) frequency range. The implications of this theoretical framework were discussed by considering phase sensitive measures to analyze local and large scale integration processes between different neural networks.

### **Event Related De/Synchronization (ERD/S) Based Neurofeedback**

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#### ***Introduction***

Event related de/synchronization (ERD/S) is a current EEG power computed for a given frequency band in response to a sensory stimulus or movement and in relation to a pre-stimulus or pre-motor time interval. This parameter reflects changes in the oscillating state of the cortex associated with a given event. In contrast to stationary spectrograms, ERD/S shows how the brain reacts to a certain behavioral task at different time intervals after stimulus presentation or motor action.

#### ***Method***

The paper presented an overview of the ERD/S method in relation to neurofeedback. In particular, the method of wavelet decomposition (that gives an EEG power-time-frequency representation of the cortical response) was described. The method was compared with ERP (event-related potentials) approach.

#### ***Results***

The results of the author's study of ERD/S in response to GO/NOGO stimuli in ADHD children were presented. Using the wavelet analysis we studied 19-channel EEG responses measured for GO and NOGO stimuli in normal (n = 30) and ADHD (n = 120) groups. Our data showed that event related de/synchronization in alpha band as well as event-related synchronization in beta band correlate with age and task performance. These reactions are smaller in young children in comparison to older ones, and in the ADHD group in comparison to the normal group. Twenty sessions of relative beta EEG training improved the

quality of performance (decrease of omission and commission errors) and led to significant changes in ERD/S.

### ***Conclusion***

This study indicates a high diagnostic power of ERD/S in discriminating executive dysfunctions. It also shows that the ERD/S method provides a powerful tool for prescription of individually tailored neurofeedback protocols.

### **QEEG Changes in the Recipients of Ceremony and Prayer**

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### ***Introduction***

Studies are accumulating showing that prayer affects physiological conditions, including recovery from myocardial infarction and survival in the coronary care unit. Markers are needed to indicate when prayer is working and to help explain how intent and thought (non-physical information) interact with matter (the human body).

### ***Method***

The subjects' QEEG were recorded at 256 Hz with Lexicor equipment. Relative power, absolute power, and cordance were calculated. Hierarchical linear modeling techniques were used for statistical analysis. A control condition duplicated the sensory experiences of a Native American prayer ceremony, but without the actual intent to pray or the use of the sacred. Subjects were blindfolded. The actual ceremony was conducted with sacred objects, a Native American healer, and traditional songs.

### ***Results***

Using the control ceremony as baseline, significant differences were observed during the real ceremony, including increases in left prefrontal cordance in both delta and theta, right temporal cordance in delta and theta, central alpha cordance, and right occipital alpha cordance. Relative power increases were seen for delta and theta in the left prefrontal

cortex, the right temporal cortex, and for alpha in the right occipital cortex. Absolute power decreased overall by 20% during the ceremony. Subjects reported both ceremonies felt authentic and had powerful spiritual experiences in either ceremony. The largest changes occurred during the point in the ceremony in which the first sacred song was sung and during the time in the ceremony when the formal prayer occurred.

### ***Conclusion***

QEEG markers may exist to indicate when a subject is actually the recipient of prayer. An interaction may occur in the brain's biofield to indicate interaction of spirit and matter. Further studies are underway to determine if the healer must be in the room with the recipient of the prayer, or if distant prayer will show similar phenomena.

### **Update of EEG-Biofeedback Treatment of Anxiety Disorders**

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In 2000 the author published a review of the EEG-biofeedback treatment of anxiety disorders (Moore, 2000). Only controlled studies in peer-reviewed journals were included. Enhancement of alpha, theta and alpha-theta were effective treatments. Alpha suppression was also effective, but less so. Perceived success in carrying out the task played an important role in clinical improvement. It was concluded that research was needed to find out how much more effective these treatments were than placebo, and which variables were important for efficacy. Variables needing study were: duration of treatment, type and severity of anxiety, number and type of EEG waveforms used, pre-treatment with other kinds of biofeedback, position and number of electrodes, and presence of concomitant medication. Analysis of a further three years of publications has been carried out, and an update on progress will be presented.

### REFERENCE

- Moore, N. C. (2000). A review of EEG biofeedback treatment of anxiety disorders. *Clinical Electroencephalography*, 31 (1), 1-12.

## **Effects of Audio-Visual Stimulation (AVS) on the Hemoencephalographic (HEG) Response**

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### ***Introduction***

Previous research with audiovisual stimulation (AVS) has demonstrated that repetitive fixed-frequency visual stimuli have measurable and reliable influences on the EEG. This study extends investigation of these effects to a different response modality, regional blood flow as measured by Toomim's method of hemoencephalography (HEG).

### ***Method***

Adult subjects participated in multiple sessions consisting of three-minute periods of AVS stimulation alternated with baseline periods of no AVS. Stimulus conditions were initiated only at times when the HEG response demonstrated no systematic downward or upward trend. AVS consisted of red light delivered to closed eyes at an illumination level determined to be comfortable by the individual. Each individual was exposed to three frequencies of visual stimulation: 0.5 Hz, dominant alpha frequency, and 18 Hz, were presented in random order across the series of sessions. The HEG response at Fpz was recorded throughout each session; individuals received no feedback regarding their HEG levels. HEG levels immediately following each stimulus period were compared to the preceding no-AVS baseline.

### ***Results***

AVS produced reliable elevations in HEG levels. Higher frequency stimuli tended to produce larger changes in the HEG. Elevations generated by AVS tended to be short-lived after termination of exposure to the stimulus, however.

### ***Conclusion***

Implications of these findings for potential therapeutic effects of AVS will be discussed. The possibility of a combined modality which includes both AVS and HEG neurofeedback will also be considered.

**Neglected Neurobehavioral Areas of Traumatic Brain Injury***Rolland S. Parker, PhD*Department of Neurology, New York University School of Medicine,  
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TBI is a process occurring at a patient's developmental stage, whose outcome is dependent upon the baseline, the nature of the brain and somatic injury, and environmental support, opposition, or neglect. Its phases can be conceptualized (a) primary: neurotrauma at the moment of injury caused by kinetic forces, (b) secondary: pathophysiological processes initiated by primary trauma (e.g., hemorrhage; ischemia; neurotoxic, etc.); (c) tertiary: late physiological dysfunctioning consequent to damage to the hypothalamic-pituitary-endocrine axes (e.g., hyper- and hypo-arousal related to stress); (d) quaternary: late neurological conditions (e.g., seizures; dystonia; neurodegenerative diseases); and (e) special problems of children.

The range of potential dysfunctions reflects human adaptation (a) neurological (consciousness, body schema, sensorimotor, cerebral personality disorders); (b) cognitive (mental ability cognition, memory, communications, mental control, information processing, executive functions); (c) mood and affect (psychodynamic mood and reactions to impairment and injury); stress reactions (initial anxiety and persistent unhealed wounds), morale and world view; "distracting" symptoms and their effects (e.g., pain and headaches); (d) integrative (autoregulation, identity); and (e) adaptive (social and affiliative, restitutive capacity).

Some neglected and poorly conceptualized areas merit research and clinician care such as lack of an accepted definition of TBI reflecting different intensities of injury (e.g., the vague definitions of "mild" TBI or concussion) and the unknown significance of the presence or absence of altered consciousness.

Head injury is frequently ignored in the emergency room, subsequent clinical consultations, and schools. The patient or parent may conceal it, and symptoms may not be known to be TBI, or taken seriously. Assessment of status, treatment, and outcome focus on symptoms, but not on deficiencies of adaptation and dysregulation, not considering physiological and neurochemical interactions with the CNS consequent to unhealed somatic wounds, which affect cerebral function. Dysfunctions are mis-attributed to TBI or not considered: allostatic load (disturbance



of homeostasis after chronic adaptive failure); stress system; locus ceruleus-noradrenergic system; hypothalamic-posterior pituitary; circadian and other rhythms significant for endocrine secretion; inflammatory system (wound repair); immune system wound detection (i.e., not-self); ignoring the contribution of TBI to other disorders. A series of 14 cases of chronic fatigue syndrome in which 12 individuals had a prior minor or major concussion have been documented. Eleven of these apparently had neurotoxic exposure.

Assessment errors include: not considering personal characteristics: genetic and constitutional conditions; pre-existing conditions; age at injury (including further brain development until adulthood); possibility of late-developing symptoms; sense of identity; stress resistance, including hardiness, coping capacity, and resilience; not utilizing comparison with an estimated pre-injury baseline; too narrow a range of examination, so that dysfunctions are missed, leading to misdiagnosis, lack of treatment and incorrect assessment of outcome; mis-attribution of symptoms to cerebral injury rather than somatic injury or peripheral nerve damage (motor aprosodia; headaches consequent to referred pain from neck and shoulders); insufficient interviewing (missing partial seizures; missing mood disturbances so that dull affect is misinterpreted as patient insincerity instead of motor aprosodia or organic depression).

### **Visual Neurophysiology for the Neurometric Clinician**

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#### ***Introduction***

Anecdotal reports and limited studies have suggested possible clinical utility of QEEG and neurofeedback for visual problems (Colson, 2001; Ordmandy, 2003). This paper provided a comprehensive review of the epidemiology of the central nervous system (CNS) based visual dysfunction among the populations most frequently encountered by neurofeedback practitioners, functional visual neuroanatomy, published studies using QEEGs and neurofeedback for rehabilitation of

CNS-based visual dysfunction, and case presentations to demonstrate several clinical areas of current research.

### ***Method***

A literature review and case presentation addressed the use of QEEG and neurofeedback in cases of oculomotor dysfunction in ADHD, amblyopia, binocular vision dysfunction in TBI, “blindsight”/hemianopsia in CVA, and visual hemispatial neglect syndrome.

### ***Results***

Attendees received a thorough review of the emerging field of visual neuro-rehabilitation and the role of visual stimulation in guiding neural cognitive processes.

## REFERENCES

- Colson, C. (2001). Subcortical neglect as a consequence of a remote parieto-temporal dysfunction. A quantitative EEG study. *Cortex*, 37, 619-625.
- Ordmandy, J. (2003). Increase of visual acuity in a male with amblyopia: A single case study. [Abstract]. *Journal of Neurotherapy*, 7 (1), 70-71.

### **Brain and Consciousness Re-Assessed**

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Contrary to the current opinion in philosophical circles my view is that consciousness makes communication between organisms MORE accessible. There are some problems with this view which are summarized by two philosophical positions: (a) that consciousness is an epiphenomenon, and (b) that consciousness supervenes directly on brain processes. Both of these positions are, in themselves, wrong but can be rescued when both are seen to have a place in the time course of the brain processes that make conscious experience possible. The details were presented in the keynote presentation.

**Case Study: Ten Year Old Male with Asperger's Syndrome**

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***Introduction***

The purpose of this study was to explore the effectiveness of neurotherapy in the treatment of Asperger's Syndrome. A comparison was performed using neurological and behavioral data of a 10-year-old boy with Asperger's Syndrome before and after 40 sessions of neurotherapy conducted over the course of a year.

***Method***

An electronic QEEG was recorded using a Lexicor 19-channel system with eyes-closed, eyes-open, and two tasks: reading and math. This was performed before and after 40 neurotherapy treatment sessions using Neurocybernetics training equipment. The QEEG data were analyzed using the SKIL Topometric analysis program. In addition, a modified version of the Australian Scale for Asperger's Syndrome was filled out by the child's mother before treatment and again after 40 sessions. A structured intake format with behavioral ratings was performed prior to treatment and an analogous form was filled out by the child's mother after 40 sessions. A comparison was made between the pre- and post-treatment analyzed QEEGs, modified Australian Scale for Asperger's Syndrome and behavioral ratings.

***Results***

After 40 sessions of neurotherapy the subject showed an approximate two-thirds improvement in behavioral ratings. The post-treatment QEEG showed significant reductions in elevated 6-9 Hz slow wave activity in the medial and central-parietal regions with eyes open. There was also a dramatic reduction in the magnitude of elevated 9-12 Hz activity in the parietal and occipital regions with eyes open while reading and while performing math.

***Conclusion***

The subject, who was 11 years old at the time of re-evaluation, experienced significant improvements in both neurological and behavioral

functioning after 40 sessions of neurotherapy administered over the course of a year.

### **A Comparison of QEEG Characteristics in Pediatric Asperger's Syndrome and Attention Deficit Disorder**

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#### ***Introduction***

The purpose of this study was to evaluate the QEEG characteristics of seven children with Asperger's syndrome and to compare them to seven children with Attention Deficit Disorder. Each group consisted of six males and one female ranging in age from five to fifteen years.

#### ***Method***

Electronic QEEGs were recorded on each subject using a Lexicor 19-channel system during eyes-closed, eyes-open, and two tasks: reading and math. The data were analyzed using the SKIL Topometric Analysis Program. A comparison was made between the analyzed QEEG data from the Asperger's Syndrome and the Attention Deficit Disorder populations.

#### ***Results***

The QEEGs of the Asperger's syndrome subjects showed common functional features including elevation of 4-7 Hz activity in the posterior regions, slowing at the vertex and regulatory dissociations between anterior and posterior regions of the cortex. In contrast, Attention Deficit Disorder subjects showed elevations of 4-7 Hz activity in the anterior and central regions, slowing at the vertex, and an absence of regulatory dissociations between the anterior and posterior regions of the cortex.

#### ***Conclusion***

Although people with Asperger's Syndrome often present for treatment for symptoms associated with Attention Deficit Disorder, they show a marked difference in QEEG characteristics.

**Gamma: The New Wave in Neurofeedback Training***Marvin W. Sams, ND*

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***Introduction***

In 1995, I reported a mathematical relationship between 40 Hz, 35-50 Hz bands the brain uses for “binding” or “consolidating” various cortical and subcortical structures, and groups of slower frequencies known to relate to the performance of specific tasks (for example, 12-14 Hz activity and intellectual functioning; Giannitrapani, 1985; Sams, 1995). Because of the subharmonic association, I proposed that the brain uses resonance to fire task-specific cells.

An example of resonance is “sympathetic vibration.” If two precisely tuned violins are in proximity, and a string on one of the violins is plucked, the equivalent string on the other violin also oscillates. Another example is singing in the shower. The vibrations are amplified, increasing the volume, while harmonic and subharmonic oscillations blend with the primary frequencies to create a new, richer, and more complex sound. I propose the brain uses these natural laws to fire local cells to resonantly engage cells in remote areas, and to use the oscillations of only a few cells firing in specific combinations and order of firing to create the complex energy needed to perform various tasks.

Exploring this concept of resonance and brain function, I discovered two frequency bands above 40 Hz. This presentation reported these frequencies and their relationship to brain performance.

***Method***

Research was mainly clinical in nature: the fine-tuning of bandwidths and exploration of various electrode sites in multiple electrode combinations. Neurofeedback training results were determined by comparing edited, pre-training baselines of electroencephalographic activity recorded from nine electrode sites in eight frequency bands to those collected before the previous session.

***Results***

Neurofeedback training of two specific frequency bands above 40 Hz in specific electrode combinations yielded statistically predictable EEG changes in the eight frequency bands.

### **Conclusion**

Two specific frequencies above 40 Hz positively influence harmonically related slower frequencies known to occur during the performance of intellectual activity and various mood states.

### REFERENCES

- Giannitrapani, D. (1985). *The electrophysiology of intellectual functions*. Basel: Karger.
- Sams, M. W. (1995). Mathematically derived frequency correlates in cerebral function: Theoretical and clinical implications for neurofeedback training. *Journal of Neurotherapy*, 1 (2), 1-14.

### **Informed Consent & Liability Protection in Neurotherapy**

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Competent performance of neurotherapy requires adherence to ethical and legal norms that protect the therapist and the patient. New theories developed by attorneys suggest the wisdom of utilizing additional risk management procedures that are easy to implement and serve as a valuable safeguard against potential liability. Informed consent in using quantitative EEGs and neurofeedback will be discussed and a sample informed consent form will be explained.

### **The Neurobiology of Childhood Trauma**

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### **Introduction**

Child welfare agencies in the USA receive more than three million reports of child abuse and neglect annually, one million of which are confirmed. It is generally thought that treating child abuse is primarily a matter of psychological intervention and that healing the wounded child within is possible through these means. Recent research by Teicher

(2002) found that cortisol releases from childhood trauma may cause permanent damage to the cerebellar vermis, hippocampus, amygdala and other limbic structures within the left hemisphere. Damage to these structures has been linked to manic-depression, schizophrenia, autism, ADHD and anxiety disorders. Because of this neurological damage, adult survivors of child abuse often show borderline personality disorders and have difficulty interacting socially. Studies by Teicher (2002) using coherence measures show dysregulation of these structures.

### ***Method***

The Mindset, a 16-channel QEEG system (with modified input amplifiers) was used to collect data in eyes-closed, eyes-open, reading and math conditions. The data was analyzed using the SKIL brain mapper and normative database. Data was analyzed in the following categories: magnitude in 1 Hz bins and “comodulation.” Comodulation is unique to the SKIL software (cross-correlation of spectral analysis over time) but has similarities to coherence (cross-correlation of phase angle over time). Both systems are a measure of association between the various cortical regions based to the 10-20 system of electrode placement.

### ***Results***

In some cases alpha slowing was observed, but the comodulation measure showed the most striking results. A large degree of dissociation was observed in posterior regions of the brain. In particular, T5 showed dissociation. All participants also expressed difficulty with learning a second language such as French (which is taught in Canadian schools). They also reported difficulty in remembering peoples’ names, and most had a general dislike of crossword puzzles and activities relating to language.

### ***Conclusion***

These observations, although preliminary, appear to be a reliable diagnostic tool for assessing the Asignature@ of childhood trauma. These results support Teicher’s observations using coherence.

## REFERENCE

- Teicher, M. H. (2002). Scars that won’t heal: The neurobiology of child abuse. *Scientific American*, 286 (3), 68-75.

## **The Neurological Basis of Eating Disorders. I: EEG Findings and the Clinical Outcome of Adding Symptom-Based, QEEG-Based, and Analog/QEEG-Based Remedial Neurofeedback Training to Traditional Treatment Plans**

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### ***Introduction***

Eating disorders are associated with the highest mortality of any DSM-IV diagnosis (Fichter & Quadflieg, 1999). Despite dedicated efforts, intervention has proven only modestly effective. Because of this resistance to treatment, neurofeedback was added to the more traditional treatment modalities to determine if clinical outcomes could be improved. Previous EEG research in those with eating disorders revealed significant generalized abnormalities, unstable responses to hyperventilation (Crisp, Fenton, & Scotton, 1968) and inappropriate theta activity in the right parietal region, both before and after weight gain (Grunwold et al., 2001). Our study was designed to further evaluate the EEG findings in those with eating disorders, report the clinical benefit of adding neurofeedback to traditional medical and psychological treatment modalities, and compare the initial results of three different approaches to neurofeedback training.

### ***Method***

Personality, stress indices, and attentional screening tests were administered to 120 patients being admitted to a residential treatment center. One-third of the treatment group received pre-QEEG evaluation prior to neurotherapy interventions.

The neurofeedback protocols used were from one of three basic clinical approaches: (a) symptom-based, (b) QEEG-based, using traditional neurofeedback protocols, and (c) task-activated, analog/QEEG-based training using research-confirmed training protocols.

### ***Results***

In all three neurofeedback approaches, Beck Depression Scale (BDI) scores, neuroticism scores, and Eating Disorders Inventory (EDI) scores demonstrated significant change. Weight changes were in the desired direction.



EEG/QEEG findings will be reviewed, but, in summary, right brain dysfunction and significantly increased delta slow wave activity with cognitive challenge were common.

The initially determined difference in the three neurofeedback training approaches is that the research-designed training protocols are statistically more likely to reduce or eliminate the need for medication.

### **Conclusion**

Our study confirms that EEG abnormalities are commonly present in those with eating disorders. Importantly, adding neurofeedback to traditional treatment protocols to address these neurological issues significantly enhances treatment outcome.

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- Grunwald, M., Ettrich, C., Assmann, B., Dahne, A., Krause, W., Busse, F., et al. (2001). Deficits in haptic perception and right parietal theta power changes in patients with anorexia nervosa before and after weight gain. *International Journal of Eating Disorders*, *29*, 417-428.

### **Sequential Electroencephalographic Comodulation: Analysis of Spatial-Temporal Reorganization of the Brain During Transients and Transitions**

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### **Introduction**

Analysis of the moment-to-moment correlation in spectral magnitude trends in a given frequency between pairs of electrode sites has been labeled "comodulation." Mathematical analysis has shown that this measure is both accurate and valid for data samples as brief as one to two seconds. This fact was exploited here in an evaluation of relatively brief and sequential changes in spatial-temporal organization accompanying abnormal EEG transients or transitions between functional states.

### ***Method***

Standard 10/20 EEG data were obtained with linked ear reference from 10 clinical patients who displayed either abnormal EEG transients or sustained, recurrent state changes during recordings. Transients were noted with eyes closed or open and during tasks, while state changes involved transitions into and out of drowsiness and sleep with eyes closed. EEG transients lasting two to five seconds were averaged and compared to associated baseline data. State changes were processed as sequential five- to ten-second samples across transitions. Using the SKIL program, digitized data streams were subjected to spectral transform and between-site correlation analysis in relevant frequency ranges. Findings were compared statistically to a normative database.

### ***Findings***

Comodulation analysis in the posterior dominant frequency band showed a range of relatively normal to mildly attenuated correlation patterns in patients with closed head injuries and behavioral disorders. Analysis of the slower frequency bands identified during abnormal transients disclosed a significantly disturbed pattern of correlations, with frontal areas showing generalized dissociation and posterior areas excessive comodulation. Patients with head injuries showed a generalized posterior hyper-comodulation, while behavioral disturbances showed hyper-comodulation that was more localized to temporal and left posterior quadrant areas. State transitions were characterized by a relatively abrupt hyper-comodulation between frontal and occipital regions in the dominant frequency band, and then between frontal and parietal areas in slower theta and delta frequency bands. These changes were reversed with transition to resting wakefulness.

### ***Conclusions***

These preliminary findings provide only for speculation at this point. The transient patterns evaluated here in closed head injury and behavioral disorders were generally associated with disturbances in executive integration and related (consequent) loss of perceptual differentiation. This effect was most diffuse in head injury patients. Transitions to and from periods of sleep suggested an initial loss and then recovery in the frontal executive regulation of first occipital and then parietal activities. Further analysis is under way.

## **Cranial Electrotherapy Stimulation for the Treatment of Centrally Mediated Disorders**

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### ***Introduction***

Cranial electrotherapy stimulation (CES) is a non-pharmacological therapy involving the application of a small amount of current, usually less than 1 milliampere, through the head via ear clip electrodes. It was developed in the Soviet Union in 1954 and its use spread to the U.S. in the late 1960s. Until recently, it was little known to the neurofeedback community. A recent series of studies by Hefferman (1997) proposed the use of spectral smoothness as a model to evaluate the effectiveness of CES in treating pain. This paper will present a state of the art review on CES and its potential benefits to neurofeedback providers.

### ***Method***

A literature review of the research on CES was conducted using the standard databases, including PubMed and PsychInfo.

### ***Results***

Reviews of 126 human studies and 29 experimental animal studies indicate that CES has been used to successfully treat a variety of centrally mediated conditions including insomnia, stress-related disorders, anxiety, depression, pain (including fibromyalgia) and addiction. It has also been shown to potentiate the effects of analgesia, psychotropic medications, biofeedback and psychotherapy. Several mechanisms of action have been proposed including stimulation of the hypothalamic-pituitary axis, normalizing brain functions and neurotransmitters, and stimulation of the pain neuromatrix.

### ***Conclusion***

CES is effective for the treatment of many centrally mediated disorders including stress, depression, anxiety, insomnia, addiction, fibro-

myalgia and other pain conditions. It has the ability to potentiate analgesia, psychotropic medications, biofeedback and psychotherapy. Future research should investigate the synergistic benefits of systematically combining and/or integrating the use of CES in EEG biofeedback.

## REFERENCE

Hefferman, M. (1997). The effects of variable microcurrents on EEG spectrum and pain control. *Canadian Journal of Clinical Medicine*, 4 (10), 4-11.

### **Electroencephalographic (EEG) Discriminant Analyses of Children with Learning Disabilities: Correlations to School Achievement and Neuropsychological Performance**

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#### ***Introduction***

Our objective was to evaluate the ability of the qEEG to discriminate between age-matched normal children and children diagnosed as learning disabled and to correlate the qEEG with school achievement and neuropsychological test scores.

#### ***Methods***

The EEG power spectrum was measured in resting eyes-closed from 19 scalp locations in two groups of children: (a) children diagnosed as learning disabled by being two grade levels or more below average in school achievement tests, and (b) an age matched normal control group (N = 282) with no history of learning disabilities or problems in school. EEG coherence, phase, anatomical power ratios, absolute power, relative power and relative power ratios were the qEEG variables. T-tests and factor analyses were used to select a reduced set of qEEG variables to enter into discriminant analyses. The behavioral dependent variables were the Wide Range Achievement Test (WRAT) to measure school achievement and the WISC-R sub-tests to measure cognitive function in all of the 356 children.

### **Results**

Cross-validated qEEG discriminant sensitivity was 94.59%, specificity was 99.3%, positive predicted values were 94.59%, and negative predicted values were 98.62%. Eight of the nine discriminant variables were EEG power differences (amplitude asymmetries). Theta/beta ratios from specific electrodes were important in the analyses and EEG coherence and EEG phase were comparatively weaker.

### **Conclusion**

The order of effect size of EEG measures in predicting learning disorders and school performance was amplitude asymmetries, then theta to beta ratio, then EEG phase, then EEG coherence, then relative power, then absolute power. The strongest effect size variables were temporal lobe EEG amplitude greater than frontal EEG amplitude and posterior EEG amplitude greater than frontal EEG amplitude.

### **Eyes-Open and Eyes-Closed EEG Difference Norms**

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### **Introduction**

The problem under study was the statistical validity of eyes-open vs. eyes-closed EEG norms.

### **Method**

EEG was acquired in the eyes-closed alert condition and the eyes-open alert condition from four hundred and seventy seven individuals (N = 477) ranging in age from 3 years to 82 years of age with no history of neurological disorders and performing at grade level and/or otherwise normal. Neuropsychological tests including the WRAT and WISC-R were measured in 233 of the subjects. FFT power spectral analyses were performed on edited samples of EEG from all of the subjects in the eyes-closed and eyes-open conditions. Differences between eyes open and eyes closed were calculated for all spectral measures and the means and standard deviations for four different age groupings were computed

in four different age groupings: (a) three years to 4.99 years, (b) 5 years to 9.99 years, (c) 10 years to 12.99 years, and (d) 13 years to 82 years. Measures of skewness and kurtosis were computed and transforms applied in order to approximate Gaussian distributions for each age grouping. Gaussian cross-validation was then performed by computing a Z score for each measure and each subject and testing for Gaussianity and from this computing sensitivity measures. The difference norms for eyes open and eyes closed were then correlated with neuropsychological measures.

### **Results**

The results of the analysis demonstrated close approximation to Gaussian distribution and adequate levels of sensitivity and clinical correlation.

### **Conclusion**

This study showed that eyes-open vs. eyes-closed differences are statistically and clinically valid and help to further define the nature of brain dynamics and the allocation of resources between these two states.

### **Asperger's and ADD Differences and Similarities: Preliminary Observations**

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### **Introduction**

Autistic spectrum disorders are characterized by primary deficits in the ability to interpret, initiate and maintain social interactions, handle anxiety, and sustain external attention. Asperger's do not have the language delays that are characteristic of autism. They exhibit the classic symptoms of Attention Deficit Disorder and are often diagnosed first as ADHD. In Asperger's, anxiety in social situations appears to be at the core of their difficulties. In ADD, anxiety can be a protective factor that can result in the child doing well academically and not acting out.

### ***Findings***

Preliminary observations concerning the EEG in Asperger's appear to show slowing (theta and alpha) in the right parietal and temporal areas (P4, T6) and, at times, frontally at F3 and F4. There are also findings of comodulation (spectral correlation) differences including hypercomodulation between P4, C4 and F4 and a comodulation 'disconnect' between the right cerebral hemisphere sites and the left frontal area. However, these children also show the characteristic patterns seen in ADD with slowing at C3, Cz and C4, and/or at F3 and Fz with a 'dip' in 13-15 Hz (SMR) across the central region (C3, Cz and C4).

On intellectual and academic testing Asperger's children often show excellent verbal and reading capacities (left hemisphere strengths) and they tend to have symptoms of non-verbal learning disabilities (right hemisphere problems). The ADD children, on the other hand, may perform well on non-verbal performance tasks but demonstrate increased incidence of preschool speech disorders (Love & Thompson, 1988) and reading difficulties in the early school years.

### ***Discussion***

In those with Asperger's and ADD excess slow wave activity corresponds to being more in their own world; low SMR is consistent with fidgety and impulsive behaviour and also with the tactile sensitivity exhibited by many; high left prefrontal and frontal slow wave activity is consistent with lack of appropriate inhibition. In Asperger's high slow wave activity in the right parietal-temporal area is consistent with inability to interpret social cues and emotions. Improved social interaction found in conjunction with EEG shifts makes sense: more activation means becoming more alert to the outside world and thus better able to benefit from socialization efforts.

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**Hemoencephalography (HEG) Shows Brain Linearity: Predicts Number of Training Hours for TOVA Normalcy***Hershel Toomim, ScD*

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***Introduction***

Quantified linearity of brain response to training places neurofeedback on firmer ground as a scientific reality. The existence of quantifiable fundamental brain qualities in coefficients of linearity in neurofeedback exercises was shown. Linearity allows approximation in advance of the number of training hours required by developmental disorders to reach normalcy. Progress during training can be objectively compared to normal and improvement changes can be made.

***Method***

Twenty-eight (28) subjects with various brain problems underwent pre-training tests with MicroCog, TOVA, and a history exam to help locate below-normal brain areas. All subjects had primary brain disorders in the prefrontal cortex. Subjects were trained with hemoencephalography (HEG) at Fp1, Fp2 and Fpz for 10 minutes each for 10 sessions. Retests with TOVA and a varied version of MicroCog were then administered. Gains in TOVA impulsivity and HEG for Fp1 were then examined for linearity and correlation.

***Results***

Linearity slope was 89.5 TOVA points per HEG point with a correlation coefficient for the group of  $r = 0.746$  accounting for 55% of the variance. The data for Fp2 and Fpz were added and examined with multivariate analysis to develop more definitive measures.

***Conclusions***

Voluntary control of blood flow in selected brain areas was confirmed. Cumulative improvements in brain blood flow were confirmed with SPECT imaging. Linearity of a fundamental brain quality was experimentally quantified. Quantification of TOVA gain per session was



achieved. Prediction of the required number of sessions was tested in clinical practice. A project is underway to determine if voluntary control of deeper brain structures can be demonstrated with fMRI.

### **Treating Anxiety with Frontal Hemoencephalography**

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#### ***Introduction***

It has been theorized that pathways from the frontal lobes to the amygdala may play a role in inhibiting anxiety symptoms. Strengthening these pathways may be a viable method of treatment for anxiety and panic disorders. This study presents QEEG and LORETA maps of five subjects who received hemoencephalographic treatments at various frontal sites for the treatment of their severe and chronic anxiety symptoms

#### ***Methods***

Three men and two women, all with at least a two-year history of severe anxiety symptoms, were the subjects of this study. Each presented for treatment at an outpatient mental health center in the Midwest. Each had had multiple treatment interventions at other services in the past. None had experienced any sustained relief from prior treatments that included traditional psychotherapy and medications. Three of the subjects were on medications for their anxiety when they requested services from the center. All subjects on medications agreed to maintain their medications at the same dosage throughout treatment. Those not on medications agreed to remain medication free throughout the study. All subjects underwent QEEG examination with the NeuroSearch-24 by Lexicor Medical Corporation before and after a series of hemoencephalographic treatments. The QEEGs for each subject were conducted at the same time of day and on the same day of the week both before and after treatment. Treatment consisted of frontal hemoencephalography of various times and frontal sites.

### ***Results***

Each of the five subjects reported a significant decrease in the frequency and intensity of their symptoms. Each showed frontal lobe changes in their pre- and post-QEEG and LORETA maps. One of the subjects reported continued relief from his symptoms at the eight month follow-up. Another reported continued improvement at six months post treatment. Follow-up on the other three subjects was not completed at the time of this writing.

### ***Discussion***

Frontal lobe treatment with hemoencephalography produced positive effects in the reduction of anxiety in these cases. The results support the theory of frontal lobe involvement in the control of anxiety.

### **The Effects of Response Predictability on High Density-Event Related Potentials (HD-ERPs) and Reaction Time (RT) Measures Across Studies of Deception**

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### ***Introduction***

High-density brain event-related potentials (HD-ERPs) and reaction times (RTs) related to deception were examined. Previous ERP studies of deception manipulated recollection of past events to study waveforms associated with deceptive responses (Boaz, Perry, Raney, Fischler, & Shuman, 1991; Dionisio, Granholm, Hillix, & Perrine, 2001). This manipulation potentially confounds the ERP results of deceptive responding. To circumvent the memory issue, three experiments were undertaken in which participants were directed to lie or tell the truth (deception) by agreeing or disagreeing (congruity). Response predictability was modified between studies; each study provided fewer predictive cues than the previous study.

Hypotheses: We expected that (a) increased preparedness to lie would be associated with decreased RTs, (b) deceptive responses would have longer RTs than truthful responses, (c) RTs would be longer for incongruent than congruent responses, (d) a larger N4 for incongruent re-

sponses, (e) a larger N4 for deceptive stimuli, and (f) changes in the P3 related to deception, response congruity and test difficulty.

### ***Method***

Participants included 105 right-handed undergraduate students (ages 18-43,  $M = 21$ ,  $SD = 5.77$ ) with normal vision and no known medical disorders.

Participants viewed a series of color-coded statements that were obviously true or false (e.g., I am human.) followed by a second stimulus (e.g., TRUE). During presentation of the second stimulus, participants pressed a key to indicate whether the second stimulus agreed or disagreed with their answer to the first stimulus. Participants were randomly assigned the stimulus color to which they would respond deceptively; another color cued truthful responding.

In the first experiment, both stimuli were color-coded to cue participants to respond truthfully or deceptively and whether or not to respond congruently. In the second study, the color of the first stimulus predicted only deception, while the second stimulus provided cues to both deception and congruity. In the third study, neither deception nor response congruity was cued by the first stimulus; only the second stimulus provided deception and congruity cues.

### ***Results***

Our data show that response demand predictability affects both reaction time and ERP measures in the detection of deception. Significant effects were noted for the effects of deception, congruity, and predictability on the P3a, P3b, and N4 waveforms, as well as on reaction time. ERP and RT measures consistently identified deception across paradigms.

### ***Conclusions***

Three waveforms with similar spatio-temporal distributions were investigated in the three paradigms: an early positive component (P3a) related to attentional switching, a subsequent centro-parietal positivity (P3b) related to workload, and a late-occurring negativity (N4) related to response congruity. The ERP findings support a theory of deception in which early attentional processes are followed by evaluative and decision-making processes, and then by a final reanalysis. In addition, the

RT data indicate that decreasing response predictability increases task difficulty, resulting in longer reaction times. Modified ERP response, coupled with reaction time data, consistently identify deception across paradigms. This suggests that both measures can be used as markers to identify deceptive responding. These data provide further evidence of the applicability of ERP measures in real-world detection of deception.

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### **Quantitative EEG of Convicted Murderers**

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#### ***Introduction***

Quantitative electroencephalographic (qEEG) data were collected from 71 men convicted of murder and sentenced to death and 23 brain-damaged sex- and age-matched controls. The literature consistently shows that brain damage is more common in violent offenders than nonviolent offenders (Mednick, Brennen, & Kandel, 1988; Lewis, Lovely, Yeager, & Femina, 1989; Weller, 1986). This study examined the qEEG of individuals sentenced to death who presumably committed extremely violent acts; information about these individuals' characteristics should be especially valuable for research into the etiology of violence.

#### ***Method***

QEEG assessments of convicted murderers were completed on several different occasions over a multi-year period. During the same period, qEEG was collected on controls in hospital and private-sector

settings. Study 1 included data from 46 convicted murderers and the 23 controls. Study 2 included data from a different sample of 25 convicted murderers compared to the original controls. Approximately three minutes of EEG activity was sampled from 19 scalp electrode sites during two eyes-closed conditions in both studies.

Following artifact correction, mean magnitude was calculated for the following frequencies: low-theta (3.5-5.45 Hz), high-theta (5.5-7.45 Hz), low-alpha (7.5-8.45 Hz), mid-alpha (8.5-11.45 Hz), high-alpha (11.5-13.45 Hz), beta-13 (13.5-16.45 Hz), and beta-16 (16.5-19.45 Hz). Coherence and peak frequency were calculated for all sites for delta, theta, alpha, and beta frequency bands.

### **Results**

In both studies, convicted murderers consistently had significantly lower mean peak-to-peak magnitudes than controls, except for low-theta and mid-alpha bands.

In Study 1, theta coherence in both conditions was significantly lower at FP1 and FP2 in convicted murderers than controls. In Study 2, this effect was identified only in the second eyes-closed condition. At T6, theta coherence was higher in the second eyes-closed condition of study 1, and in both conditions of Study 2. In Study 1, theta coherence was higher for O1 and O2; this effect was not replicated in Study 2. Beta coherence was greater for convicted murderers than controls at F2, T6, O1, and O2 across all conditions of all studies and greater for F1 in all but the first eyes-closed condition of Study 2. This essentially replicates the findings of Evans and Park (1997).

In Study 1, convicted murderers had a significantly lower peak frequency in the theta band than controls during both the first eyes-closed [ $t(67) = -2.06, p = .043$ ], and the second eyes-closed conditions [ $t(52) = -3.11, p = .003$ ]. In the second study there was a similar trend in the theta band for both conditions [ $t(45) = -1.82, p = .076$  and  $t(42) = -1.98, p = .054$ , respectively].

### **Conclusions**

These findings suggest the potential value of including qEEG assessments in comprehensive forensic neuropsychological evaluations. Clinicians in the field of neurofeedback are demonstrating that learning voluntary control over EEG parameters via appropriate feedback can lead to remission of symptoms of various disorders, including the

symptoms of traumatic brain injury. Diminished mean peak-to-peak magnitude has been correlated with age-related changes (Breslau et al., 1989). However, other potential explanations exist.

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## **Long-Term Remediation of Seizures in Refractory Epilepsy with QEEG-Guided Neurofeedback Training**

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### ***Introduction***

A 31-year-old man had recurrent partial complex and secondarily generalized seizures and frequent episodes of status epilepticus. Treatment with nine different anticonvulsants singly, and in combination, did not control his seizures or prevent status episodes. He was not a surgical candidate because depth electrode monitoring revealed independent foci of onset in the left and right temporal lobes. A vagal nerve stimulator was implanted and did not reduce his seizures or prevent episodic status epilepticus.

### ***Method***

A QEEG (John database) revealed an increase in absolute theta at F7 and T4 and increased relative theta at FP1, FP2, F7, and F8. Decreased coherence of theta was found at T3/T5, O1/O2, and C3C4. Decreased

beta coherence was found at O1/O2. Training was done three times per week. First, theta coherence was down trained at T3/T5 (10 sessions), and then O1/O2 theta coherence was down trained (5 sessions). Next, beta coherence was down trained at O1/O2. Then, theta coherence was down trained at C3/C4. Finally, theta was down trained and SMR (12-15 Hz) was up trained at T3.

### **Results**

Since completion of the first protocol, there have been no further episodes of status epilepticus. Generalized seizures decreased to one per week after the first protocol and none have occurred since the second protocol was done. Partial complex seizures decreased to 10 per week after the first protocol, to 5 per week after the second, and to 1 per week after the third. When an increase in seizure frequency was noted with the fourth protocol, it was discontinued and the fifth protocol was done. Training was completed December 1, 1998. The patient has had no more seizures. He was able to return to work full time and to begin driving again. Phenytoin was discontinued in October of 1998. His speech is no longer slurred and his memory is improved. He chose to continue his other medication, not wanting to risk a seizure while driving.

### **Conclusion**

This case illustrates the powerful potential of QEEG-guided neurofeedback in the management of severe epilepsy. The training is non-invasive and was effective in a relatively short time. The cost is quite low compared to epilepsy surgery or vagal nerve stimulation. It may prove to be particularly important for drug resistant epilepsy. The combination of coherence training with traditional power training may work better than either approach alone.

### **Splitting the Normal Brain**

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### **Introduction**

The split brain serves as a model system for modularity in the human mind/brain (Zaidel, Clarke, & Suyenobu, 1990). Each cerebral hemisphere is an independent, if different, cognitive system including its

own perception, memory, language and sense of self. The two hemispheres can process information independently and in parallel. And yet, the split brain patient appears normal in everyday behavior, possessing a seemingly unified consciousness. How is that possible?

### ***Methods***

We reviewed the latest findings from split brain research with special reference to right hemisphere language, unified and divided systems of attention, interhemispheric transfer, interhemispheric control and the unity of consciousness. We next used the split brain as a model to operationalize hemispheric independence in the normal brain.

### ***Results***

Several systems of attention regulate interhemispheric interactions in the split brain. Some are split and regulate information processing in one hemisphere, whereas others are unified and permit interhemispheric coordination. Indeed, certain interhemispheric attentional effects, normally inhibited by the corpus callosum, are magnified in the split brain (Iacoboni, Ptito, Weekes, & Zaidel, 2000). A surprising amount of cognitive information can transfer between the hemispheres subcallosally and unconsciously, and this is subject to individual differences (Zaidel, 1994).

The language repertoire of the disconnected right hemisphere is surprisingly rich, especially in comparison with residual language following aphasiogenic left hemisphere lesions. Some disconnected right hemispheres even exhibit speech (Zaidel, 2001). However, effective error monitoring requires interhemispheric cooperation and is impaired in the split brain (Kaplan & Zaidel, submitted).

Many lateralized behavioral tasks follow the split brain model. Thus, lateralized lexical decision with target words and pronounceable non-words reveals independent hemispheric profiles, with a remarkably rich language competence in the normal right hemisphere, exceeding the language repertoire of the disconnected right hemisphere (Iacoboni & Zaidel, 1996). By contrast, dichotic listening to stop consonant-vowel (CV) syllables, which calls for phonetic analysis, shows exclusive specialization in the left hemisphere (LH), so that the left ear (LE) score reflects both callosal relay and LH processing (Zaidel et al., 1990).



### Conclusion

Each disconnected hemisphere is capable of adaptive problem solving, has feelings and possesses a distinct concept of self, complete with a sense of past (Schiffer, Zaidel, Bogen, & Chasan-Tabor, 1998), present and future (i.e., each is conscious; Zaidel, Iacoboni, Zaidel, & Bogen, 2003). We argue that the same is true of the normal brain.

The normal right hemisphere is adept at visual word recognition but not at phonetic analysis. It is selectively sensitive to error feedback during lateralized lexical decision (Iacoboni, Rayman, & Zaidel, 1997; Kaplan & Zaidel, 2001). This suggests a division of labor: the left hemisphere is specialized for certain language processes; whereas, the right hemisphere is specialized for monitoring those processes.

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