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Selected Abstracts of Conference Presentations at the 2009 International Society for Neurofeedback and Research (ISNR) 17th Annual Conference, Indianapolis, Indiana

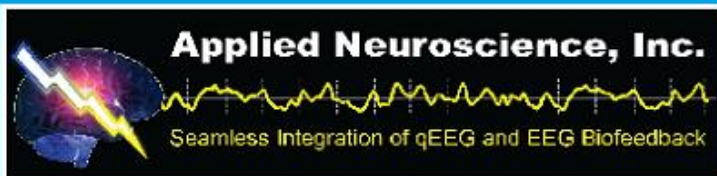Published online: 30 Nov 2009.

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PROCEEDINGS OF THE 2009 ISNR CONFERENCE

Selected Abstracts of Conference Presentations at the 2009 International Society for Neurofeedback and Research (ISNR) 17th Annual Conference, Indianapolis, Indiana

The 17th annual conference of the International Society for Neurofeedback and Research (ISNR) was held in Indianapolis, Indiana, Labor Day weekend with more than 400 people in attendance. If you happened to miss the meeting, or a talk or two, what follows are abstracts along with e-mail addresses of the presenters, when available. Abstracts have been edited for length and clarity and most references removed. Please contact author(s) for further information on this research or purchase the DVD of the presentation from ISNR.

David A. Kaiser, PhD
Editor

Meta-Analysis of the Efficacy of Neurofeedback in ADHD on Inattention, Impulsivity & Hyperactivity: Level 5 Efficacious & Specific

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Introduction

Since the first reports of neurofeedback treatment in ADHD in 1976, many studies have been carried out investigating the effects of neurofeedback on different symptoms of ADHD such as inattention, impulsivity, and hyperactivity. This technique is also used by many practitioners, but the question as to the evidence-based level of this treatment is still unclear.

Method

In this study selected research on neurofeedback treatment for ADHD was collected and a meta-analysis was performed. In total, 15 studies were incorporated with a total sample size of 1,194 individuals. For all studies means, sample sizes and standard deviations for measures of inattention, impulsivity, and hyperactivity were used to

calculate the effect sizes (ES; Hedges' *D*). Forest plots were made and the grand-mean ES was calculated for all three measures.

Results

Both prospective controlled studies and studies employing a pre-and postdesign found large ES for neurofeedback on impulsivity and inattention and a medium ES for hyperactivity. Randomized studies demonstrated a lower ES for hyperactivity suggesting that hyperactivity is probably most sensitive to nonspecific treatment factors.

Conclusions

Due to the inclusion of some very recent and sound methodological studies in this meta-analysis, potential confounding factors such as small studies, lack of randomization in previous studies, and a lack of adequate control groups have been addressed and the clinical effects of neurofeedback in the treatment of ADHD can be regarded as clinically meaningful. Four randomized controlled trials have shown neurofeedback to be superior to a (semiactive) control group, whereby the requirements for Level 4: Efficacious are fulfilled (criteria for evaluating the level of evidence for efficacy established by the AAPB and ISNR). Three studies have employed a semiactive control group, which can be regarded as a credible sham control providing an equal level of cognitive training and client–therapist interaction.

Therefore, in line with the AAPB and ISNR guidelines for rating clinical efficacy, we conclude that neurofeedback treatment for ADHD can be considered Efficacious and Specific (Level 5) with a large ES for inattention and impulsivity and a medium ES for hyperactivity.

Neurofeedback for Children and Adolescents with Tourette's Syndrome: A Case Review

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Gilles de la Tourette Syndrome is characterized by a pattern of motor and vocal tics that persist several times per day for 1 year or more. Current research suggests that neurofeedback, or EEG biofeedback training, is an effective treatment for attentional deficits and seizure disorders, and may also be helpful for movement disorders. Research on neurofeedback and tic disorders including Tourette Syndrome has produced positive results (Dopfner & Rothenberger, 2007; Poncin, Sukhodolsky, McGuire, & Scahill, 2007; Tansey, 1986). The purpose of this case review is to investigate whether 40 sessions of neurofeedback focused on sensorimotor rhythm (SMR) training, often in combination with biofeedback and metacognitive strategies, may be an efficacious intervention for the reduction of symptoms associated with Tourette Syndrome. This article presents the results from a chart review of data collected before and after neurofeedback training conducted with children and adolescents with a diagnosis of Tourette Syndrome.

Method

This study consists of approximately 15 participants from 8 to 18 years of age who meet the *Diagnostic and Statistical Manual of Mental Disorders* (4th ed.; American Psychiatric Association, 1994) criteria for Tourette Syndrome. Participants who received an initial assessment but did not proceed with neurofeedback training serve as a control group. All training was done over the sensorimotor strip at CZ, C4, or C3 to increase SMR. SMR range was either 12–15 Hz or 13–15 Hz. Theta was decreased, with ranges determined based on Dr. Lynda Thompson's individual assessment, as well as the presence of any comorbid disorders. The broadest range for theta was 3–10 Hz.

All client ranges fell between these values. Initial assessment data will be compared with data collected following a minimum of 40 treatment sessions. In some cases, participants have completed more sessions (up to 100 sessions). Metacognitive strategies were taught when feedback indicated that client was relaxed, calm, and focused. Data are reported according to which tests were administered at baseline and after training (pre and post). For each client this includes at least one of the following: Intermediate Visual and Auditory Continuous Performance Test, Tests of Variables of Attention, Wechsler Intelligence Scales, Wide Range Achievement Test, and EEG data (such as theta/beta power ratios), as well as questionnaires and self-reports. Symptom severity is collected through self-report measures before and after neurofeedback. Change in presence of tics as well as change in medication were discussed in initial assessment and follow-up appointments with Dr. Thompson. Success is defined in terms of symptom reduction. Participants who received an initial assessment but did not receive neurofeedback are contacted for self-report updates in regards to their symptoms. Change in symptoms including reduction in frequency and severity are taken into account, as well as any medications taken after initial assessment. A chart review of pre- and posttreatment data is conducted.

Results and Conclusions

Because of the small number of participants and multiple interventions (neurofeedback, biofeedback, metacognitive strategies), no definitive conclusions are drawn about efficacy of neurofeedback from this chart review. There is, however, a case review, which, with favorable outcomes, is used to encourage further controlled studies. The review also indicates which of the various measures used are the most sensitive for tracking change.

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Perioperative Sensorimotor Mapping by Task-Related EEG Activation: Method Validation Based on a Series of 10 Surgical Epilepsy Patients

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Introduction

The objective of this work was to demonstrate clinical utility for an adjuvant method for preoperative sensorimotor mapping in patients with intracranial grid implants for the localization of epileptic foci who are at risk for postoperative motor deficits. Task-related EEG activation has a wide range of potential uses, yet clinicians are still to be won over, possibly because of lack of validating studies showing clinical utility. Here we validate a clinical application of this method, which relies on the analysis of task-related spectral changes after Pfurtschellers notion of event-related desynchronization of EEG (ERD).

Methods

ERD in the beta (13–35 Hz) frequency band was quantified by using a statistical Z score comparison of average beta power during and prior to sustained motor contraction. ERD maxima localized the hand and mouth areas in 10 patients with subdural grids with frontoparietal coverage, then the localization was compared to that of widely adopted techniques of electrical stimulation (ES) and median nerve somatosensory evoked

potentials (SSEPs), obtained from the same grid electrodes.

Results

In 7 patients who had unequivocal sensory and/or motor hand-area findings on ES and SSEPs mapping, the maximum ERD was concordant. In 7 patients who had definitive mouth-area findings on ES, the maximum ERD was in agreement. In cases where the hand ($n = 2$) or mouth ($n = 3$) area was not localized with ES due to prolonged seizures or lesions, ERD mapping was either in agreement with SSEPs for hand area, or localized to plausible anatomical locations for mouth area.

Conclusions

The beta ERD method for preoperative sensorimotor mapping is as reliable as ES/SSEPs and is superior to both in terms of efficiency and safety. We suggest that ERD mapping be adopted as a technically simple and reliable adjuvant to standard-of-care clinical mapping with ES and SSEPs.

Internally Generated Cell Assembly Sequences in the Service of Cognition

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How cell assembly sequences underlie cognitive processes was discussed.

Self, Other and Object Processing in the Addicted Brain

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Introduction

To investigate the neurophysiological differences between recovering substance abusers (RSA) and controls using quantitative electroencephalography and standardized low-resolution electromagnetic tomography when evaluating photographic images of a hammer, another face, and the self.

Methods

This study was conducted with 38 participants: 18 recovering substance abusers and 20 nonclinical controls. EEG data were recorded in three experimental conditions: while viewing an image of a hammer, while viewing an image of another's face (a novel female face, the same for all participants), and while viewing an image of their own face. We performed voxel by voxel t tests between groups for each condition. The subjective reports were rated by three independent raters; two were blind to experimental conditions.

Results

The RSA group processes each of the images in different regions of the cortex in both alpha and beta frequencies as compared to controls. The specific regions of difference between groups occur within Brodmann Areas (BA) 24/32, 25, 9/10, and 47 in the anterior regions and BA 19, 7, and 31 in the posterior regions.

Conclusions

The regions of significant difference are shown active during fMRI experiments during tasks related to self-recognition, autobiographical memory, and self-reference, as well as emotional, social, memory, visual-spatial, and cognitive processes. The subjective reports provided by all participants at the end of the sessions indicated RSA viewed the hammer more as a weapon rather than a tool and tended to focus on perceived negative attributes of the other and their own image, whereas the controls tended toward practical elements of the hammer and rated the other and self in more neutral or positive ways. In this population of RSA the content of self report during the recordings while processing photographs of other, an object, and self is more negative than

controls. This may reflect negative perceptual and maladaptive self-referential cortical processes; alternatively, it may represent processing differences in general or substance-related changes inperceptual processing. This is a topic for future study. Clinical implications are discussed relative to alpha/theta training and Peniston's work.

Infrared Images of Migraine, Head Injury, ADD, Depression, Anger, Autism, and Other Common Disorders
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PIR HEG as a clinical procedure has now been in use for 11 years. This presentation reviews its development, along with clinical observations.

Assessment of Mild TBI in Three Retired NFL Football Players
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QEEG has been shown to be a useful component of a comprehensive evaluation for mild traumatic brain injuries such as concussions. Three former NFL football players received comprehensive QEEG and neuropsychological assessment. The presenting complaints were fairly similar in all three cases, primarily involving problems with headaches, memory, and concentration. All played receiver and/or special teams positions, and therefore received multiple blows to the head. The blows were mostly received from contact of the helmet to the ground, but some were from helmet-to-helmet contact. QEEG was sensitive to damage, even though it had occurred about 3 to 10 years prior. In these cases, QEEG revealed diffuse delta in large areas of the brain, which was especially concentrated in the left temporal and tempero-parietal regions as well as in either or both frontal lobes. Neuropsychological evaluation confirmed functional impairments in memory, auditory and/or

visual processing, and attention. The integration of QEEG and neuropsychological testing was synergistic in all cases, with information from one complementing and augmenting the other. Neurofeedback was recommended in all three cases, as research supports neurofeedback as an intervention for the concerns they mentioned. Biological, psychological, and social implications are discussed.

Out of Injury Comes a New Discovery of Neurofeedback for a Baseball All-Star
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The use of biofeedback to improve baseball hitting and mental performance was discussed by a Major League Baseball All-Star athlete and his associates.

EEG Coherences Validated by MRI Diffusion Tensor Imaging: An Autistic Case Series
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Normal brain functioning depends on synchronization within distributed brain networks. Breakdown of such connectivity correlates with behavioral and cognitive deficits (Wolters & Raffone, 2008). EEG coherence is the clearest indicator of this synchronization and coherence anomalies have been associated with such diverse conditions as autism, traumatic brain injury, and childhood sexual abuse (Coben & Hudspeth, 2008). However, there are different methods to assess coherence that provide disparate information (Kus, Kaminski, & Blinowska, 2004), and coherence is not considered to be necessarily equivalent with physical neural connectivity that can be measured in other ways (Teipel et al., 2009). MRI Diffusion Tensor Imaging (DTI) has emerged as the premiere measurement of physical and functional neural connectivity. MRI-DTI measures the diffusion of water molecules

in three dimensions across the fiber tracts of the brain. As such, it is considered a measurement of how information flows within and across the white matter tracts of the brain.

Autistic disorders have been conceptualized as dysfunctions in neural connectivity (Coben & Myers, 2008; Rippon, Brock, Brown, & Boucher, 2007). In a case series of children with autism, data are presented including both MRI-DTI and EEG data. EEG data was acquired with a high-density array of 64 cephalic electrodes all digitized with a three-dimensional tracking system. This enables localization of electrode sites for precise matching of spatial localization of activity across EEG and MRI platforms. Data are presented, including multiple forms of coherence (pairwise, multivariate, source coherence) and their relation to MRI-DTI findings in these patients. Such analyses allow a comparison of the functional and neurophysiological significance of such coherence measurements such as has never been available previously. Implications for assessment and intervention are discussed.

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Group Independent Component Analysis of Brain Resting-State Networks: Nearly Identical Findings on Two EEG Databases

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Interest in brain function in a resting state has recently increased considerably. On average the human brain extracts about 40% of available oxygen in the blood and disposes about 20% of the energy for the whole body. Still, it amounts to only 2% of the total body weight. The aim of this study is to extract eyes-closed resting EEG networks using group independent component analysis. We employ a test–retest strategy using two independent large sample normative databases ($N = 57$ and $N = 84$) and retain as many independent components as we can replicate. We characterize the cortical structures involved in each component by a distributed source localization of the spatial maps and their spectral profile. We also study their out-of-phase (lagged) coherence using recent advances on connectivity measures adapted to EEG data. We are able to replicate on the two databases seven components with nearly identical spatial and frequency distribution, explaining about 93% of the total EEG variance. Furthermore, we are able to replicate the organization of the extracted components in two networks, within which components oscillate coherently with a complex multiple-frequency dynamics, and exchange information at multiple time-lag rates.

Positive Subjective Experiences Related to Clarified Gamma Brainwave Neurofeedback from the Prefrontal Cortical Region of Meditators and Nonmeditators

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Introduction

Previous studies showed that 25 to 42 Hz brainwaves from the prefrontal cortical region in advanced Tibetan Buddhist meditators were found to be correlated with heightened experiences of compassion and clarity. In the present study, participants who were either advanced practitioners of Transcendental Meditation (TM; $n = 6$) or nonmeditating controls ($n = 6$) were engaged in a single session of neurofeedback in this same brainwave region using the Peak Brain-Happiness Trainer (PBHT). The PBHT is a novel type of neurofeedback instrument that can assess and train various dimensions of mental processing, including the Clarified gamma experience, which is hypothesized to be related to the processing of new learning and its reinforcement by positive feelings. To create the Clarified gamma neurofeedback protocol, the PBHT clarifies the 40 Hz band of gamma EEG production from the prefrontal region by filtering out signal artifact from muscle tension or movement.

Methods

Real-time unlabeled auditory and/or visual neurofeedback from this clarified gamma protocol was provided to the participants in a controlled laboratory setting. They were asked to do the following sequential tasks: (a) to explore the Clarified gamma-related experience and to subsequently describe it in their own words; (b) to engage for 2 min in each of 16 different emotional and cognitive states spoken to them as a sequence of descriptive words or phrases, and to decide, by comparing their momentary experience to that moment's clarified gamma neurofeedback, how strongly these states correlated with the clarified gamma neurofeedback; (c) to engage in a neutral state to measure baseline values of clarified gamma; and (d) to quickly produce their maximum value of clarified gamma neurofeedback.

Results

Self-assessed descriptions of the clarified gamma experience were comparable for both groups. Associations of 11 of the 16 descriptors with the clarified gamma neurofeedback were positive, with the largest scores for "happiness" and "loving" and 3 of the 16 descriptors with the clarified gamma neurofeedback were negative with the largest scores for "stressed" and "disappointed." Baseline measurements of the clarified gamma band were indistinguishable for the two groups. Although both groups were able to significantly increase clarified gamma neurofeedback values, meditators were better able to quickly increase these gamma brainwaves at the prefrontal region than controls ($p = .02$).

Conclusions

We conclude that the clarified gamma experience appears to involve positive emotions of happiness and love, and lowered stress, and that TM practitioners have greater facility than controls in achieving it in a single neurofeedback session.

Significant Cognitive Improvements from Neurofeedback in Five Sessions: A Controlled Study

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Introduction

A study of thirty 16- and 17-year-old high school students found that the InAll Focus Training Protocol used in the Peak Achievement Trainer produced very substantial improvements in measures of concentration, attention, and memory in just five sessions. They were trained to focus their attention using this patented prefrontal wideband suppression protocol once a week for 30 to 45 min each.

Methods and Results

Performance on one of the attention measures—The Trail Making Test (TMT) Part A from the Halstead-Reitan Test

Battery—nearly tripled, whereas the group average on the more difficult TMT Part B doubled.

TMT Part A consists of encircled numbers from 1 to 25 randomly spread across a sheet of paper. The object of the test is for the participant to connect the numbers (follow the dots) in order, beginning with 1 and ending with 25, in as little time as possible. TMT Part B is more complex than A because it requires the participant to connect numbers and letters in an alternating pattern (1-A-2-B-3-C, etc.) in as little time as possible. The improvements due to Peak Achievement Training were significant on both Part A and Part B. The study also included control groups using the Freeze Framer (now EmWave PC) from HeartMath and the Inner Tuner Expert System, Ultra Mind International. Neither the heart rate variability feedback training nor the electrodermal response feedback training produced significant gains on these tests in five sessions.

In addition, performance on both the Forward and Backward Digit Span Tests improved significantly with the In(hibit)All wideband suppression protocol. The number of digits remembered when quizzed in the forward direction increased from 7 to 8, whereas the number remembered while stating them in reverse order increased from 4 to 4.5. Of the other two biofeedback groups, the only one that showed a significant improvement on Digit Span was the heart rate variability feedback training in the forward direction.

The study also showed that five sessions of wideband suppression training significantly enhanced the participants' abilities to focus. This is indicated by how long they could keep their concentration going without a lapse, as measured by the InAll Protocol.

Conclusions

These results are consistent with the idea that neurofeedback protocols that are easier to understand are rapidly learned. Our clinical experience with the Concentration protocol and the newer Focus protocol indicate that almost everyone who tries one under proper guidance can understand it and begin to control it in less than 2 min.

Wideband suppression protocols are based on the concept of reinforcing a desynchronized EEG pattern, which indicates more underlying neuronal activity. We discuss the idea that the measurable EEG patterns are synchronized idling rhythms, based on what is known about the origin of thalamocortical EEG patterns. Feedback based on wideband desynchronization versus synchronization is clearer than other types of feedback because it is based on a more robust phenomenon. Prefrontal feedback is more easily perceived by participants because it is more closely related to conscious processes.

Limbic Dysrhythmia

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Introduction

Recent studies indicate that multiple theta generators exist in the human brain permitting integration of the limbic system activity with activity of the brainstem, the hypothalamus, and the neocortex. Except for the well-known link between theta and memory, theta is generated in emotion processing in humans to both positive and negative stimuli. Thus the main domain of theta activity seems to be memory and emotional regulation.

In the resting awake state the dorsal anterior cingulate cortex oscillates at theta frequencies, driving prefrontal cortex to oscillate at the same rate and vice versa. In a combined EEG–MEG study it was found that the frontal midline theta is generated in the dorsal ACC, alternating with the ventromedial prefrontal cortex (PFC).

It has been suggested that this bidirectional coupling is influenced by the ventral tegmental area (VTA). The mediodorsal nucleus of the thalamus and VTA exert a complex dopaminergic (D1, D2, and D4) gating action over PFC neural activity, either facilitating or inhibiting firing in the hippocampal–PFC pathway depending on the frequency and

relative timing of the arrival of afferent input. The electrical stimulation of the lateral, parvocellular part of the mediodorsal thalamic nucleus only activates the anterior cingulate when the stimulus frequency is in the theta range (6–8 Hz). Thus the midline theta might be under influence of the dopaminergic VTA.

Nonthalamic subcortical delta generators are found in all parts of the mesolimbic dopaminergic reward system, that is, the VTA nucleus accumbens, ventral pallidum, and PET/EEG studies indicate a positive correlation between waking delta and PET metabolism in the medial frontal cortex, also related to the mesolimbic dopaminergic reward system. Therefore it has been suggested that awake delta activity is related to motivational drive for fulfilling basic needs such as food and sex. Thus delta oscillations activate brain motivational systems that signal salience and make the brain paying attention to biological relevant stimuli.

Furthermore, it has been established that frontal midline theta oscillations are involved in attentional processes and that both sympathetic and parasympathetic indices are increased during the appearance of frontal midline theta. Theta band activities in the frontal area are correlated negatively with sympathetic activation.

Methods

A normative database of independent resting state EEG components has been developed by Congedo and John (NICA), in which three components are characterized by a theta spectrum, all anatomically located at the anterior cingulate, extending into the insula and amygdala and parahippocampal gyrus. The frontal midline theta corresponds to the activity of NICA component 1 (5 and 6) consisting of a functionally connected network of the amygdala, subgenual anterior cingulate, dorsal anterior cingulate, and insula. The spectral analysis of NICA component 1 demonstrates this functional network oscillates at theta frequencies at rest. The amygdala–anterior cingulate–anterior insula network might relate to the emotional significance and salience of internal and external stimuli, by combining networks involved in arousal and intrinsic alertness, interceptive awareness, and motivation.

Results

Analogous to thalamocortical dysrhythmia we present data suggesting that an absence of midline frontal theta with an associated increase of delta and/or beta activity might be an electrophysiological manifestation of a common pathophysiological mechanism underlying several distress and autonomic pathologies and propose to call this limbic dysrhythmia. Basically it is a dysrhythmia of component 1,5,6 in NICA.

Conclusions

Based on data in pain and tinnitus patients and on a literature research we suggest that this mechanism could potentially be extended from "distress" to include anxiety, major depression, PTSD, and autonomic dysregulation (irritable bowel, hypertension, syncopes, etc.). This group of clinical entities should be differentiated from motivational drive pathologies such as obsessive compulsive spectrum disorders and reward deficiency syndromes, which can be considered abnormal delta oscillation pathologies, in contrast to limbic dysrhythmia, which is suggested to be a dysrhythmic theta pathology.

This heuristic concept argues that limbic dysrhythmia pathologies should be treated by normalization of this delta-beta coupling to its resting theta rhythm, by neurobiofeedback, tDCS, TMS, or implanted electrodes, whereas motivational drive pathologies should be treated with normalization to normal delta.

"The Thoracic Pump"—Impetus for the Respiratory Arterial Pressure Wave and Breathing Induced Heart Rate Variability

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Human physiology is configured such that breathing serves to promote both blood flow

and gas exchange. When we inhale, a significant volume of blood is ushered through the venous system into the lungs via the right heart. When we exhale an equal volume of blood exits the lungs via the left heart filling the arterial tree. This action gives rise to the well-understood but little recognized phenomenon of the "respiratory arterial pressure wave," which can be observed in the arterial blood flow plethysmographically, oscillometrically, and via catheterization. A view of the respiratory arterial pressure as measured in the finger with the J & J Engineering Physio-Data PPG is presented. An understanding of the relationship between the thoracic pump and breathing induced heart rate variability is offered.

Characterization of Impedance and Current Flow in the Human Body as a Function of Connectedness to Earth Ground

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The human organism has an electrical relationship to Earth "ground." Although certain to be infinitely more complex than presently understood, initial findings are in themselves somewhat surprising. Impedance and resultant current flow in the human organism are a function of connectedness to Earth ground. As such, impedance and current flow can be modified by modifying the resistance between human and earth. Characteristic impedance as measured across multiple adults and children is presented. Implications to electrically coupled biofeedback methods, that is, EEG and EMG, are offered.

Examining Neurological Basis for Effective Leadership

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Three different research studies are examined to establish the link between the potential neurological basis and effective leadership qualities. The first study used quantitative electroencephalographic procedures (qEEG); the brain activity of 46 senior leaders was recorded while at rest and when engaged in a visionary communication task. The findings support the expectation of frontal right-brain differences between leaders who engage in socialized, versus more personalized, visionary communication. Socialized visionary communication, in turn, predicts follower perceptions of charismatic leadership. I discuss brain plasticity and the potential to use neurological information for the purpose of leader development.

In the second research study examined, hope, optimism, confidence, and resiliency are instrumental capacities for effective leadership. These capacities have generated interest among leadership researchers and practitioners primarily because they are considered to be open to development and have an impact on performance. I summarize some new and groundbreaking evidence that suggests the brain activity of leaders who are hopeful, optimistic, and resilient differs from those who are not.

The third research study examines Complex Adaptive Leadership, and its core component of self-complexity, is an emerging conceptualization of leadership that is based on the premise that complex operating environments require leaders to be highly adaptive in adjusting their behavioral responses to meet diverse role demands. I demonstrate that qEEG technology can provide valuable information about the neural correlates of various cognitive processes underlying leader self-complexity. With each research study I compare and contrast the correlations of leadership and EEG in the 40 Hz gamma band.

Transcranial Direct Current Stimulation (tDCS): Putative Mechanisms of Action and Clinical Effects of a Simple and Powerful Method of Cortical Electrical Stimulation

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Transcranial direct current stimulation (tDCS) is a noninvasive method of brain

stimulation that has been increasingly tested for the treatment of neuropsychiatric disorders. It has useful characteristics, such as low cost, ease of use, reliable sham methodology, and relatively powerful effects on cortical excitability. Because of its potential to modulate cortical excitability noninvasively, tDCS has been tested for the treatment of neuropsychiatric disorders for several decades. In this presentation I review the mechanisms of action, the main characteristics, and the evidence on the use of tDCS for major neuropsychiatric disorders. I also compare tDCS with other techniques of neuromodulation, especially transcranial magnetic stimulation, and suggest future directions for the use of tDCS in neuropsychiatry. Recent clinical studies on tDCS using novel approaches, such as different parameters of stimulation, have improved its neuromodulatory effect thus resulting in larger clinical effects.

Findings to date encourage further studies in this area that should explore novel parameters of stimulation. It appears that current methods of tDCS might not be fully optimized and, in fact, (a) individualized parameters of stimulation, (b) longer stimulation sessions, and (c) methods to focalize tDCS might be useful strategies to provide greater clinical benefits. Finally tDCS as compared to TMS might provide additional clinical benefits in specific situations such as when used to enhance learning.

Referenced EEG—Ready for Medication Implementation: A Review of the Recent Research

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Referenced EEG is a tool for personalized medicine that helps identify biomarkers for medication responses. By categorizing known medication responses to a patient's brainwaves, a clinician can be helped to identify the optimum individualized drugs for each patient. This talk presents the latest data on several recent studies including use in eating disorders, SSRIs in children, substance abuse, medication washout, and a pilot study that served as the prototype for a large blinded academic study. Finally, the most recent results from the multisite controlled study are discussed along with implications of use in clinical practice.

Self-Control Strategies for Modulation of Chronic Pain: Clinical and Research Implications

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Although there remains much to be learned, a great deal is now known about the neurophysiological processes involved in the experience of pain. Research confirms that there is no single focal "center" in the brain responsible for the experience of pain. Rather, pain is the end product of a number of integrated networks that involve activity at multiple cortical and subcortical sites. Our current knowledge about the neurophysiological processes that subserve pain has important implications for understanding the mechanisms underlying the effects of various self-control strategies for chronic pain management, including self-hypnosis and neurofeedback training. For example, hypnotic analgesia interventions have demonstrated specific effects on activity in various cortical structures and EEG measures of brain activity, and these effects appear to differ as a function of the specific hypnotic suggestions used. Fewer studies have examined the effects of neurofeedback on cortical activity, although the research that has been performed suggests that training individuals to alter activity in specific bandwidths may decrease the experience of pain. The research findings support the need for additional studies to (a) examine the effects and mechanisms of training patients in self-control strategies for pain management, (b) study the effects of these interventions on different measures of cortical activity, and (c) develop self-management training interventions that produce the most benefit for individuals suffering from chronic pain.

Relationship of Alpha-Theta Amplitude Crossover During Neurofeedback to Emergence of Spontaneous Imagery and Biographical Memories

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Introduction

Alpha-theta training is a brainwave biofeedback training protocol designed to facilitate a deeply relaxed state that is often associated with hypnagogic imagery. The clinical utility and effectiveness of alpha-theta training was demonstrated with military veterans treated for alcoholism and posttraumatic stress disorder (PTSD). Eugene Peniston, who conducted these early experiments, identified an alpha-theta amplitude crossover state that usually occurred during the course of this therapy and that was thought to represent a state of consciousness in which the individual could access hypnagogic imagery symbolic of issues in his life. Peniston believed that alpha-theta brainwave training facilitated the emergence of repressed anxiety provoking events from an individual's past through this hypnagogic imagery, and he suggested that the emergence of these abreactive imageries and/or memories should be the target and goal of alpha-theta training. In a significant observation, Peniston posited that increased beta and theta activity reflects a brain process which helps us remember and relive past traumatic events. He further postulated that the healing process of self-awareness is manifested in high amplitude beta waves occurring in conjunction with the aforementioned cross-over of theta waves over alpha. Since the development of Peniston's successful brainwave training protocol, there has been some controversy among researchers in the field about the clinical relevance of the alpha-theta crossover phenomenon. This study is an attempt to clarify methodological and technical considerations related to alpha-theta crossovers during alpha-theta brainwave training to address controversial aspects of this biofeedback training protocol. This study attempts to answer the following research questions:

1. What constitutes a therapeutic alpha-theta crossover? Is the quality in terms of degree of amplitude of the theta-alpha crossover important to the emergence of spontaneous imagery and memory?
2. Are there relationships and ratios of specific bandwidths that are relevant to the type of imagery content that emerges?
3. Is a minimum amount of cognitive beta amplitude increase necessary to recall the content of imagery and memories evoked in alpha-theta training after a client returns to an alert state of consciousness?
4. Is there a relationship between delta brainwave activity and deeper states of consciousness?
5. Are higher amplitude crossovers related to better overall treatment outcomes?

Methods

Ten to 12 records of clients who received alpha-theta brainwave training as part of their neurofeedback treatment were obtained for analysis. A polynomial logistic regression analysis was performed to analyze the data for relationships among the variables of interest.

Results and Conclusions

A review of the data provides a number of tentative conclusions. Imagery recall appears to be dependent on higher amplitude and longer duration crossover variability and unrelated to very brief interactions of various bandwidth waveforms. Lower frequencies (i.e., theta to delta) correlate to deeper imagery experiences (i.e., biographical to transpersonal). During crossover patterns, imagery occurs with greater frequency when cognitive beta is observed to rise concurrently with theta and delta frequencies as well. Delta activity correlates with deeper, transpersonal experiences. Greater crossover

activity correlates with positive treatment outcomes.

The Role of EPA/DHA (Omega-3s) in Mental Health: Implications for Practitioners

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The critical role of omega-3s in mental health and cardiovascular disease is poorly appreciated by most clinicians, and many patients are left confused when confronted with a myriad of fish oil product formulations on the market. This presentation focuses on detailed discussion of both epidemiologic and clinical trials of omega-3s in the realm of neuropsychiatry and why both EPA and DHA are important to ensure overall improved treatment outcomes as well as long-term maintenance of healthy mental function and mood states. From nutritional and dietary perspectives on a population level to biochemical pathways, this presentation helps provide the attendee with a strong foundation in the neurochemistry behind omega-3s and how to help equip your patients from cradle to grave with nutrients that can optimize your desired practice outcomes. Last, a new area of interest where combining specific, powerful natural antioxidants with omega-3s for enhancing benefits is mentioned.

Quantitative EEG in Children with Early Histories of Abuse, Trauma, and Neglect

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Introduction

In the present study we examine whether there is a pattern of quantitative EEG features that is consistent across individuals in the two groups of children diagnosed with reactive attachment disorder, all of whom have documented histories of abuse and/or neglect. Specific findings of cortical dysfunction would allow for a better understanding of the mechanism of this disorder and potentially assist in the development of more precise and effective treatment regimes.

Methods

This research used a two-cohort design allowing for independent replication of findings. All participants were seen in clinical consultation at one of two clinics specializing in treatment of behavioral disorders collaborating in this study. All participants were seen either at the Pisgah Institute, Asheville, North Carolina (Cohort 1, $N = 42$) or the Attachment and Bonding Center of Atlanta, Georgia (Cohort 2, $N = 23$). All individuals had a primary diagnosis of Reactive Attachment Disorder (ICD10: F94.1, F94.2; *DSM–IV–TR*: 313.89).

Results

Z-score analyses comparing each individual to an age-appropriate reference database showed a consistent group effect for relative power measures. There is significantly less relative delta power over frontal cortex in this population of children diagnosed with Reactive Attachment Disorder. In Cohort 1, the largest single deviation was for the F4-F8 sequential pair where the group average z score was -2.10 ($p < .05$). Frequency distributions confirm that these findings are not the result of a small number of extreme cases. Z-score deviations approach a normal distribution in this relatively small sample. The prediction that a comparable cohort of participants, with the same diagnosis, referred for clinical evaluation in a similar manner, and with data recorded and analyzed in an identical fashion would also show reduced frontal relative delta power was confirmed. In Cohort 2, the largest deviation was for relative delta power over the frontal regions (Fp2F4, $z = 1.69$, $p < .04$, one-tailed). Similar findings were seen with respect to effects of age and medication as in Cohort 1. Findings again were not correlated with age and were seen in the absence of medications.

Discussion

It should be emphasized that the relative power measures for different frequency bands are interdependent. Relative power is a proportion of each frequency band compared to the whole frequency spectrum, in this study defined as 1.5–25.0 Hz. This measure is sensitive to the shape of the frequency spectrum but not overall power or amplitude. It is notable that relative delta power was decreased but no other single band was increased. In addition, there were no significant effects for absolute power measures, or coherence and symmetry measures. A mild increase in mean delta frequency was observed in anterior leads. These results speak to the specificity of the findings.

Results document decreased relative delta power recorded over anterior cortex in a population of children diagnosed with Reactive Attachment Disorder. These changes represent aberrant neurophysiological activity and are largely independent of age and medications used. This suggests that medications are used largely to ameliorate symptoms associated with relative attachment disorder but do not appears to affect the persistent finding of low relative delta power anteriorly.

Further studies should be directed toward the specific psychological correlates of low frontal delta power. In addition, techniques such as EEG biofeedback could be employed to modulate phase relationships in the frontal EEG to modify effects of neglect and behavioral disturbances seen in reactive attachment disorder.

sLORETA and Independent Component Analysis of EEG in Obsessive-Compulsive Disorder: Implications for Neurofeedback Intervention

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Introduction

Despite of medical progress, there are still a high percentage of obsessive-compulsive patients not responding or not responding sufficiently to current treatment. Accumulating evidence indicates that obsessive-compulsive disorder (OCD) has a distinct biological background and is connected with dysfunctional fronto-striatal loops involving orbitofrontal and anterior cingulate cortex. It has been shown that the activity in deep cortical structures such as anterior cingulate can be modified through tomographic neurofeedback and possibly also through independent component neurofeedback. In OCD; however, source localization EEG studies that are necessary to guide a potential neurofeedback intervention targeting anterior cingulate or orbitofrontal cortex are missing.

Method

To fill the gap, we analyzed EEG of 50 OCD patients (20 drug free and 30 medicated with SSRIs) and 50 controls matched for age, sex, and handiness using standardized low-resolution electromagnetic tomography (sLORETA) and independent component analysis (ICA). Analyses were performed between 2 and 45 Hz with frequency resolution of 1 Hz. ICA was computed in the control group and resulting weights and norms were used to compare EEG of OCD patients. Symptom severity in the patient group was assessed using the Yale–Brown Obsessive-Compulsive Scale and Hamilton Anxiety Scale.

Results

sLORETA and ICA consistently showed an excess in power at low frequencies (2–6 Hz) localized primarily in the medial frontal cortex, including anterior cingulate and medial orbitofrontal cortex ($p < .05$, corrected). The only component abnormal in OCD compared with controls included signal also from insula (BA 13), superior temporal and parahippocampal gyri (BA

38), and lateral frontal cortex (BA 6, 8, 9). The pattern was present in drug-free as well as in SSRI medicated patients and was even more pronounced in medicated patients. Symptom severity was not related to the increased low-frequency power, however, the medicated group had higher compulsion score ($p = .04$).

Conclusions

Our results are consistent with previous findings of medial frontal hyperactivation and performance monitoring hypothesis in OCD. Performance monitoring in OCD has been linked with anterior cingulate hyperactivation and with an enhanced error-related negativity that arises from ongoing theta generated in the medial frontal cortex. Moreover, elevated theta activity in SSRI medicated group and a high percentage of SSRI nonresponders in our sample are congruent with previous reports of high theta power in OCD patients not responding to SSRIs. Our study is the first to apply sLORETA or ICA methods in OCD patients and has direct implications for neurofeedback intervention.

Acknowledgment

QEEG and Event Related Potentials Endopenotypes: Applications for Diagnosis, Neurofeedback and Transcranial Direct Current Stimulation

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Spontaneous resting state EEG and cortical potentials in response to tasks provide two relatively independent windows to the human brain functioning. The spontaneous EEG is assessed by conventional spectral (power vs. frequency, coherence vs. frequency). The EEG responses to tasks are assessed by ERPs (averaged potential vs. time). This presentation describes results of application of Independent Component Analysis (ICA) for (a) decomposing spontaneous EEG into spatially separated components associated with different types of oscillations (such as parietal, occipital and central alpha oscillations, frontal midline theta rhythm and beta activities) in the human brain, and for (b) decomposing ERPs into independent components associated with different psychological operations (such processing in dorsal and ventral visual streams, orienting response, engagement, motor suppression and monitoring operations). More than 1,000 healthy participants and more than 1,000 patients with different brain disorders (ADHD, dyslexia, depression, schizophrenia, OCD, stroke, and TBI) participated in the study. The results of application of the EEG/ERP ICA for diagnosis (discrimination) different brain dysfunctions are presented. In the final part of the paper I present a methodology for constructing protocols of neurofeedback and tDCS on the basis of comparison the individual QEEG/ERP parameters with normative data (HBI reference database). Recently developed methods of neurotherapy such as sLORETA, ERP-based neurofeedback, and local source tDCS are introduced.

More Words Than No: Two Cases of Juvenile Autism Treated with the LENS

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In this unique clinical comparison, two advanced clinical practitioners of the LENS from opposite sides of the country present two little girls: ZG and ES, both diagnosed as severely autistic, and with only one word each at the beginning of treatment: "No!!" Both were 4 years old at the beginning of treatment, ZG on multiple meds, diagnosed by conventional practitioners as hopelessly autistic, with very little hope for progress. A regional center challenged the legitimacy of the neurofeedback treatment, but the

treatment led to big and obvious improvements in school and an independent evaluation of remarkable progress. ES was an amazingly cute little ball of negativity observed by many professionals but whose parents refused drug treatments. Both were almost impossible to get to sit still for the sensors to be attached at the beginning. At the current stage of treatment each is far more functional and pliable, and has many more words than "No!" ES is beginning to speak in sentences and spell and read aloud as well as play interactively with other children.

These cases are dramatic because of the thoroughness in which their disorders—and their remediation is documented: multiple reports from therapists and teachers, multiple brain maps done over 2 years, and in the case of ZG, a record of e-mails marking progress from the little girl's mother, and with ES comments from professionals astonished at the big improvements the little girl showed, and wondering what possible method could produce them (the LENS seems to empower other therapeutic modalities such as OT and LT). There were also movie clips and images as well as maps—an unforgettable glimpse into the rescue of the Autistic child from solipsism and isolation.

QEEG Subtypes of Autistic Spectrum Disorder: Why are They Important?

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This presentation reviews the QEEG subtypes of Autism and Asperger's reported by other clinicians and based on 9 years of approximately 300 clinical case studies that were evaluated in our clinical practices and reviewed by Jack Johnson, PhD, Jay Gunkelman, QEEGT, and several neurologists. The cases were qualitatively evaluated for patterns in both EEG and QEEG measures. These observable patterns (subtypes) allowed the following benefits:

1. Clearer diagnoses and exploration of possible etiologies for Autism and Asperger's.
2. Rule out abnormal EEG and possible seizures.
3. Easier explanations of Autism (High Functioning) and Asperger's to parents, physicians, and educators.
4. Improved selection of neurofeedback protocols.
5. Increased ability to individualize and predict medication response.
6. Greater ability to monitor & measure the results of neurofeedback treatment.

Intensive Neurotherapy Facilitates Recovery from Severe Brain Injury and Seizures

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Introduction

Patients with severe brain injury and refractory seizures often have poor recovery. Intensive neurotherapy reinforcing sensory motor rhythm (SMR) may promote neuroplasticity in thalamo-cortical circuits, significantly improving outcome.

Method

A 29-year-old man had a severe traumatic brain injury after a motor vehicle accident 10 years ago. He had spastic quadriparesis, uncoordination, dysphasia, aphasia, and sleep disruption and refractory secondary generalized seizures with postictal impairment lasting up to 10 days. All previous therapies failed to improve his condition. Twenty-four-channel EEG recordings (NeuroNavigator) were analyzed using SKIL software. It showed excessive diffuse delta and theta ($+12$ z score) compared to healthy adults, with little SMR or alpha activity.

Daily neurotherapy aimed to progressively reinforce SMR in central regions and 8.6 to 10.6 Hz activity in other brain regions.

Therapy sessions continued to increase in length and complexity as he improved. He underwent three 30-day periods of neurotherapy with the same protocols, separated by 5 months each.

Results

After the first session his sleep integration increased from 2 hr to 8 hr per night. Seizures decreased in frequency, intensity, and duration without postictal impairment. Speech, swallowing, coordination, and motor control in trunk and extremities improved by at least 50% significantly increasing his abilities. Posttraining QEEG showed more normalized delta and theta ($+2$ z score), and SMR and alpha activity were present. Despite stopping neurotherapy for 5 months he continued to improve in all areas including seizure control, allowing him to be independent in his daily life. His posttraining QEEG revealed more SMR and alpha activity.

Conclusions

Intensive neurotherapy facilitated recovery from brain injury and seizures 10 years after injury and despite failure of other therapies. Neurophysiological and clinical changes were robust, durable, and self-regenerating. We believe that this intensive neurotherapy protocol normalized thalamocortical circuits by facilitating Long Term Potentiation (LTP). LTP increases neural protein synthesis, growth, and remodeling.

Efficacy of Neurofeedback as a Treatment for Children and Adolescents with a History of Early Relationship Trauma
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This study addresses the long-term efficacy of neurofeedback as a treatment for children and adolescents with a history of early relationship trauma. Pretreatment, posttreatment, and longitudinal data using the Vanderbilt Assessment Scale (child and adolescent version) has been collected. Initial assessment of the data indicates 80% of clients do not meet diagnostic criteria for attention deficit disorder, oppositional defiant disorder, or depression/anxiety at the end of treatment. Longitudinal data, collected 6 months to 3 years following termination of treatment, indicates that 80% of clients continue to maintain behavioral gains. Data collection is ongoing at this time and a complete statistical analysis will be made available at a later date.

Attention Deficit Hyperactivity Disorder: The New Approach in Diagnostics with Neuropsychological and Electrophysiological Endophenotypes
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ADHD is one of the most prevalent dysfunctions in children and increasingly in adults. ADHD people poorly perform in school and in work, have a low self-esteem, have deficient social skills, and are at high risk for drug abuse. Until recently, the only diagnostic criteria for ADHD were behavioral symptoms, and the only officially accepted medicine was stimulant treatment. With newcriteria from the *Diagnostic and Statistical Manual of Mental Disorders* (5th ed.), diagnoses have to be done on the base of endophenotypes.

The brain and trauma foundation in Switzerland performed a large study in ADHD in adults. Behavioral, neuropsychological, and neurophysiological data of the whole sample (178 participants) is analyzed and is compared with a control group (same size).

Multidimensional analyses of the data set show very surprising results. The prominent biomarkers, which we used before (e.g., Theta/beta ratio, spectra) are not longer valid and have to be redefined. The view of the working brain, measured with ERPs, shows much better results. We propose a new method of diagnoses ADHD based on ICA ERP-components in a multidimensional space. The space is defined by several dynamics of neurobiology. This brings the diagnose close to an effective treatment.

The oral presentation shows the results of the adults ADHD study. We demonstrate that ERPs of executive system taken in visual, auditory, and emotional continuous performance GO/NOGO tasks give significant results between ADHD and controls. Furthermore we discuss which elements of the diagnosis (questionnaires, interview, neuropsychological testing, QEEG/ERPs) are helpful for treatment.

EEG Suppression: A Theoretical/Clinical Talk on an Important New Variable in Neurofeedback and Neuroscience

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This presentation introduces a new concept of EEG suppression that differs from its appearance in the neurology/anesthesia literature. This definition of EEG suppression shows the importance of standard deviation and amplitude reductions in the EEG, how to assess them, and how this can help the clients in neurofeedback. The presentation covers its definition, early signs of its significance, its calculation as the coefficient of variation, its interaction with EEG amplitudes, and its influence on the recovery of human functioning. The ability to predict the course of EEG amplitude fluctuations has ramifications for evaluating the success in neurofeedback and understanding the making and breaking of connectivity. It also has ramifications for providing clients with a context for the changes in their EEGs. The presentation is supported by case histories accompanied by EEG topographic map series as well as charts showing changes in symptom ratings. Attendees are shown how to make their own suppression reports if the appropriate data are present in their neurofeedback systems. Implications for research are addressed.

Improving Decision Making with Noninvasive Brain Stimulation

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In recent years, dual-process theories that contrast automated and controlled processes have been put forward to explain different areas of human cognition. In this context, will-power refers to goal-driven cognitive control or regulation of impulses, passions, cravings, and habits. Such regulation may be conceptualized as cognitive control over the balance between a "cool," reflective mental system that effortfully represents rational and reasoned goals, such as long-term mental and physical health, and a "hot," reflexic mental system that automatically guides quick, impulsive, and emotional responses to environmental stimuli.

In recent years, lesion and functional neuroimaging studies suggest that the prefrontal cortex is a critical component of the neural circuitry engaged when people voluntarily and consciously regulate their behavior. In addition to neuroimaging studies, lesion studies suggest that particularly the right prefrontal cortex plays a central role in behavioral regulation and the control of impulsive, reflexic tendencies.

Modulation of will-power and dual-process theories offers a valuable framework that can serve to guide translational insights from cognitive neuroscience into the clinic. Proof-of-principle studies reveal that noninvasive brain stimulation of the dorsolateral prefrontal cortex with repetitive transcranial magnetic stimulation or transcranial direct current stimulation can influence decision making, enhance will-power, and promote reflective processes in healthy subjects. The same type of noninvasive brain stimulation can suppress alcohol, cocaine, nicotine, and even food craving in patients, who are known to have impaired decision-making behaviors. Modulation of decision making, and enhanced cognitive regulation of emotion, reward, and gratification, could have widespread mental and physical health benefits, including effective therapies for mood disorders, anxiety, ADHD, PTSD, substance abuse, smoking, and obesity.

EEG Source Localization of Object Processing

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Introduction

This study investigated the neurophysiology of object processing in a population of normal university students. We utilized standardized low-resolution electromagnetic tomography (sLORETA) to map sources of the EEG recorded at the scalp.

Methods

We obtained 100 students (60 female) with a mean age of 21. EEG data were recorded for 4 min while participants viewed an image of a hammer. We performed EEG source localization using sLORETA. We compared the image condition to baseline using all voxel by voxel *t* tests. Significant voxels of difference were mapped onto an MNI atlas containing 6,329, 5 mm voxels. The phenomenology of the recording was obtained at the end of the EEG recordings.

Results

The contrasts between baseline and object processing show specific differences in regions in the left hemisphere in delta, theta and alpha frequency domains, wheras alpha and beta activity show significant increase in right anterior cingulate (BA 24) and prefrontal regions in addition to right parietotemporal areas.

Discussion

The left hemisphere appears to play an important role in object processing. The increase is related to the evaluation, categorization, and experiential memories utilized while focusing on the image. The right anterior regions may also play a role in the identification of the object but may also be important to the meaning of the object and its known function in social and intrapersonal contexts. The subjective reports of mental processes and experiences of the participants offer evidence for the patterns of significant increase in these regions.

Incremental Gains in Self-Regulation Skills: Comparison After 20 and 40 Sessions of Neurofeedback
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Introduction

EEG biofeedback practitioners around the world have been publishing studies on the effectiveness of neurofeedback training on ADHD. This research has demonstrated that neurofeedback is an efficacious treatment for ADHD, but it has not clarified the number of neurofeedback training sessions that lead to optimal gains. Some practitioners have examined results after 20 sessions of feedback, whereas others have presented results following 40 sessions of training. This pilot project proposes to fill this void by analyzing the effect of the number of sessions of neurofeedback on attention, EEG, and short-term memory (digit span). This study will compare client scores on these measures before neurofeedback training, after 20 sessions, and after 40 sessions of training.

Method

Clients range from age 6 to adult, and all met the criteria for diagnosis of ADHD or Asperger's Syndrome according to the *Diagnostic and Statistical Manual of Mental Disorders* (5th ed.). All clients will have been tested using the Integrated Auditory and Visual Continuous performance test (IVA) at their initial assessment, after 20 sessions of training and after 40 sessions of training. A subset of clients will also have data on EEG changes, Weschler Intelligence Scale IV digit span subtest data and questionnaire data post-20 sessions and post-40 sessions of

training. There will be a minimum of 20 participants in this study. Training sessions are 50 min, and most clients attend twice a week. Training parameters are based on an initial assessment of EEG performed by Dr. Lynda Thompson. Most clients already in the study have been doing training at either Cz or C4 reference to the left ear. The aim for the majority of clients is to decrease slow wave activity (3–7 Hz, 4–8 Hz, or 3–10 Hz), increase sensorimotor rhythm (12–15 Hz or 13–15 Hz) while decreasing any high frequency beta or spindling beta (23–35 Hz). EEG biofeedback training sessions are also combined with meta-cognitive strategies.

Results

This study is not yet completed. Results will include the IVA, questionnaire data (Conners' Global Index for ADHD, ADD Centre's ADDQ, and DSMIV questionnaire for ADHD), and EEG. EEG ratios include theta/beta and theta/SMR ratios.

Conclusions

This design will be implemented and findings may be reported at a future conference.

Neuroplastic Effects of Endogenously Entrained Brain Rhythms: A TMS-EEG Study

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Introduction

We investigated whether a 30-min session of EEG neurofeedback (NFB) at left motor cortex of 24 naive participants modified corticomotor plasticity.

Methods

Effects on corticospinal excitability as well as short intracortical inhibition and facilitation of either alpha (8–12 Hz) suppression or low beta (12–15 Hz) enhancement NFB were assessed by single-pulse and paired-pulse transcranial magnetic stimulation applied to right and left hemisphere motor cortex. Immediately before and twice after the NFB session, the motor evoked potential and intracortical parameters were measured.

Results

Net corticospinal excitability of the left hemisphere was significantly increased more than 20 min after the end of alpha suppression (desynchronization), as reflected in the average magnitude of the motor evoked potential (MEP; 130% of baseline), together with a significant reduction of short intracortical inhibition (165% of baseline). Of importance, MEP change was inversely correlated with percentage of alpha amplitude change during NFB ($r > -0.5$, $p < .05$), as well as with the ratio of pre-to-post alpha baseline at rest. Following low beta NFB training there was a significant enhancement of intracortical facilitation, without reliable main effects in MEP amplitude, both seemingly a result of uneven entrainment. Nevertheless a significant negative correlation was observed between the magnitude of low beta synchronisation and single-pulse MEP change ($r > -0.5$, $p < .05$). In contrast, no statistically significant alterations in TMS parameters were seen in the untrained (right) hemisphere for either protocol.

Conclusions

Prolonged desynchronization of endogenous alpha rhythm, generally regarded as an indicator of cortical activation, is associated with potentiation of corticospinal excitability and reduced intracortical inhibition, whereas synchronized low beta rhythms, albeit suboptimally entrained, correlate with reductions in corticospinal excitability. The current study provides the first evidence for the "missing link" between the historically reported but inadequately recognized effects of cumulative neurofeedback training and

direct validation of LTP-like neuroplastic change following a discrete training session. It furthermore supports an explicit and endogenous role for brain oscillations in the mediation of synaptic plasticity.

Note

This presentation won the Student Paper Award.

The Complex Trial Protocol in Detection of Deception and Malingering
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Introduction

The P300 event-related EEG potential (ERP) is an endogenous ERP, evoked by meaningful stimuli presented rarely in a sequence of meaningful and non-meaningful items. Rosenfeld et al. (1991); Rosenfeld, Angell, Johnson, and Qian (1988); and Farwell and Donchin (1991) developed a "3-stimulus protocol" (3SP) for using P300 to detect deception and malingering.

Methods

In this protocol, on each trial, either a probe (P), a target (T), or an irrelevant (I) item was presented. Ps and Ts each had a probability of about .15, and Is had a probability of .7. Ps were guilty knowledge items such as the amount of money stolen in a crime, such as $500. Is and Ts were irrelevant to the crime but in the same category as Ps (e.g., other amounts of money such as $100, $200, $1000, $2000, $5,000). One of the Is was a designated T, say, $200. It was incorrect but suspects were told to say "yes" when shown this T. They said "no" to all other amounts, including $500, the P, thus lying. The items were presented randomly, and it was expected that P would elicit a P300 because it was rare and meaningful. Is would not. Ts would because they elicited the unique "yes" response that made them

meaningful as well as rare; however, the whole point of T was to force attention to all randomly presented stimuli. The test of guilty was guilty knowledge recognition, as provided by the fact that the P300 to the P would be greater than that to the I.

Results and Conclusions

This 3SP was used successfully in dozens of reports to detect malingering by head injury simulators as well as deception and guilty knowledge possession by lab-simulated criminals—until we finally successfully attempted to defeat it with countermeasures (CMs) in 2004, as replicated by Mertens and Allen (2008). It was thus necessary to come up with a new P300-based CM-resistant protocol, which we introduced in 2008. We hypothesized that the older 3SP was vulnerable to CMs because on each trial the subject was forced to do two simultaneous tasks that competed for attentional resources: the explicit target versus nontarget (NT) discrimination, plus the probe recognition task. The increased task demand produced by dual tasking is known to reduce P300. Thus Rosenfeld et al. (2008) separated the P-I recognition task in time from the T-NT discrimination. This modification allowed 90 to 100% accuracy in detection of guilty participants—whether or not they used CMs—with 0 to 8% false positives. This protocol has now also been used in malingering related protocols with detection of concealed autobiographical information detection, as well as in mock crime scenarios with detection of concealed crime detail information. Most recently, we have developed an antiterror scenario in which we can detect planned details of terrorists acts while in the planning stage and before the acts have been committed. We can even do this when we do not know in advance what the correct answers are.

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Integrating Cognitive Rehabilitation and Neurofeedback: A Review of the Research

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The clinical efficacy and effectiveness of cognitive rehabilitation has been recognized and accepted by the general scientific community based on numerous controlled research studies. Neurofeedback training has often been implemented simultaneously with educational and learning skill tasks. This cognitive-educational training methodology constitutes a "push–pull" technique that fosters both the generalization of neurofeedback and the development of divided attention. The application of specific computerized attention training exercises in conjunction with neurofeedback has been shown to significantly improve attentional functioning for both mTBI and adult ADHD populations in only 20 training sessions. In addition, cognitive training provides an ethically appropriate control treatment for neurofeedback research. These studies and additional research incorporating meta-cognition training in identifying effective means for the integration of cognitive rehabilitation and neurofeedback are reviewed in this paper.

Brain Oscillatory Correlates of Visual Attention and Short-Term Memory

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As we are continuously bombarded with visual information, we have to select relevant from irrelevant visual input. Based on a recent hypothesis on the functional meaning of electroencephalographic (EEG) alpha activity, local 10-Hz oscillations are discussed as a correlate of efficient suppression of irrelevant visual information. It is demonstrated that local alpha activity is increased at posterior brain sites during processing of irrelevant visual input in visuospatial attention tasks as well as during short-term memory retention. Thereby, cognitive processing of relevant information will be increased in efficiency, a mechanism that can be supported (as prove of principle) by repetitive transcranial magnetic stimulation (rTMS). In addition, evidence is presented indicating interregional alpha activity to be relevant for the control of visual attention and selection mechanisms. Finally, the role of theta activity (around 5 Hz) during processing of relevant information in visual short-term memory tasks is discussed. Data are presented suggesting theta to be important for encoding of relevant information into short-term memory and indicating phase synchronization between theta and fast oscillations to be a correlate of short-term memory retention of relevant information.

Effects of Neurofeedback-Based Behavioral Therapy on ERP Measures of Executive Functions in Drug Abuse

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Introduction

Neurofeedback training integrated with other behavioral techniques could be one of the potentially efficacious intervention options for cocaine addiction treatment. Our study combined SMR neurofeedback treatment with motivation enhancement therapy for the treatment of outpatients with cocaine addiction. EEG changes in beta and theta power are typical for withdrawal

from cocaine. Executive prefrontal functional deficits have been reported for both active users and recovering addicts. We proposed that cocaine abusers may benefit from SMR and SMR/Theta neurofeedback protocol. Motivational interviewing techniques were employed to engage outpatient subjects in neurofeedback and retain them during 12-session-long neurofeedback training course. Cognitive test based on Eriksen flanker task with dense-array event-related potential (ERP) recording was used to assess intervention effects on such executive functions as cortical inhibition, motor response conflict detection, and error monitoring along with more traditional clinical outcome measures. We report immediate post-treatment effects in 14 subjects and 6 months follow-up effects in 11 subjects.

Method

ERPs were acquired with a 128 channel Electrical Geodesics Inc Net Station EEG device prior and following 4 week long bio-behavioral intervention using a speeded forced-choice reaction time task (Eriksen flanker tests) with NoGo trials. Follow-up test was conducted after 6 months. Beside behavioral and ERP measures during flanker test, the treatment outcomes included cocaine and marijuana use rate (urine and saliva screens), maintaining treatment retention, and psychiatric status (PTSD, depression). From 20 outpatient participants with cocaine addiction initially enrolled in the study, 14 participants completed whole course of neurofeedback, motivational interviewing sessions, and pre- and posttreatment ERP tests and clinical evaluations. Only 11 of them were available for 6-month follow-up tests and evaluations. Most participants tested positive both on cocaine and marijuana use on the intake stage. Each of these SUD participant participated in 12 sessions of SMR up/Theta down training (30 min, twice a week) and up to 3 sessions of MI. The neurofeedback session included two blocks with "SMR increase" and single blocks of "SMR increase and Theta decrease" and "SMR/Theta" ratio increase.

Results

Most of the participants successfully learned to increase SMR rhythm (mean increase per session $= 11\%$) at C3 site but were less successful in simultaneous SMR-up/Theta-down blocks. Participants who completed whole course of combined neurofeedback and MI intervention showed improvement on behavioral and ERP measures of executive functions in posttreatment flanker test. Frontal N200 latency indicative of motor interference detection functionality increased from 289 to 319 msec, whereas frontocentral P300 amplitude indexing cortical inhibition function in NoGo trials increased from 1.39 to 3.4 V ($p < .05$). Frontal P300 latency in Go trials also increased from 371 to 431 msec. Error-Related negativity (ERN) amplitude at the fronto-central area increased from -2.52 to -4.99 V, pointing at an enhanced error monitoring functionality in the posttreatment period. Follow-up flanker test showed that positive changes in frontal N200 and P300 components were still maintained, whereas the ERN measure did not show significant difference from the intake level. Among the clinical outcome measures the most significant was a decrease of depression scores (BDI–II, $p = .01$) and a decrease of PTSD scores ($p = .02$). Depression scores on follow-up remained lower than at the pretreatment level (pre, 25.8; post, 14.7; follow-up, 12.5, follow-up vs. pretreatment, $p < .05$). The drug screens did not show significant decrease in cocaine use posttreatment; however, number of positive tests for marijuana use decreased significantly (post- vs. pre-NFB urine drug screens: cocaine use, nonsignificantly decreased by 14%, $p = .16$, marijuana use rate decreased by 71%, $p < .01$). Lower rate of marijuana use was confirmed at follow-up tests. Cocaine use rate at follow-up assessment was lower than at intake but still did not reach significance level.

Conclusions

The results of this pilot study support our suggestion that a combination of motivational interviewing with neurofeedback

might be a promising approach to biobehavioral intervention for addictive disorders, and specifically for treatment of cocaine addiction co-occurring with marijuana use in outpatient population. The project showed feasibility of such biobehavioral intervention in both active users and recovering outpatient cocaine addicts. Application of cognitive neuroscience techniques in a form of cognitive ERPs to test executive functions can significantly improve methodology of posttreatment assessment of cognitive and electrocortical outcomes of neurotherapy.

The Effects of Different Breakfasts on a Child: A Data Analysis of Three QEEGs

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Introduction

Many U.S. children have very poor eating habits, which have greatly contributed to a rise in their obesity and diabetes rates. In addition, studies suggest poor nutrition diminishes mental functioning and exacerbates mental and behavioral disorders. Nutritional scientific investigation has run the gamete of study from malnutrition through a multitude of dietetic combinations. These studies have measured a variety of mental functioning including IQ, cognitive abilities, processing speed, and memory. Decades of research suggest that optimal brain functioning is proportional to a well-balanced nutritional diet that minimizes glycemic swings with calories adjusted to level of activity and metabolism of each individual. In a search of the literature, John Polich studied the effects of intake on event related potentials. However, no investigation has assessed the effect of intake on QEEG data. The goal of this study is identify any statistical differences in QEEG data under three typical breakfast choices of children: (a) no food for breakfast, (b) a breakfast made up of high sugars and high carbohydrates, and (c) a nutritionally balanced breakfast.

Methods

The participant in this study was a 12-year-old healthy female volunteer who came to me with a desire to do a brainwave study for her school's science fair. The variables that were controlled were time of day, intake after breakfast, and sleep. Each qEEG was done on the same participant, at noon on three different school days after the participant sleep approximately the same amount of hours with the participants' eyes closed. The rationale for doing the qEEGs at noon prior to lunch was to assess the expected differences in the qEEG data due to hypoglycemia from not eating breakfast and from the insulin response to a high sugar, high carbohydrate breakfast.

The three EEGs were recorded (Deymed Diagnostic, TruScan 32) from 19 scalp locations. The first qEEG was done after the participant skipped breakfast altogether. The second qEEG was done after eating a breakfast consisting of a Pop-Tart and a glass of orange juice. The third qEEG was done after she eating a nutritionally balanced breakfast consisting of a glass of milk; a half slice of whole wheat toast; two eggs; one half cup of a combination of strawberries, bananas, and apples; and one fourth cup of tomatoes.

Results

The results were extrapolated from the qEEG statistical data of relative power in the eyes closed condition from all three qEEGs. The most significant differences were found in the participant's anterior lobes (F7, F3, FZ, F4, F8, C3, CZ, C4) in 26–30 Hz.

Conclusions

The 26 to 30-Hz high beta activity are correlated with irritability and anxiety and this activity in the anterior lobes would affect brain functions such as executive function, working memory, motor control, and so forth. This pilot study suggests that at least for this 12-year-old female participant,

eating no breakfast greatly increases her high beta activity especially in her anterior lobes. When she eats a breakfast consisting of high sugar, high carbohydrates, her high beta activity is somewhat diminished but is still significant. Finally, when she eats a nutritionally balanced breakfast, her high beta activity comes very close to normalizing. The direction of future investigation should study larger numbers of children both with and without psychopathology and learning issues. It would also be interesting to track how changes toward nutritionally balanced diets affect scholastic achievement.

Autism and EEG Phase Reset: A Unified Theory of Deficient GABA Mediated Inhibition in Thalamo-Cortical Connections

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Introduction

The purpose of this study was to explore the relationship between EEG phase reset in autistic spectrum disorder (ASD) participants as compared to age-matched normal participants.

Methods

The electroencephalogram (EEG) was recorded from 19 scalp locations from 54 autistic participants and 241 normal participants ranging in age from 2.6 years to 11 years. Complex demodulation was used to compute instantaneous phase differences between all pairs of electrodes and the first and second derivatives were used to measure phase reset by phase shift duration and phase lock duration.

Results

In both short (6 cm) and long (21–24 cm) interelectrode distances phase shift duration in ASD participants was significantly

shorter in all frequency bands but especially in the alpha-1 frequency band (8–10 Hz; $p < .0001$). Phase lock duration was significantly longer in the alpha-2 frequency band (10–12 Hz) in ASD participants ($p < .0001$). An anatomical gradient was present with the occipital-parietal regions the most significant.

Conclusions

The findings in this study support the hypothesis that neural resource recruitment occurs in the lower frequency bands and especially the alpha-1 frequency band, whereas neural resource allocation occurs in the alpha-2 frequency band. The results are consistent with a general GABA inhibitory neurotransmitter deficiency resulting in reduced number and/or strength of thalamo-cortical connections in autistic participants.

Multi-Channel *Z*-Score EEG Biofeedback: Laplacian, Average Reference, Phase Reset, and Discriminant Functions

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Currently, there are no 19-channel *Z*-score biofeedback capabilities. One advantage of age-matched 19 or more channels of *Z*-score biofeedback is the real-time biofeedback of Laplacian and average reference *Z* scores as well as discriminant functions and phase reset. The purpose of this presentation is to show the methods and steps involved in overcoming technical and scientific challenges. One challenge was to minimize time delays using a large array of channels. A second challenge was organizing the thousands of possible EEG features that arise from 19 channels or more. Adequate speed of processing and display is accomplished by the use of the real-time Hilbert transform implemented as Complex Demodulation. The selection and organization of *Z*-score biofeedback is accomplished using a symptom check list that generates hypotheses and links to specific surface scalp regions according to the

scientific literature. Clinicians can veto the symptom check list links and create their own selections of EEG features. The ability to inhibit and reinforce specific EEG features at specific locations is accomplished by the use of the real-time Z-scores themselves as the goal is to reinforce movement of the EEG measures toward $Z = 0$. This allows for simultaneous inhibition and reinforcement. Another method to minimize the large universe of possible EEG features is to link the Z scores derived from a quantitative EEG analysis to the patient symptom check list and further refine hypotheses that best match the patient's symptoms and complaints. The step-by-step mathematical details and computational details are presented and the results of 19-channel Z-score EEG biofeedback on a selected group of patients are presented.

QEEG-Guided Neurofeedback for Remediation of Migraine Headaches

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Seventy-one patients with recurrent migraine headaches in a neurological practice were evaluated with a quantitative EEG (QEEG). Forty-six of them elected to do neurofeedback training to remediate their headaches. Each patient had five 30-min sessions of neurofeedback. Twenty-five of them (54%) experienced cessation of their headaches for a period of 1 year or longer. Another 18 patients experienced a 50% or greater reduction in headache frequency over the following year. Two patients (4%) experienced a reduction in frequency, but less than 50%. One patient did not improve. None experienced an increased frequency. In comparison, of the 25 patients who elected not to do neurofeedback, all continued to have frequent migraine headaches (greater than or equal to three per month). Seventeen (68%) maintained a similar frequency over 1 year's time. Six experienced a reduction in frequency less than 50%, and 2 experienced a greater than 50% decrease in frequency.

The only abnormalities on QEEG that significantly correlated with recurrent migraine were excesses of high frequency beta (21–30 Hz). All sites with excessive high frequency beta were down-trained for five sessions each. The effective sites included P3(16), P4(13), FP2(8) PZ(7), CZ(7), FZ(6), FP1(6), C3(6), F4(5), C4(5), T3(4), T4(3), F8(3), O1(2), F7(2), and OZ(1). The patient who did not improve had down-training of excessive 21–30 Hz at F8 and O1.

PANELS

Neurophysiology of Self: Constructs, Optimism, Gender Differences and Hypercriticality

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Introduction

The self is a topic of considerable interest to researchers and psychologists alike. Current neuroimaging techniques have utilized self-recognition tasks to evaluate this phenomenon. It is unlikely that self-recognition alone constitutes fundamental components involved in the processing and evaluation of self. This study investigates neurophysiological components involved in processing of self utilizing quantitative electroencephalography (qEEG) and standardized low-resolution electromagnetic tomography (sLORETA).

Methods

This study was conducted with 100 nonclinical university students. Four assessment instruments were completed while EEG was continuously recorded and item responses were marked within the EEG record. These were extrapolated and compared for significance. We utilized the Self Perception and Experiential Schemata Assessment, the Brief Symptom Inventory (BSI-18), the Tennessee Self Concept Scale

(TSCS), and the Life Orientation Test in addition to three photograph conditions. Participants were recorded while viewing an image of a hammer, a picture of a novel female face, and a picture of self. Subjective reports were obtained for the image conditions and evaluated by three independent raters as positive of negative in content. Cortisol measures were obtained pre- and post-EEG sessions and correlated to assessments and sLORETA maps.

Results

Item analysis of the assessment responses indicated the female participants report more instances of sexual abuse and tend to rate self and self-in-experience more negatively on select scales than male participants. The participants show no differences in optimism, depression, or anxiety scales on the BSI. The TSCS shows five significant differences between genders. The sLORETA maps show each of these instruments involves different cortical regions in each frequency domain. The female participants rate the image of self more negatively than male participants at significant levels; this pattern of negativism toward self increases alpha/beta activity in the right insular cortex.

Conclusions

Female participants rate the image of self significantly more negative than male participants. This evaluative process involves regions in the right insular cortex and left parietal lobe. As a group, each of the constructs measured by the instruments appears to involve specific neural networks in specific frequency domains. Overall, female and male participants appear to process self-referential-information utilizing different neural mechanisms. Cortisol differences are perceptible to increase with the stimuli evoking the greater degree of negative emotion (internal stress inducing) mechanisms, with the evaluation of self and image of self creating the greatest negative processes.

Electroencephalograph in the Default Mode of Brain Function

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Introduction

Recent research exploring cortical functional connectivity defines a default network (DNt) of brain function. The DNt is a set of dynamically coupled brain regions that are more active at rest than during cognitively demanding tasks. Structural cores are proposed to share associative properties of centrality such that they comprise connections between all major structural components. The posterior cingulate and parietal regions are proposed to play an important role in this structural core, in association with medial frontal and temporal regions. The electroencephalographic activity in these components of the human default network has not been examined in detail. This study aimed to examine frequency specific activity within and between 12 DNt regions of interest in both resting-state and active tasks.

Methods

This study was conducted with 70 non-clinical participants—40 female and 30 male with a mean age of 20. The participants were recorded during eyes-closed (ECB) and eyes-opened (EOB) baselines and active task (AT) conditions (language and image processing). We estimated EEG source localization with standardized low resolution electromagnetic tomography (sLORETA) in 12 of the 13 regions of interest used by other default mode studies. We extrapolated current source density from each of the ROIs and the nearest neighboring voxel. We contrasted ECB with EOB and EOB with AT for each frequency domain in each ROI. We utilized partial and bivariate source functional connectivity procedures to examine the relationship between the ROIs in each frequency domain. The participants also provided written reports of the mental processes and

experiences during baseline recordings. There were coded by three independent raters for content.

Results

The ECB resting condition shows higher activity in delta and theta frequencies for all ROI. Contrarily, alpha 1, alpha 2, and beta show the effect in some but not all of the ROIs. Likewise, the active tasks show differential effects for increased activity as compared to EOB for each ROI in each frequency domain. The inter-rater reliability for the subjective reports shows Cohen's Kappa of .83. Functional connectivity between regions is also influenced by specificity of task.

Conclusions

Data are in agreement with other neuroimaging techniques (fMRI/PET) investigating the default mode of brain function and further shows that the three-dimensional localization accuracy of LORETA EEG is sufficient for the study of the DNt. In examining both within and between functional core regions there is a higher degree of activity in lower frequency bands during eyes closed; however, this pattern does not extend to all ROIs in the higher frequencies. We conclude that this difference represents functional connectivity relating to endogenous/ exogenous attention states as opposed to the simple concept of "resting" or "nonactivity." Further study of the functional relationships between EEG frequencies within and between the default core of the cortex may prove important to understanding the complex nature of functional integration.

Qualitative Observations of Four Traumatic Brain and Acquired Brain Injury Case Studies Using LENS: A Preliminary Report
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Traumatic brain injuries (TBIs) are a major public health problem resulting in more than 1.5 million injuries each year in the United States. They are caused by a blow to the head or a penetrating injury occurring outside the body. The Centers for Disease Control and Prevention estimate that 5.3 million people in the United States have a TBI that causes them to need help with activities of daily living either long term or for life. An acquired brain injury is an event occurring within the body such as a stroke or sudden cardiac arrest (SCA).

The first case is a 72-year-old woman with an ABI due to Sudden Cardiac Arrest arriving at the hospital 10 minutes after event with no pulse or respirations. When first seen by therapist 4 months postevent, she was nonverbal, was nonresponsive to verbal cues, was in a wheelchair, had no swallow reflex, and was incontinent in bowel and bladder. After treatment, she is verbal, able to swallow, able to eat beans and cornbread, and can walk with support. A 5-min video documenting her progress is presented.

The second case is a 19-year-old man with an ABI due to inhaling Ritalin as well as alcohol intoxication resulting in problems of motor planning, expressive and receptive speech difficulties, flat affect, headaches, sleep, and riding in the car. He had dramatic reduction in symptoms after first session. After treatment, he was able to return to college and graduate in May 2009.

The third case is a 23-year-old man 3 years' post-TBI from motor vehicle crash resulting in skull crushed in two places and $3\frac{1}{2}$ months in a coma. Presenting symptoms were very significant balance issues preventing him from walking without a walker and nystagmus of right visual field. Nystagmus was almost eliminated after first LENS session. After the fifth session he was able to walk across the room without assistance. A video documenting these changes is presented.

The fourth case is a 61-year-old woman with multiple TBIs as well as ABI from environmental toxins with issues of migraine headaches, chronic pain, balance, inability to sleep, mental degeneration, and

inability to work or maintain friends. After treatment, she had a part-time job, no longer needed medication to sleep, and had an increase in strength, stamina, and balance.

All cases were evaluated with a LENS map and treated according to the site sort. The specific protocols and decision-making processes are discussed.

Adjunct Therapies to Neurofeedback: Significant Results Obtained by National and International Clinicians

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Dr. Roxana Vasiliu discusses that the use of adjunct therapies (pROSHI, Alpha-Stim, and LENS) associated with neurofeedback accelerated the recovery of a young adult with multiple addictions, depression, ADHD, and borderline personality. Lynda Kirk presents results obtained in her clinic combining pROSHI, AlphaStim, and multimodal BF that enhanced neurotherapy and speeded up the progress of many difficult clinical cases, including CVA (stroke), PTSD, and age-related cognitive decline. Dr. Stephen Overcash, who has been working with traumatized (physically and emotionally, PTSD) policemen clients, compares the relaxation and antistress effects of the pROSHI versus the Alpha-Stim. He divided the clients into two groups of 10 and treated them for 8 to 12 weeks with Enhanced, by the adjunct devices, Biofeedback sessions. The results obtained were statistically analyzed and are discussed.

Dr. Joe Kamiya on Neurofeedback, Biofeedback, and First-Person Science

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This presentation proposes a long-range program of research on the relationship of human subjective experience to its physiological and environmental concomitants. Subjective experience has been a long-debated topic, and attempts to rule it out of bounds of scientific inquiry have not been totally successful. The history of modern psychology started in the late 19th century as the study of consciousness, with trained introspection as the method of observation and the verbal reports of the results being the data.

Among the reasons for the failure of the approach was disagreement among different observers in the verbal reports of their introspections, presumably of the same object of observation. However, the process of introspection itself, apart from the reporting thereof, is the observing of events internal to the observer. Dreams, imagery, pains, hopes, thoughts, and feelings are still present, for all their privacy, waiting to be comprehended more adequately in a framework of all scientific knowledge. Because the activity being observed is private to the observer, we refer to this as first-person observation, and when reported verbally is commonly termed subjective report, and sometimes nonfalsifiable. This contrasts with the third-person reporting of observation of events external to the observer, where the reports of the observations can be publicly verified. Such reports are called objective, sometimes falsifiable.

Stoyva and I have pointed out that the temporal correlates of such private events with publicly observable events (both physiological processes of the observer himself as well as events of his external environment) are an important tool for consciousness studies. The logic is that when there is covariation over time between the occurrence of a private event (such as dreaming as indicated by verbal report upon being awakened and the presence of eye movements and EEG stage changes prior to the awakening), the convergence of the two observables provides increased confidence that dreaming did occur as suggested by the report.

That physiological events can thus be at least partial indicators of subjective experience underlies several avenues of research. One, exemplified by current work of Richard

Davidson and associates, shows that the magnetic resonance images of the brains of meditators is related to their activity of meditation. Thus the ancient human activity of deploying attention in specific ways as reported by the meditators is at least partially indexed by a physiological marker, thus making possible studies of the specific brain processes underlying the first-person experiences of these participants. Another approach is one I reported on in 1968 to train participants by operant discrimination procedures to identify moments, each time I rang a single ding of a bell, when occipital EEG alpha activity was dominant, versus moments when it was absent, by a simple dichotomous verbal response (A for alpha dominance, B for its absence). Successful discrimination was achieved by most participants, permitting inquiry of the participants as to the subjective differences between the two EEG states. Despite considerable individual differences in some of the verbal reports there was a tendency toward common verbal characterizations of the differences, suggesting that the subjective experiences themselves of most persons may have common correlates in brain activity.

To reduce the noise to be found in everyday language reports of subjective experience, it is proposed first that extensive discrimination training and feedback training be used on a selected variety of physiological measures, so as to increase the sensitivity of the individual to the "feel" of discriminating and/or controlling each of, say, 20 measures. Then, from each participant are obtained paired comparison ratings of the degree of subjective similarity (on a 5-point scale, say) of each measure to every other measure. This will result in a matrix to which principal components analysis can be done to specify the independent dimensions of the total subjective space associated with the measures. Thus, for example, the feel of EEG alpha at the central leads might be specified as occupying a specific spot in the derived multidimensional space. Verbal labels can be applied to the dimensions later, with the risk of introducing cultural biases in word usage. But to the extent that the maps derived from all participants are similar to each other,

there will be a basis for improved verbal agreements about the subjective qualities.

The method would significantly increase the precision of mapping the subjective judgments of physiological measures. Of course, the representativeness to real life of the measures selected for training will be crucial, and this will emerge only after very extensive multimeasure research in basic psychophysiology of everyday life, particularly that involving interpersonal interactions.

PowerPoint slides are used to illustrate the power of dimensional analysis of a matrix of subjective ratings of paired comparisons. As an example, a map of different food tastes is presented, dimensionalized along sweet, sour, bitter, and salty (which rather well account for all food tastes). It would show where, for example, apples, sweet pickles, raw cucumbers, and beef would likely appear as projections along the axes of the multidimensional space.

ERPs Endopenotypes in Diagnosis and Therapy of Brain Disorders

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During the last few years a new approach for assessment brain functions and dysfunctions was developed in our laboratory. This approach is based on two suggestions: (a) Information processing in the brain is characterized by event related potentials (ERPs) recorded in humans during various cognitive tasks, and (b) the ERPs represent a sum of neuronal activities associated with different psychological operations. To separate these neuronal activities an Independent Component Analysis (ICA) was applied to a collection of ERPs recorded in a large group of healthy individuals who participated in five psychological tests, such as auditory tests; three stimulus tasks; two stimulus GO/NOGO tasks; and mathematical, reading, and auditory tasks. Using the ICA method, a set of independent components was estimated for all task conditions. Each component was characterized by time dynamics

and cortical topography and was associated with a certain psychological operation. Spatial filters were further built up on the basis of these topographies and provided the means for extraction the individual brain components associated with the specific psychological operations. Comparison with the data base thus consisted of computing z scores—standardized measures of deviation of individual ERPs components from the corresponding normative data.

This new approach was applied for discrimination a group of healthy participants ($N > 1,000$) from groups of patients with ADHD (>500 patients), dyslexia ($N = 36$), stroke with hemispatial neglect ($N = 20$). The data were collected in different centers in Switzerland (A. Mueller), Norway (S. Hollup & J. Brunner), England (T. Steffert), and Russia (I. S. Nikeshina & E. A. Yakovenko). The results of discriminant function analysis of the data are presented in the paper. Briefly, the results show that each brain disorder is characterized by impairment of a specific independent component associated with a specific psychological operation.

In the final part, we present a practical application of the new approach for (a) constructing protocols of conventional EEG-based neurofeedback, for (b) constructing protocols of transcranial direct current stimulation, and (c) for constructing protocols of a newly developed method of ERPs based neurofeedback. In addition, (d) the results of pilot studies on ERP-based monitoring the effects of pharmacological treatment are presented.

Healing the Wounds of War and Violence: TBI and PTSD with Vets and Terror Survivors

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Neurofeedback possesses valuable and powerful tools for ameliorating the effects of the extreme kinds of trauma experienced by service men and women in war and by victims of terror. Dr. Stephen Larsen, who has treated many vets and accident and terror survivors, provides an overview of the field and its problems and pitfalls, including the self-protective and neuroprotective mechanisms involved in trauma; the issues of sensitivity, reactivity, and complex multiple traumas; and a look at neurology, psychodynamics, and possible mechanisms of healing.

Dr. Len Ochs discusses a Study of Brain Injured and post-traumatic stress disorder (PTSD) clients in which all participants (also patients) were treated with the LENS or its predecessors, and which correlates drops in the amplitudes of EEG with changes in subjective symptoms. This study is being prepared for presentation to the Armed Forces Centers for Excellence: Unites States Department of Defense.

Dr. Mary Lee Esty presents as follows: Six OEF/OIF male and female veterans with mixed TBI/PTSD symptom syndromes referred to the Neurotherapy Center of Washington were treated with Flexyx Neurotherapy System for up to 25 sessions. Measures completed at pre- and immediately posttreatment included the Neurobehavioral Functioning Inventory (Depression, Somatic, Attention/Memory, Communication, Aggression, and Motor scale scores) and PTSD Scale (Total as well as Re-experiencing, Avoidance, and Arousal subscale scores), and individual treatment session 0 to 10 ratings of current symptoms (fatigue, cognitive clouding, sleep, anxiety, depression, irritability/anger) and activity levels. Statistically significant results are presented.

Dr. Siegfried Othmer discusses the compelling case of a Vietnam vet with PTSD of 40 years' duration. The vet was rescued by the Salvation Army in Los Angeles and brought to the Othmers for treatment. Three sessions produced a 50% symptom reduction, with a diminution of suicidality, nightmares, and binging. Further treatments consolidated these amazing early results and went on to achieve a 90% remission in 18 symptom areas. The vet also agreed to undergo q-EEG with Q-Metrx and SPECT imaging courtesy of the Amen Clinic.

QEEG Guided Amplitude and Coherence Neurofeedback for Autistic Spectrum Disorders
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These symposia review EEG & QEEG patterns and subtypes of Autism and Aspergers (Autistic Spectrum Disorder/ASD), including six subtypes of Autism and two subtypes of Aspergers. We discuss how to utilize EEG and QEEG amplitude and coherence patterns of ASD to guide protocol selection for more neurofeedback training. We present data, including pre–post QEEG's and CPT tests, showing the positive effects of neurofeedback with ASD students. Research studies of neurofeedback with ASD are reviewed.

Induced EEG Gamma Oscillations in Response to Drug- and Stress-Related Cues in Cocaine Addicts and Patients with Dual Diagnosis
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Introduction

The overall goal of this pilot project was to utilize single trial EEG variables and behavioral performance measures to examine cue reactivity to drug-related stimuli (three-stimuli oddball with pictorial stimuli) in a group of patients with substance (cocaine) use disorder (SUD), patients with cocaine addiction comorbid with PTSD (DUAL), and controls (CNT). Our experiment was designed to examine behavioral and EEG measures of cue reactivity to pictorial drug- and trauma-associated stimuli, and to investigate how heightened orienting to these salient distracters will interfere with cognitive functions during performance on a visual three-category oddball task. Dependent variables included EEG gamma oscillations (30–80 Hz), amplitude, and power density in response to nontarget categories of pictorial distracters containing both drug- and trauma-related cues. We expected that patient with SUD will express heightened reactivity of gamma only to drug-related cues, whereas the patients with dual diagnosis will show enhanced reactivity to both task-irrelevant drug and trauma cues and will present selective attention to these highly salient distracter signals, which will negatively affect processing of task-relevant stimuli.

Methods and Results

Twenty-three subjects (M age $= 38.2$ years) participated in this experiment: 8 participants in control group, 8 patients in DUAL group, and 7 patients in SUD group. PTSD diagnosis in drug abusing subjects was confirmed by Drs. Stewart and Hollifield using PSS-R questionnaire and clinical interview. Drug abuse was confirmed by Dr. Stewart's clinical evaluation and urine drug screening (DrugCheck4 NxStep) and saliva test. Cue category (neutral, trauma, drug) had main effect on reaction time (RT) ($p = .033$), and accuracy of responses ($F = 3.79$, $p = .045$) without any significant Cue $\times$ Group (CNT, DUAL, SUD) interaction. However, RT to neutral and trauma cue was slower in addicts compared to controls (neutral: 592 msec vs. 502 msec, $p = .047$; trauma: 642 msec vs. 529 msec, $p = .036$), whereas no between group differences were found in RT to drug cues (532 msec vs. 570 msec).

Along with behavioral and ERP measures (reported in Sokhadze et al., 2008) we analyzed single trial induced EEG gamma oscillations (30–80 Hz) for 30 trials in each of eight conditions (target-drug, nontarget drug, target-neutral, nontarget neutral, target-trauma, nontarget trauma cues) using Morlet Wavelet analysis at 14 EEG sites (frontal F1, F2, F7, F8, AF3, AF4; central C3, C4; parietal P3, P4, P7, P8; and occipital O1, O2). SUD group showed higher gamma density in response to target drug cues at the frontal sites (AF3, $p = .06$ trend; F7, $p < .05$). At the lateral frontal site (F7) we

found significant Stimulus (target, non-target) $\times$ Cue (drug, neutral, trauma) $\times$ Group (CNT, SUD) interaction effect, $F(1, 17) = 5.03$, $p = .02$, that can be described as a higher gamma density to nontarget drug cues, a lower gamma response to both target and nontarget neutral stimuli, and a lower gamma density to nontarget traumatic stress cues in the addicted individuals as compared to controls. Patients in the DUAL group showed higher bilateral gamma density to nontarget trauma cues at the frontal and central sites (F7, F8, C3, C4) as compared to SUD-only and CNT groups (e.g., F7, $p = .015$; F8, $p < .01$). Therefore, induced gamma demonstrated excessive response to both target and nontarget drug cues in SUD group, and overreactivity to nontarget traumatic stress cues in participants with dual diagnosis (SUD comorbid with PTSD).

Conclusions

Analysis of induced gamma oscillations in a cognitive task with drug- and stress-related visual cues showed between group differences in patients with substance use disorder and patients with dual diagnosis (substance abuse co-occurring with PTSD). We used these EEG markers of overreactivity to motivationally salient stimuli as the outcome measures in a neurofeedback trial where patients with SUD and dual diagnosis were treated by neurotherapy based on neurofeedback training integrated with motivational interviewing. We discuss utility of early and late components of induced gamma activity to assess preattentive processing and explicit orienting to drug-related items in addicted patients.

Transcranial Magnetic Stimulation Study of Gamma Frequency Induction in Response to Illusory Figures in Patients with Autism Spectrum Disorders

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Introduction

Neuropathological models of autism indicate an increased number of cortical minicolumns with less peripheral neuropil space in the dorsolateral prefrontal cortex (DLPFC). A lack of peripheral neuropil space in the cortical minicolumns of individuals with autism is associated with a reduction in gamma-aminobutyric acid (GABA)-mediated inhibitory interneuron activity, and the inhibitory interneuron activity of minicolumns is important for the fine tuning of cortical information processing. The generation of normal gamma oscillations directly depends on the integrity of the connections of GABAergic interneurons within cortical minicolumns, and individuals with ASD have been shown to exhibit significantly more EEG oscillations in the gamma range compared to controls. As a treatment modality, Transcranial Magnetic Stimulation applied at low-frequencies (≤ 1 Hz) has been shown to increase inhibition of stimulated cortex. We investigated gamma frequency induction in individuals with ASD in response to Kanizsa illusory figures before and after six sessions of 0.5 Hz rTMS applied to the left DLPFC. In unimpaired individuals gamma activity is readily induced by Kanizsa illusory figures in neurocognitive tasks, and gamma induction is generally higher in response to target Kanizsa stimuli and attenuated to nontarget Kanizsa and non-Kanizsa stimuli. We expected the baseline (pre-rTMS) power (μV2) of induced gamma oscillations to be increased to nontarget and standard illusory figures at a majority of recording sites in individuals with ASD relative to controls. After six sessions of 0.5 Hz rTMS applied to the DLPFC we expected the power of gamma oscillations to standard and non-target stimuli to significantly decrease in individuals with ASD especially over the DLPFC.

Methods and Results

The study included 13 patients with ASD, all male, with a mean age of 17.2 ± 4.6 years. Eight of them were assigned to an active

rTMS treatment group and 5 were assigned to a waiting-list group. An equal number of controls were recruited, 8 male and 5 female with a mean age of 18.6 ± 6.2. All participants had IQs in the normal range (Full Scale IQ > 80) and met *DSM-IV-TR* criteria for ASD. There were no statistically significant age or IQ differences between the two groups. rTMS was administered to the left DLPFC two times per week for 3 weeks at $0.5\,Hz$ and 90% MT with a total of 150 pulses per day (10 trains with 15 stimuli per train). Motor threshold was determined before each session using EMG of the contralateral first dorsal interosseous hand muscle. The power ($\mu V2$) of induced gamma oscillations between 30 and 80 Hz from 0 to 800 msec poststimulus was recorded at frontal, central, parietal, and occipital EEG sites over both hemispheres and was analyzed using MATLAB wavelet analysis applications. The density ($\mu V2/Hz$) of induced gamma oscillations and the density difference between gamma induced responses to nontarget and target Kanizsa stimuli were also analyzed. The ERP results were reported in our recent preliminary study.

There were baseline (pre-rTMS) group gamma differences as individuals with autism showed increased levels of gamma induction to non-target and standard stimuli relative to controls at 8 of 12 recording sites: left frontal (F1, F7), left and right parietal (P1, P2, P7, P8), and occipital (O1, O2) EEG channels. A Stimulus $\times$ Group (control, autism) interaction indicated highly significant gamma power increases to nontargets in the autism group relative to controls at all recording sites ($p < .001$). Also, the gamma power of autistic individuals to nontarget stimuli was similar to controls at parietal sites while significantly higher at frontal sites ($p < .05$), and group differences in gamma oscillation power to nontarget and target Kanizsa stimuli were better expressed over lateral frontal (F7, F8) and parietal (P7, P8) recording sites. After rTMS treatment individuals with ASD predominately showed reductions in induced gamma activity to nontarget and standard stimuli at frontal and parietal sites ipsilateral to the stimulation site. The power of gamma oscillations to standard and nontarget stimuli significantly decreased at the following sites: left lateral frontal (F7, nontarget from 326 to 100 $\mu V2$, $F = 5.00$, $p = .044$), left central (C3, standard from 69 to 20 $\mu V2$, $F = 7.80$, $p = .015$; nontarget from 97 to 29 $\mu V2$, $F = 5.43$, $p = .037$), left medial parietal (P1, standard from 111 to 47 $\mu V2$, $F = 6.69$, $p = .023$), left parietal (P3, standard from 119 to 36 $\mu V2$, $F = 16.15$, $p = .001$; nontarget from156 to 42 $\mu V2$, $F = 10.31$, $p = .007$), and right lateral parietal (P8, nontarget from 395 to 111 $\mu V2$, $F = 6.12$, $p = .028$) EEG sites. The autistic participants in the waiting-list group ($N = 5$) did not show any changes in induction of gamma activity.

Conclusions

Individuals with ASD show significant gamma power increases to nontarget and standard stimuli at a majority of recording sites relative to controls, and group differences in gamma oscillation power to nontarget and target Kanizsa stimuli were better expressed over lateral frontal and parietal recording sites. Repetitive low-frequency transcranial magnetic stimulation administered to the left DLPFC reduced induced gamma activity to nontarget and standard stimuli at frontal and parietal sites ipsilateral to the stimulation site. Low-frequency repetitive transcranial magnetic stimulation tends to increase cortical inhibition and reduce induced high-frequency EEG activity to standard and nontarget stimuli in individuals with ASD. TMS may restore a balance in the ratio between cortical excitation and inhibition and improve sensory stimulus discrimination in patients with ASD.

Neurofeedback: The Past, Present, and Future

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Abstract by Leslie Sherlin, PhD

As any previous ISNR attendee will tell you, much of the learning experience occurs in the hallways and around dinner tables with experienced providers. In my early career and still today I find catching conversation with the brightest minds of our field to be the most satisfying and educational experiences and the one that I always remember most from the conferences. If you're lucky enough to find an empty seat at a table with one of our elder pioneers or an up-and-coming innovator you should take advantage of this opportunity to just capture the stories of their experience. In the meantime, I have invited and created a special panel that has quickly become an ISNR favorite for bringing this same idea into a room for all to enjoy.

Our first special panel took place in 2008 with contributions from Tom Budzynski, Joel Lubar, and Barry Sterman. It was truly one of the most entertaining and educational events of the conference as we all came together to share experiences and speculate about our common future. The panel participants are given a very loose goal of making a 30-min presentation each sharing their perspective of neurofeedback's past, present, and future. It ranged from a photo slide show of other pioneers and colleagues highlighting landmark achievements, presentation of data, and studies to simple story telling about our field and accomplishments.

Our special panel presenters have unique histories in the field of neurofeedback, and each has changed our history and guided our future through their work.

POSTERS

The pRoshi: An Investigation Into Its Applications as a Stand-Alone Tool for Relaxation and Its Use in Combination With Selective Music
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The pRoshi was developed by Chuck Davis as a stand-alone unit that would function in a similar way to the original computer-linked Roshi. The viability of the pRoshi as a clinical tool is assessed in different conditions, the pRoshi alone and the pRoshi in combination with a musical CD. The musical CD is also assessed as a stand-alone treatment. EEG data for each condition were measured in terms of amplitude ratios and Z scores for each individual. Data for 30 participants, 10 in each condition, were then subjected to statistical comparisons.

A Study of Breathing, Heart Rate Variability Amplitude, and Blood Pressure
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This poster presents results of a study examining the absolute relationship between heart rate variability amplitude and blood pressure. Clients participated in 8 to 12 min of resonant breathing with HRV biofeedback. At the end of this period, their blood pressure was assessed and correlated with their average HRV amplitude for the period.

Gender Differences in EEG Source Localization During Processing of an Unfamiliar Face
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This study investigated neurophysiological activity during the processing of a face unfamiliar to the subject, utilizing standardized low-resolution electromagnetic tomography (sLORETA) to map sources of the EEG recorded at the scalp. We obtained 100 university students (60 female) with a mean age of 21. EEG data were recorded for 4 min while participants viewed an image of an unknown female face. We performed EEG source localization using sLORETA and compared the image condition to baseline using all voxel-by-voxel t tests. Significant voxels of

difference were mapped onto a Montreal Neurological Institute (MNI) atlas containing 6,329 5 mm voxels. Subjective reports were obtained from each participant after the EEG procedures. These were rated by three independent raters for positive, neutral, or negative content. The sLORETA comparisons between female and male participants show less activity in delta and theta frequencies in left BA 7 and mid-line cuneus for female participants. However, female students show increased activity, as compared to male students, in right BA 7 in the alpha frequency and in right BA 8 in low beta power. The subjective reports of the experience of viewing the image of the unfamiliar face was neutral to positive in content and shows no differences between groups. The subjective reports indicate that male and female participants rate the unfamiliar face in similar fashion in a neutral or positive description. This consistency, however, appears to involve different cortical mechanisms. First, as compared to male students, female students showed less activation in the left precuneus and mid-line cuneus in the slower frequency domains. In addition, female students showed increased activity in alpha and low beta power in the right frontal and right precuneus, with less higher beta activity in the right somatosensory cortex. The difference in EEG activity may reflect the heightened evaluative state of female participants as a result of socialization.

P300-Based Protocol (With Acoustic Stimuli) for Assessing Memory Deficit, Malingering, and Deception in Clinical and Forensic Settings
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It has been previously shown that event-related potential (ERP) methodology can be effectively used for assessing memory deficit/intactness and feigning/deception. All previous P300-based recognition and memory assessment protocols utilized video stimuli. In the present study we test a novel audio version (words) of ERP (P300)-based protocol for detecting memory deficit, malingering, and deception.

Methods

Participants were 26 individuals (14 male and 12 female) recruited through advertisements at Northwestern University campus. EEG was recorded from Fz, Cz, and Pz while participants were listening to the audio stimuli via headphones. A modified audio (words) version of the oddball protocol was implemented. The protocol included three types of stimuli: (a) A "Probe" (Pr—a relevant to the participant (his or her Last Name), (b) "Irrelevant" (Ir—a last name, *not* relevant to the participant), and (c) a "Target" (Tr, an item with "assigned significance"). There were seven different stimuli (last names) in the protocol: five Irrelevant names, one Probe, and one Target. Each of the names was repeated 30 times in a test run. Participants responded to all Irrelevants and the Probe with a LEFT button on a two-button response box. They were instructed to press a RIGHT button when they heard a "Target" name.

Results

Two groups were tested: an experimental (E) group where one of seven repeatedly presented stimuli was a participant's last name (Probe), and a control (C) group where all the stimuli were irrelevant to participants. Bootstrapped-based hit rates in the E group were 100%, based on Probe versus five Irrelevants combined, and 78% for Probe versus maximum Irrelevant. In the C group there was one (of 12) false positive (8.3%), based on Probe versus five Irrelevants combined as well as Probe versus maximum Irrelevant. A 2×2 (Group $\times$ Stimulus Type) mixed analysis of variance was performed to examine the effects of Group (E vs. C) on P300 amplitude (Probe and Irrelevants). There was main effect of group ($p < .001$). We also

found significant effect of stimulus type ($p < .001$), and a significant interaction of Group $\times$ Stimulus Type ($p < .001$).

Conclusions

The study confirmed that P300 component can effectively serve as an indicator of audio recognition (as well as feigning and deception) in ERP-based protocol: P300 amplitude significantly increases when presented audio information is recognized (even when a person denies it) compared to unrecognized stimuli.

Recovery of Vision with NeuroRehabilitation in Children with Cortical Visual Impairment
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Introduction

Cortical Visual Impairment (CVI) is bilateral visual impairment due to brain injury in posterior visual pathways without significant anterior pathway (eye, retina, or optic nerve impairment), therefore the light reflex is intact. CVI is an increasing common cause of blindness in children. CVI is often caused by perinatal or postnatal anoxia or trauma. CVI due to gray matter and white matter involvement, the presence of seizures, or anoxic etiology has a very poor prognosis for recovery of vision.

Methods

Twenty-one consecutive cases from the Institutes for Achievement of Human Potential, a neurorehabilitation center met the criteria for CVI. MRI or CT documented brain injury in visual areas. Informed consent was obtained. No one had better than crude outline perception. All 21 had extensive gray and white matter injury to visual areas; 20 also had seizures. Children ranged in age from 1 to 10 years. Neurorehabilitation with visual stimulation was based on the neurodevelopmental acquisition of vision. At the lowest

level, light/dark stimulation was given multiple times daily until light perception was intact. Next progressively complex visual stimulation consisted of black-and-white 12-in squares followed by high contrast outline then with increasing details as vision improved. Then similar but unlike visual symbols were followed by identification of symbols and letters and in some reading.

Results

At the start of the program all children had light reflex and some had crude contrast perception. Success on the program was considered to occur if the child could distinguish complex symbols or read. Of the 21 children, 20 (95%) achieved visual recovery in an average of 6.9 months with visual neurorehabilitation; the range was 5 to 13 months.

Conclusions

Studies of CVI in children rarely show recovery of useful vision; however, visual neurorehabilitation programs were not used. In our study, the 21 children that met criteria were multiply handicapped and had extensive white and gray matter injury. Twenty also had seizures. This represents the most severe population and would bias this study against recovery. However, in all cases, useful vision was recovered. This implies considerable neuroplasticity in the visual system. Success in our study appears to be due to the neurodevelopmental approach to visual stimulation based on the participant's initial level, increasing in complexity until recovery. This model may be useful in other neurorehabiltation settings.

Intensive Neurotherapy Facilitates Recovery From Severe Brain Injury and Seizures
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Introduction

Patients with severe brain injury and refractory seizures often have poor recovery. Intensive neurotherapy reinforcing sensory motor rhythm (SMR) may promote neuroplasticity in thalamocortical circuits, significantly improving outcome.

Methods

A 29-year-old man had a severe traumatic brain injury after a motor vehicle accident 10 years ago. He had spastic quadriparesis, uncoordination, dysphasia, aphasia, and sleep disruption and refractory secondary generalized seizures with postictal impairment lasting up to 10 days. All previous therapies failed to improve his condition. Twenty-four-channel EEG recordings (NeuroNavigator) were analyzed using SKIL software. It showed excessive diffuse delta and theta ($+12$ z score) compared to healthy adults, with little SMR or alpha activity. Daily neurotherapy aimed to progressively reinforce SMR in central regions and 8.6 to 10.6 Hz activity in other brain regions. Therapy sessions continued to increase in length and complexity as he improved. He underwent three 30-days periods of neurotherapy with the same protocols, separated by 5 months each.

Results

After the first session his sleep integration increased from 2 to 8 hr per night. Seizures decreased in frequency, intensity and duration without postictal impairment. Speech, swallowing, coordination, and motor control in trunk and extremities improved by at least 50% significantly increasing his abilities. Posttraining QEEG showed more normalized delta and theta ($+2$ z score), and SMR and alpha activity were present. Despite stopping neurotherapy for 5 months he continued to improve in all areas including seizure control, allowing him to be independent in his daily life. His posttraining QEEG revealed more SMR and alpha activity.

Conclusions

Intensive neurotherapy facilitated recovery from brain injury and seizures 10 years after injury and despite failure of other therapies. Neurophysiological and clinical changes were robust, durable, and self-regenerating. We believe that this intensive neurotherapy protocol normalized thalamocortical circuits by facilitating Long Term Potentiation (LTP). LTP increases neural protein synthesis, growth, and remodeling.

Examination of Cranial Electrotherapy Stimulation on Alpha-Amylase Levels, Cortisol Levels, and State-Trait Anxiety Scores in the Chronically Mentally Ill
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This randomized, double-blind, placebo-controlled study was designed to measure the efficacy of Cranial Electrotherapy Stimulation (CES) in a population that is most susceptible to problems related to anxiety, the chronically mentally ill. Changes in anxiety levels were identified using pre- and posttest measures of alpha-amylase, cortisol, and the State-Trait Anxiety Questionnaire. Participants were randomly assigned to one of three treatment groups: active CES, sham CES, and no treatment. This experimental design was implemented to address potential placebo effects.