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General Conference Presentation Abstracts

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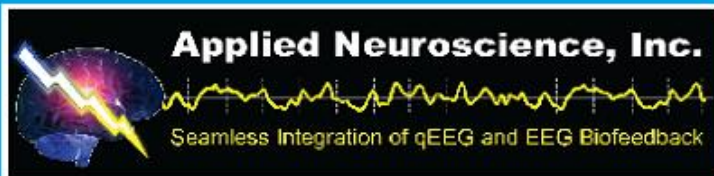
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General Conference Presentation Abstracts

Effect of Neurofeedback Training on the Neural Bases of Cognitive Deficits in Children with Attention-Deficit/Hyperactivity Disorder: Functional Magnetic Resonance Imaging (fMRI) Studies

Mario Beauregard, PhD

Université de Montréal, Montréal, Quebec, Canada

<mario.beauregard@umontreal.ca>

Introduction

These fMRI studies were undertaken to measure the effect of neurofeedback training (NFT) on the neural bases of cognitive deficits in AD/HD children.

Methods

Twenty unmedicated AD/HD children participated in the study. Fifteen children were randomly assigned to the experimental (EXP) group, whereas the other five children were randomly assigned to the control (CON) group. Only subjects in the EXP group underwent NFT. EXP subjects were trained to enhance the amplitude of the SMR (12-15 Hz) and beta 1 activity (15-18 Hz), and decrease the amplitude of theta activity (4-7 Hz). Subjects from both groups were scanned one week before the beginning of NFT (Time 1) and one week after the end of NFT (Time 2) while they performed a Counting Stroop task and a Go/NoGo task.

Results

At Time 1, for both groups the Counting Stroop task was associated with significant activation in the left superior parietal lobule (SPL). No activation was noted in the anterior cingulate cortex (ACC). For the Go/NoGo task, in both groups, there was no significant activity in the

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prefrontal cortex (PFC) and striatum at Time 1. At Time 2, for both groups the Counting Stroop task was still associated with significant activation of the left SPL. This time, however, there was a significant activation of the right ACC, left caudate, and left substantia nigra in the EXP group. No such activation was seen in CON subjects. For the Go/NoGo task, significant loci of activation were noted, in the EXP group, in the lateral PFC, bilaterally, as well the left caudate nucleus, left thalamus, left substantia nigra, and right ACC. No significant activation of these brain regions was measured in CON subjects.

Discussion

These results suggest that NFT has the capacity to functionally normalize the brain systems mediating attention and response inhibition in AD/HD children. Given the pivotal role played by dopamine in these executive functions, we hypothesize that NFT modulates dopaminergic neurotransmission in fronto-striatal circuits.

Breaking the Silence: Brain-Computer-Interfaces in Paralysis (Keynote Address)

Niels Birbaumer, PhD

Full Professor of Medical Psychology and Behavioral Neurobiology, University of Tuebingen, Germany; University of Trento, Italy; National Institute of Health (NIH), Human Cortical Physiology
<Niels.Birbaumer@uni-tuebingen.de>

Brain-Computer Interfaces (BCI) using neuro electric activity from the brain provide signals for external devices such as computers, wheel chairs, and prostheses. Here invasive and non-invasive BCIs using slow cortical brain potentials, mu (SMR) rhythm and high frequency gamma oscillations are presented. The "Thought Translation Device" trains completely paralyzed patients with Amyotrophic Lateral Sclerosis (ALS) to regulate their slow cortical potentials (SCP) with neuro-feedback. After achieving 75%, control patients can select letters or words. Locked-in patients continue to communicate with this system.

Data on quality of life and ethical considerations on doctor assisted suicide were discussed. An invasive system using subdural implantation of macroelectrodes and Support Vector Machine- ECoG-Classification allows verbal communication with brain activity in very short time peri-

ods. A new system for rehabilitation in chronic stroke connects an artificial hand affixed to the paralyzed hand with the lesioned motor area: patients move the paralyzed hand with motor imagery and changes in SMR-rhythm.

S.T.A.R. Training: True, Real-Time Interpersonal Neurofeedback Training in a Group Setting

Valdeane W. Brown, PhD

Zengar Institute Victoria, BC, Canada

<val@zengar.com>

S.T.A.R. training is a group-based neurofeedback training environment specifically oriented to facilitating spiritual transformation and renormalization (S.T.A.R.). It integrates the use of concurrent, parallel neurofeedback training, as well as a completely unique cross-person training approach in which individuals are cross connected to shared neurofeedback equipment. Participants are arranged like the rays of a star, with their heads at the center of a circle while their feet point outwards. Multiple NeuroCARE Pro® installations are used—one per participant—and concurrent training is done using standard CARE® procedures as a “warm up.” In the next phase, each training system is placed BETWEEN participants so that the A channel of a system is connected to the left hemisphere of one person, while the B channel of the same system is cross connected to the right hemisphere of the next participant. This pattern of connection is repeated across all participants. In this way two people are connected to each training system and each person is functionally cross connected with at least one other person if only a couple is trained, or two other people if three or more participate. Data and experiences from this unique training environment were presented.

ZenX Modes and Autonavagation: Self-Correcting Neurofeedback for the Home and Office Using NeuroCARE Pro®

Valdeane W. Brown, PhD

Zengar Institute Victoria, BC, Canada

<val@zengar.com>

NeuroCARE Pro® has deployed increasingly more comprehensive and adaptive targeting approaches. Currently it is the only true two-channel, 16 target training system using real-time Gabor-based transforms to

process EEG. From the beginning this training approach has been diagnostically agnostic as well as blind to symptom and condition. This has meant that a single comprehensive, adaptive approach to targeting can be, and has been, used across all settings in which neurofeedback has been utilized before. It has also meant that trainers needed to continually adjust the width of each target in order to maximize the training response. ZenX modes are pre-packaged combinations of targeting parameters that allow for a programmed sequence of training in which only a single difficult factor needs to be modified by the trainer. With these foundational tools in place, an additional layer of optional automation offers a truly revolutionary option: true real-time neurofeedback that is completely self-correcting. We call this process Autonav. This presentation explored the use of these new tools.

Neurofeedback and Expressive Writing

Dmitry Burshteyn, PhD

Siena College, Loudonville, NY

<dburshteyn@siena.edu>

Introduction

The purpose of this study was to investigate the effects of alpha-increase neurofeedback training on emotional disclosure and health outcomes.

Method

Twenty participants were randomly assigned to each of two matched groups, one involved expressive writing (EW) only, the other include expressive writing as well as biofeedback (B+EW).

Results

The effect of Group \times Pre / Post interaction on systolic blood pressure was statistically significant, with $F(1,18) = 5.96$ and $p < .025$. The simple effect for the B + EW group yielded an $F(1,9) = 13.75$, $p < .005$, indicating a statistically significant decrease in systolic blood pressure for the B + EW group. No significant changes were observed in EW group. Our alpha increase training enabled all of our B + EW participants to successfully raise their alpha amplitudes as compared to the baseline.

Among the ten B+EW participants, eight were able to raise their alpha amplitude by 15% from their baseline levels.

Conclusion

The results of our study seem to be promising, even though some theoretical and methodological issues need to be addressed. Among them, one question we would like to discuss is whether EEG biofeedback facilitates expressive writing? Our content analysis yielded slightly significant results for one out of three major categories; nevertheless, it should not be taken lightly considering the small size of our sample. Considering that the present study is exploratory in nature, the compromise of statistical power contributed by small sample size is understandable.

Electrophysiological Models of Attention-Deficit/Hyperactivity Disorder: How Accurate Is Our Current Understanding of These Dysfunctions? (Keynote Presentation)

Adam R. Clarke, PhD, Robert J. Barry, DSc, Rory McCarthy, FRACP, and Mark Selikowitz, FRACP

University of Wollongong, Department of Psychology, Wollongong NSW, Australia
<aclarke@uow.edu.au>

Introduction

Attention deficit hyperactivity disorder (ADHD) is one of the most common disorders of childhood, yet the causes of the disorder are not fully understood. Children with ADHD have been found to have consistent differences in their EEG compared to children without the disorder. These EEG differences typically include increased delta and theta activity, with decreased alpha and beta. However, other profiles such as increased beta activity are found in a small group of children. These results have been interpreted as representing several different underlying dysfunctions, including cortical hypo- and hyper-arousal, or a maturational lag of the central nervous system. However, the validity of the models has not been fully tested.

Methods

Over the past ten years our group has collected data from children with and without ADHD. Children with ADHD have been medication naive

patients at a pediatric practice. Children without ADHD have been drawn from schools and community groups in the local area. All subjects were tested using an eyes-closed resting EEG.

Results

From this work, a number of studies have been conducted in which each of the hypo- and hyper-arousal, and maturational lag models of ADHD have been explored. There appears to be little support for the hyperaroused model of ADHD, with many results indicating that these children have a similar dysfunction to those with excess theta activity. Results for the hypo-aroused model are mixed as are those for the maturational lag model of ADHD.

Discussion

These results have important implications for our understanding of this disorder, and for the development of treatment protocols. This was discussed in this presentation.

Assessment-Guided Neurofeedback for Autistic Spectrum Disorder

Robert Coben, PhD

Private Practice, Massapequa Park, NY

<robcohen@optonline.net>

Introduction

The Center for Disease Control has estimated that between 1 in 500 (2/1,000) to 1 in 166 children (6/1,000) have Autism and Autistic Spectrum Disorder (Boyle et al., 1994). Jarusiewicz (2002) has published the only study documenting effectiveness for neurofeedback of autistic disorders, but included only 12 children in the experimental and control groups and was based on the use of only one assessment instrument. The present study seeks to extend these findings with a larger sample size and a wider assessment of outcome.

Method

Twenty-five patients diagnosed with Autism or Autistic Spectrum Disorder underwent assessment-guided neurofeedback training. Each

patient received approximately 20 sessions of training. Each patient received pre- and post-treatment Neuropsychological, Neurobehavioral/ Rating Scale, Infrared Imaging and QEEG assessments. A control group of 12 Autistic patients that did not receive neurofeedback were available for comparison on at least one rating scale measurement.

Results

Findings were positive in showing that the patients changed significantly with improved neuropsychological test results and reduced autistic symptoms. There were also significant and therapeutic changes in measures of brain functioning. Our clinical group of autistic patients improved significantly. There was a 90% success rate over the course of the study. There was clearly a significant ($p < .01$) difference on Autism Treatment Evaluation Checklist and Gilliam Aspergers Disorder Scale scores compared to a no treatment control group.

We then calculated a benefit : harm ratio as per the Autism Research Institute and compared the impact of the neurofeedback to that of medication, biomedical and speech therapy intervention. This ratio for NF was 90, which makes it the most effective form of intervention for autistic problems compared to those listed above.

Further, there were statistically significant ($p < .05$) improvements on neuropsychological tests related to attention and executive functions. There were also significant ($p < .01$) improvements on behavioral rating scales related to socialization, emotional control, cognitive deficits, pragmatics, and behavioral problems.

Neurophysiological measures of change also showed promising results. There were significant ($p < .05$) changes on Infrared Imaging reflective of greater metabolic flow to frontal cortices. There were also significant ($p < .01$) QEEG changes in a therapeutic direction with movement towards normalization in relative power and connectivity analyses.

Conclusion

These results suggest that neurofeedback is an effective form of intervention in cases of Autistic Spectrum Disorder. Changes in cognitive skills and behavioral ratings corresponded to changes in measures of brain functions. These findings were discussed with regard to diagnosis, treatment formulation, and outcome measurements.

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Passive Infrared Hemoencephalography for Traumatic Brain Injury

Robert Coben, PhD

Private Practice, Massapequa Park, NY

<robcohen@optonline.net>

Introduction

Approximately 1.4 million people suffer traumatic brain injury (TBI) annually in the U.S. alone (CDC, 2004). EEG biofeedback has been shown to help this population (Schoenberger et al., 2001). Hemoencephalography has been presented as an alternate form of neurofeedback with promise. Carmen (2004) has shown passive infrared HEG to be effective in the treatment of migraine headaches. This study investigated the effects of pirHEG in treating TBI-related cognitive/neurobehavioral changes and post-traumatic headaches.

Method

Twenty-five patients diagnosed with TBI received approximately 20 sessions of pirHEG over Fpz. Each patient received pre- and post-treatment neuropsychological, neurobehavioral, headache monitoring, infrared imaging and QEEG assessments. A control group of seven persons undergoing occipital nerve stimulation for TBI was available for comparison.

Results

Findings showed significant improvement in 90% of our population. Improvements were noted in headaches, neuropsychological and neurobehavioral functioning, infrared imaging and QEEG connectivity measures. Comparison of infrared imaging with an alternate treatment group showed greater impact of pirHEG on frontal system functioning.

In addition to a 90% success rate, there were significant reductions in headache intensity ($p < .01$), frequency ($p < .01$) and duration ($p < .01$). Significant pre / post improvements were noted on tests of attention ($p < .02$), memory ($p < .01$), and executive functions ($p < .02$). Neuro-behavioral measures showed significant gains for energy ($p < .05$), emotional control ($p < .05$), executive skills ($p < .05$).

Neurophysiological measures showed improvements as well. Pre/post infrared imaging showed a significant ($p < .05$) reduction in variability across the frontal cortex. QEEG measures showed significant improvement in global connectivity ($p < .05$).

There was a significant correlation ($r = .70$) between infrared and connectivity changes suggesting that these variables may be related in some way.

Conclusion

These findings suggest that many of the problems associated with TBI can be successfully treated with pirHEG. This study has shown in a moderately large group of patients that neurofeedback, specifically pirHEG, can be effective in treating the multiple effects of TBI.

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QEEG Findings in Autistic Disorders: Absolute, Relative Power and Coherence Measures

Robert Coben, PhD (1), Bill Hudspeth, PhD (2), Adam Clarke, PhD (3), and Robert Barry, DSc (3)

(1) Private Practice, Massapequa Park, NY

(2) Neuropsychometric Laboratory, Los Osos, CA

(3) University of Wollongong, Wollongong, Australia

<robcohen@optonline.net>

Introduction

Thompson and Thompson (2003) have examined the EEG of Asperger's and Linden (2004) examined the QEEG data of autistic disorders. In addition to regional QEEG anomalies, there is reason to believe that persons diagnosed with autistic disorders may have coherence deficits (Courchesne, 2004; Chung et al., 2004).

Method

We have collected QEEG data on 30 patients with autistic disorders. In part one of this study we averaged this data and compared it to normative standards across QEEG databases. In part two of this project we compared our patient group to an age-matched sample of normal controls in terms of multiple metrics of coherence.

Results

Findings were presented regarding deviation from normal in terms of absolute and relative power across EEG frequency ranges. There was an emphasis on the EEG frequencies and brain regions most impacted in autistic disorders. We also presented deviations as compared to a normal control group in terms of coherence anomalies.

Conclusion

While patients with autistic disorders present with heterogeneous symptoms, it appears as though brain regions impacted are similarly. There is also evidence of significant hypocohereance as compared to a normal control group. Findings were discussed in terms of their implication for diagnosis and treatment planning.

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Differential Training of Synchronous EEG Activity Using Channel Recombination and Joint Time-Frequency Analysis

Thomas F. Collura, PhD

BrainMaster Technologies, Inc., Oakwood Village, OH
<tomc1@pantek.com>

Introduction

A method is introduced that provides specific training for synchronous EEG events, based upon a simple, yet powerful signal processing model. This method reveals activity of the type reported by Freeman et al. (2003), Schack et al. (2002), Von Stein and Sarnthein (2000), and Lutz et al. (2004).

Method

Channel recombination (addition and subtraction) is used to differentially emphasize both synchronous, and asynchronous, EEG activity in different derived signals. This method combines the benefits of differential training with those of synchrony training (Fehmi & Sundor, 1989). Joint Time-Frequency Analysis provides a further method for distinguishing detected events in both time and frequency.

Results

It is possible to visualize a single brief transient in any band of interest, including gamma, using this method. Data was shown illustrating the phase and frequency selectivity of this method, and quantifying its ability to discern synchronous vs. asynchronous activity.

Conclusion

This approach is useful for assessment and visualization, as well as for training EEG rhythms. It is immediately applicable for real-time processing, and can be implemented on a wide range of systems. Results were

presented illustrating the ability to graphically depict rare and brief EEG transients, as well as the ability to train such rhythms for neurofeedback applications.

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Generating Wisdom and Compassion: QEEG and LORETA Findings

John W. DeLuca, PhD

Fearless Heart® and Colorado Center for Biobehavioral Health, Boulder, CO
<johndeluca@fearlessheart.com>

Introduction

According to the Dalai Lama, we all share a common wish to find happiness. However, happiness is not found in the accumulation of possessions such as the latest hi-tech gadget or Prada handbag. Rather, true transformation comes from within. Fueled by our determination, the essence of transformation lies in our ability to see with a clearer vision (i.e., wisdom) and to live with an open heart (i.e., compassion). These Three Principles of the Path were taught by the great scholar/yogi, Tsong Khapa. Employing various practices including meditation, we purify and transform our afflictive emotions while increasing merit (e.g., generosity, gratitude). In this presentation, we examined QEEG differences in wisdom versus compassion meditation.

Method

We compared EEG activity in a Tibetan Buddhist monk during two forms of meditation: analytical meditation on wisdom and generating feelings of compassion. A Lexicor NeuroSearch24 was used for recording and NeuroGuide, LORETA-Key, EureKa3!, and MHyT3! software for analysis.

Results

Wisdom meditation involved increased activity in the superior, middle and inferior temporal areas, bilaterally. Compassion meditation involved increased activity in right orbital frontal, insula and medial frontal regions. Consistent with recent reports by Davidson's group (Lutz et al., 2005), compassion meditation also evidenced increased left hemisphere beta coherence.

Conclusion

Different meditative practices produce unique mind states and patterns of brain functioning. Wisdom meditation activated areas consistent with insight into verbal problems, conceptual perspective taking, mental imagery in deductive reasoning among others. Compassion meditation activated areas associated with sense of self, flexibility, and empathy among others. Implications for neurofeedback training were considered.

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The Iowa Gambling Task and the Right Orbital Frontal Lobe

John W. DeLuca, PhD

Colorado Center for Biobehavioral Health Boulder, CO

<johndeluca@fearlessheart.com>

Introduction

Measuring pre-frontal lobe activity is an important although generally overlooked process in diagnostic assessments. In the past, most neuropsychological assessment batteries have been content with using the

Halstead Category Test or Wisconsin Card Sorting test to measure higher order functioning. In fact, some have even used the latter two measures interchangeably despite the fact that they measure quite different functions. This presentation provided a brief overview of the dimensions and measures of executive and frontal lobe brain activity. More specifically, our focus was on the utility of the Iowa Gambling Task (IGT; Bechara, Damasio, & Damasio, 2000) and its unique sensitivity to right orbital frontal lobe dysfunction.

Method/Results

In addition to a task analysis of the IGT, we reviewed the many neuroimaging studies using the IGT as an activation probe. We also discussed the numerous patient groups demonstrating difficulty on this task as well as presented a sample case study review using the IGT.

Discussion

The IGT has great utility in general clinical neuropsychological assessment as well as demonstrated usefulness as an activation probe in neuroimaging studies, including QEEG. The IGT is particularly useful in the assessment of individuals with head trauma, attachment disorders, and borderline personality disorders among others.

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Neurofeedback: A Relational Technology

Sebern F. Fisher, MA

Private Practice, EEG Spectrum International, Northampton, MA

<sebern.fisher@verizon.net>

Neurofeedback can improve brain function in many arenas, but most importantly in the arena of affect regulation. There is increasing consensus that affect regulation is the core issue in all psychopathology and in

effective psychotherapy. Neurofeedback can (and should) promote affect regulation and, in this, enhances the capacity for relatedness. More than any other single affect, fear corrodes the capacity for relatedness. Neurofeedback can effectively quieten fear.

The practitioner is encouraged to assess for early maternal-infant attachment disruptions and/or childhood trauma because both can contribute to high baseline states of fear and diminished capacity for trust, empathy and love. The practitioner is also encouraged not to abandon his/her role as a psychotherapist. Psychotherapy provides the relationship in which the patient can dare to experience new feeling states and the new sense of self that often accompanies neurofeedback training. The therapist helps the patient to discern the changes, to validate them and to embrace the new sense of identity as it emerges.

Neurofeedback and the Origin of Self: Low Frequency Temporal, Frontal and Pre-Frontal Training in a Man with Anti-Social Personality

Sebern F. Fisher, MA

Private Practice, EEG Spectrum International, Northampton, MA

<sebern.fisher@verizon.net>

Introduction

In his groundbreaking work, Allan Schore finds that the right orbital frontal cortex is responsible for affect regulation, most importantly the regulation of fear, through the inhibition of the amygdala, and further, that sense of self and other can emerge only when affect is regulated. He demonstrates that the right orbital frontal cortex (ROC) is the most plastic area of the brain throughout the life span. This single case study of a 55-year-old man who reported living in a constant state of fear and rage suggests the saliency of Schore's theory and the efficacy of neurofeedback in appealing to the brain's plastic capacity for affect regulation.

Method

Neurofeedback training was held two to four times weekly at the following sites: T4-P4, T6-A2, F4-A2, FZ-A2, FP1-FP2, T6-F4 and FPO2-A2. Reward frequency was lowered and placements changed, as manifestations of fearfulness and rage required. The subject has trained for 81 sessions and, presently trains at T6-F4, FZ, FP1-FP2 and FPO2 at 0-8 Hz

and 22-36 Hz inhibits, 0-3 Hz reward. Progress was tracked by clinical interview and SCL-90.

Results

Subject reports no baseline fear, and experiences no rage. He describes a robust development of sense of self, particularly within relationship to the practitioner. In pre-testing, over two-thirds of his responses to the SCL-90 were “extreme” and in testing after 81 sessions, all responses were “not at all.”

Conclusions

This case suggests several avenues for research. The first is the efficacy of frontal and pre-frontal training in fear based disorders. The second is the successful use of 0-3 Hz reward. Allan Schore calls ROC the greater amygdaloid region and concludes that it retains exceptional plasticity through the life span. This case appears to validate this view and suggests that neurofeedback may appeal to developmental regulatory mechanisms.

Neurofeedback Combined with Floatation Restricted Environmental Stimulation Therapy Facilitate Meditative Experience

Dale Foster, PhD

Memphis Integral Neurofeedback Institute, Memphis, TN
<dfoster1@MemphisNeurofeedback.com>

Introduction

This case study examined the qEEG and subjective effects of a technique in which neurofeedback (NFB) training is combined with floatation restricted environmental stimulation therapy (REST). REST and NFB training have each demonstrated positive effects on mind/body health and in this case, their combination appears to enable facilitation of meditative and unitive experiences.

Method

In this study a single volunteer subject with no formal meditation training engaged in a 90-minute interactive floatation REST session. Before, during and after the session qEEG data were recorded and monitored and

subjective experience was surveyed and monitored. NFB training and verbal guidance and communication were provided during the session. REST was provided through a ThinkTank Pathfinder FX3 floatation system. QEEG data and NFB training were provided using a Deymed 32 qEEG and NFB system with a specially modified ElectroCap interface to enable use in a floatation REST environment. Verbal interaction was maintained throughout the session via an intercom.

Results

Pre- and post-qEEG data and subjective reports indicated the subject was able to enter into and transition through EEG and experiential states characteristic of meditative states. Measures of frequency, amplitude, variability and connectivity all evolved in directions consistent with meditative states and generally paralleled published research regarding the EEG and experiential effects of effective meditation practice.

Conclusion

Based on this case study, combining NFB training with floatation REST may provide conditions more conducive to meditative experience than either of the techniques alone.

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Psychophysics of EEG State Discrimination

Jon Frederick, PhD

Department of Psychology, University of Minnesota, Minneapolis, MN
<smiile@umn.edu>

Introduction

Nearly all research on human EEG learning since the 1960s has focused on control of EEG constructs. Learning is difficult to measure in

EEG control training because thresholds are constantly adjusted based on within-subject variation, and effects of training are often smaller than the baseline variation. By contrast, a direct measurement of success is intrinsic to discrimination learning. A rigorous method of measuring a subject's perceptual acuity for discriminating EEG states could provide insight about relationships between "control" and "awareness" of these states, and a practical experimental model of EEG control training. This study investigated the ability of one subject to discriminate high from low beta/theta and relative alpha amplitude states.

Method

EEG was recorded at Fz with linked ears reference using custom software and a BrainMaster EEG. For the beta/theta task, the subject was prompted (randomly) to respond "high" or "low" when beta/theta exceeded 20 percentiles from the baseline median. For alpha, the subject was allowed to decide when to respond, alternating, when he felt a "high" or "low" alpha state was present.

Results

Success for beta/theta was insignificant, 53% over 487 trials. Success for alpha was 66% over 1168 trials ($p < .0001$). The perceptual threshold for alpha discrimination appeared to be 30%, i.e., 0-40 and 70-100 percentile amplitude events were guessed correctly (63-84%, $p < .001$), while events in between were guessed at chance levels. "High" alpha responses were more often correct (76%, $p < .0001$) than "low" (55%, $p < .01$).

Discussion

These results suggest relative alpha amplitude is discriminable and beta/theta ratios might be discriminable if subjects are allowed to decide when to respond. Future studies will assess perceptual acuity between subjects and among various EEG constructs and scalp locations.

Bridging the Gap Between Neurotherapy and Psychotherapy: A Clinical Report

David Freides, PhD

Psychology Department, Emory University, Atlanta, GA
<dfreide@emory.edu>

Introduction

Carmen (2004) described an effective neurofeedback treatment of migraine in which patients were trained to elevate infrared brain emissions from Fpz. To increase motivation, he added movie watching to the procedure and arranged matters so that an emission threshold could be set, below which the film went on pause but above which, would resume. Observations are reported which suggest that this motivational innovation may have greater utility. By exposing the patient to thematic material in the film plot, sudden and persisting declines in infrared output may objectively signal areas of emotional conflict.

Method

While conducting neurotherapy with experienced patients who consistently elevated and sustained their infrared emission, it was observed that emissions suddenly plummeted and would not return to levels previously attained. The themes in the film-plots expressed just prior to these events were (1) relationship to father, (2) being gay, or (3) resigning from prior commitments. When the session ended, the patients were asked whether they recalled what was going on in the film when their emissions dropped.

Results

The ensuing discourse, lasting 5 to 10 minutes, verified that personal associations of a conflictual and distressing nature had been elicited by the film. This led to further discussion, much like what occurs in psychotherapy, aimed at eliciting and resolving their conflicts.

Conclusions

The brain responding to objective neurofeedback is the same brain that responds to stimuli associated with emotional conflict. Movies may introduce emotionally conflictful stimuli into the training session and disrupt brain activity. Such stimuli and accompanying emotions may interfere with the progress of neurotherapy but open avenues of communication relevant to psychotherapy. Doing both may be required to assure success with either form of therapy.

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**A Physiologically Based Model of Mind/Brain and Consciousness:
Implications Based on Timing (Invited Presentation)**

Jay Gunkelman, QEEG-Diplomate
Q-Metrx, Crockett, CA
<jay@q-metrx.com>

A data-based model was constructed using the modern neuroscience-based measurements such as Go-No/Go event-related potentials, CNV/Bereitschaft's potentials, bispectral analysis, and event related synchronization/desynchronization, as well as various peer reviewed observations of timing and neural network dynamics within the brain. This model directly challenges many commonly taught concepts, such as gamma's role in binding.

**Improved EEG Coherence Estimates of the Effects of Ayahuasca
and Related Experiences**

*David Joffe, BA (1), Frank Echenhofer, PhD (2), Katee Wynia, MA (3),
and Luis Eduardo Luna, PhD (4)*
(1) Lexicor Medical Technology, Boulder, CO
(2) California Institute of Integral Studies, San Francisco, CA
(3) Sonoma State University, Rohnert Park, CA
(4) Swedish School of Economics, Helsinki, Finland
<fechenhofer@ciis.edu>

Introduction

This presentation reported EEG and experiential correlates of ayahuasca experiences. Ayahuasca is a hallucinogen used by Amazonian shaman to facilitate visionary experiences for healing and knowledge acquisition (Luna, 1984).

Method

In Brazil in January, 2005 twelve participants experienced in ayahuasca took part in a seven-hour individual EEG ayahuasca session. Nineteen EEG and two eye movement electrodes were attached using standard procedures. Dr. Luna was present at sessions to facilitate using shamanic interventions as needed.

Results

This study followed an earlier pilot EEG research conducted by Frank Echenhofer and David Stuckey in Brazil in July, 2000. EEG of two experienced individuals was recorded during ayahuasca experiences (Stuckey, 2004). Enhanced EEG gamma coherence from 36 to 64 Hz was observed among the majority of 19 standard EEG recording locations during eyes-closed ayahuasca compared to the eyes-closed baseline condition.

Conclusion

Enhanced gamma coherence during ayahuasca may indicate an enhancement of the neural processes that “bind” the elements of consciousness into one unified experience. Enhanced gamma coherence may be an EEG marker for visionary states of consciousness. The next step in this research program is to develop biofeedback protocols based upon the EEG gamma coherence patterns observed during ayahuasca experiences and then to use EEG biofeedback methods to attempt to facilitate voluntary access to visionary experiences without the need of ayahuasca. This paper reported on improved EEG coherence estimates occurring during ayahuasca with twelve participants.

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QEEG Patterns: Subgroups, Profiles, Phenotypes (Invited Presentation)

Jack Johnstone, PhD

Q-Metrx, Inc., Los Angeles, CA

<jack@q-metrx.com>

Introduction

We propose development of evidence-based methods to guide clinical intervention in neurobehavioral syndromes based on categorization of individuals using both behavioral measures and quantification of the EEG (qEEG). The notion of EEG “phenotype” is presented and contrasted with the use of qEEG for behavioral diagnosis.

Method

This presentation was based on clinical experience and review of the literature.

Results

Review of a large number of clinical EEG and qEEG studies suggested that it is plausible to identify a limited set of individual profiles that characterize the majority of the population. Statistical analysis has already been used to document “clusters” of qEEG features seen in populations of psychiatric patients (John, Pritchep, & Almas, 1992). These clusters are considered as intermediate phenotypes, based on genetics, and are reliable indices of brain function, not isomorphic with DSM categories, and with implications for therapeutic intervention.

Discussion

We called for statistical analysis methods to be applied to a broad clinical database of individuals diagnosed with neurobehavioral disorders in order to empirically define clusters of individuals who may be responsive to specific neurophysiologically based treatment interventions, namely administration of psychoactive medication and/or EEG neurofeedback. A tentative set of qEEG profiles was proposed based on clinical observation and experience. Implication for intervention with medication and neurofeedback for individuals with these neurophysiological profiles

and specific qEEG patterns was presented (see Johnstone, Gunkelman & Lunt, 2005).

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Comodulation and Coherence: Separate But Equal Measures of EEG Synchrony

David A. Kaiser, PhD

Rochester Institute of Technology, Churchville, NY

<dakaiser@mail.rit.edu>

Introduction

Coherence and comodulation analyses assess linear signal similarities between brain areas. Coherence quantifies phase relationship and comodulation amplitude relationship between EEG signals. Each approach captures two estimates of linear similarity: coherence and phase delay, comodulation and amplitude proportion. In general, coherence assesses shared constraint between signals (e.g., a common generator) and comodulation quantifies shared autonomy, intrinsic to mental representation. Both techniques are normally performed on the same frequency band, although investigation of nested rhythms and similar energies of disparate frequencies can also be addressed.

Method

Comodulation and coherency were compared using random numbers and empirical data. Twenty adult normals, 10 children with Asperger's syndrome, and 9 children with attentional deficit hyperactivity disorder (ADHD) were also analyzed.

Results

As expected, no significant coherence or comodulation was found between 2,000 pairs of random number epochs. Despite being orthogonal

measures, coherence and comodulation revealed modest correlations with each other in this analysis, possibly due to the ideal energy distribution across a spectrum. Empirically, comodulation and coherence did correlate strongly with each other, in the $r = .70$ range for eyes closed data. Related comodulatory measures were also analyzed, including a gross mean that may reflect cortical maturation. This measure correlated with age in ADHD children, and separated ADHD from age-matched Asperger's children, and children from adults.

Discussion

The role of coherence and comodulation in QEEG assessment were discussed, along with practical issues in implementing training of either measure such as the length of history to use and the sampling rates of this history. Techniques to provide fluidic, moment to moment representations of comodulation and coherency were described. Finally, a clarification of spectral analysis was provided, separating frequency analysis from power transformation which was mistakenly conjoined by past investigators (e.g., Blackman & Tukey, 1958).

QEEG Analysis of Treating PTSD and Bulimia Nervosa Using EMDR

James A. Kowal, PhD

The Center for Traumatic Stress, Naperville, IL

<jkowal@traumaticstress.org>

Introduction

This study used QEEG before and after eye movement desensitization and reprocessing (EMDR) treatment for a single incident trauma of rape and a resulting condition of bulimia nervosa. The symptoms were so severe that the patient required an emergency room visit.

Method

The patient had a pre-treatment QEEG completed using the Lexicor NeuroSearch-24. The QEEG data was artifacted and analyzed using NeuroGuide software. The patient underwent a total of 13 sessions of

treatment using EMDR. The post-treatment QEEG used the same hardware and software.

Results

Following the EMDR treatment, the patient discontinued all PTSD and bulimia symptoms. The patient returned to her usual involvement with family and friends, became more interested in school, changed her career objective and curriculum, and had an improved self-image.

The pre-treatment QEEG Z-score absolute power indicated high posterior delta and theta activity with extensive abnormalities in amplitude asymmetry in the delta and theta bands. Only minimal abnormalities in the coherence and phase lag. The patient did report three traumatic brain injuries with no loss of consciousness. The NeuroGuide TBI discriminate indicated a 75% probability of brain injury of mild (2.84) severity.

The post-QEEG Z-score absolute power indicated normal levels of delta and theta activities with absolutely no amplitude asymmetries abnormalities. However, coherence abnormalities increased. The TBI discriminate was found to be not significant.

Conclusions

In this single case study, trauma was indicated by low frequency activity primarily in the posterior region and produced significant amplitude asymmetries. Bilateral stimulation treatment methods such as EMDR were shown to be successful in treating the PTSD and Bulimia Nervosa conditions. The QEEG analysis quantified and provided evidence that supported this conclusion. It showed a return to normal levels of slow activity in the posterior regions and a complete elimination of the abnormal amplitude asymmetries.

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Low Energy Neurofeedback System (LENS): A Study of 100 Patient Outcomes

Stephen Larsen, PhD (1), and Kristen Harrington, MA (2)

(1) Director, Stone Mountain Center, New Paltz, NY

(2) Clinician, Stone Mountain Center, New Paltz, NY

<office@stonemountaincenter.com>

Introduction

Over a period of five to seven years, Stone Mountain Center has collected data on 100 patients in a clinical outcome study of neurofeedback. Patients rated their five most significant symptoms at each session, using a 1 to 10 rating scale (0 being no discomfort, 10 being the highest discomfort). The change in symptom severity was measured by subtracting the value of the last session's score from the value of the first session's score. Changes in all five symptoms were averaged together to get one final change score.

Method

Presenting problems/diagnoses include headaches, post accident traumatic brain injury or spinal injury, post traumatic stress disorder, fibromyalgia or chronic fatigue syndrome, Parkinson's disease, affective disorders including depression, bipolar disorder, anxiety disorders and Attention Deficit Disorder. Ages of the patients varied from 5 to 80 years of age. The male to female ratio was 40/60. The hypotheses of our study are as follows:

1. Neurofeedback treatment generally, and LENS in specific, reduces the severity of CNS symptoms.
2. Patients will report a reduction in the severity of their symptoms at each session, with a greater reduction of symptoms in the first ten sessions than in the second and third rounds of ten session treatments.

Results

The design of our study is single group, pretest/posttest. We are using t-test statistics to measure the relationship between different measures of outcome for each client: drop in severity of symptoms from first to last session, drop in frequency of symptoms from the CNS questionnaire pre-

test to posttest, and drop in amplitude of CZ and each patient's highest amplitude site.

For the 55 cases processed so far, there was a robust drop in severity of patient symptoms from intake to the last session. On a scale of 0 to 10, ten being most severe, the average drop in symptom severity was 4.84. That means that symptoms dropped by slightly less than 50% across the diagnostic categories.

We also measured changes in the amplitude of two key sites per client for a sub-sample of our group: CZ and the individual's own highest amplitude site as measured at intake. Preliminary results indicated a correlation between the amplitude drop and the symptom severity drop.

Conclusion

We intended to compare rate of improvement over the complete course of treatment. Preliminary data also showed greater improvement at the beginning of treatment with this method. Other similarly useful parameters for clinical treatment were studied and presented.

Status of Neurofeedback: Past, Present, and What Needs to Be Done (Invited Presentation)

Joel F. Lubar, PhD

University of Tennessee, Knoxville, TN

<jlubar@utk.edu>

Since the 1970s only a few hundred papers have been published in peer reviewed journals regarding basic or clinically based research in neurofeedback. There are excellent experimental designs for validating the effectiveness of neurofeedback yet, for example, only three double blind A-B-A studies have been published. These include two by me in the area of ADHD and epilepsy, yet this is a gold standard for most studies in medicine for evaluating effectiveness of treatments, along with randomized matched group studies.

Graphing training parameters within and across sessions is critical along with pre and post measures such as QEEGs, psychometric measures, learning measures for some patients and other metrics. This is the best and most valid way to prove to patients, insurers, and regulatory agencies that neurofeedback is specific, powerful, and worthy of recognition as a valid methodology. This was demonstrated in the presenta-

tion. The current status of databases and what still needs to be done to make them even better was also discussed.

Overcoming the Barriers to Effective Treatment for ADHD: A Neuro-Educational Approach (Keynote Presentation)

Vincent J. Monastra, PhD

Clinical Director, FPI Attention Disorders Clinic, Endicott, NY; Adjunct Associate Professor, Department of Psychology, Binghamton University, Binghamton, NY
<poppidoc@aol.com>

Introduction

Despite specific diagnostic criteria, published practice guidelines for assessing patients, and the availability of effective pharmacological treatments for children diagnosed with ADHD, an overview of prescription practices in the United States indicates that as few as 25-50% of these patients receive even minimal medical treatment for this condition. Review of the scientific literature revealed that parental concerns about cost of treatment, insufficient information about ADHD and medication, and fear of adverse treatment response, were associated with a decision not to comply with treatment recommendations. Because of the risk for long-term psychiatric, social, and health care problems in children with ADHD who are untreated, the development of intervention programs designed to address the barriers to treatment appears necessary in order to promote the well-being of these children.

Methods

In order to further clarify the factors impeding treatment of ADHD during childhood and develop a targeted intervention program to overcome these barriers, two studies involving 1,514 families were conducted. Each family included one child who had been diagnosed with ADHD by a board certified physician, but whose parents/guardians had either never proceeded with treatment or who decided to discontinue treatment within the first three months. In the first study, 856 families completed the "Barriers to Treatment Survey" (BTS) in order to clarify the factors that led to the lack of treatment. Parental responses to this survey led to the development of a three-session intervention program.

In the second study, 658 families participated in the three-session intervention program, which included a comprehensive evaluation process (including neuro-psychological and neurophysiological tests of attention; medical screening for other health problems associated with inattention and hyperactivity) and parent education about the medical causes of ADHD, the biochemical action of medications, the relationship between dietary habits and attention, and the educational rights of children with ADHD. We also developed two medication protocols (based on QEEG findings). Stimulants (methylphenidate; mixed amphetamine salts) were recommended for patients demonstrating cortical underarousal at Cz. Non-stimulants (atomoxetine; guanfacine; clonidine) were recommended for patients who demonstrated cortical hyperarousal or no slowing over this region. Follow-up sessions were conducted over a two-year period.

Results

Study 1. Review of parental responses to the BTS revealed that over 90% of parents failed to follow medical advice because of discomfort over administering medication without direct testing of attention and due to a fear of medication side effects. Among parents whose children had been treated with medication, over 95% of parents decided to discontinue treatment due to the development of side effects or the persistence of problems at home or school despite medication. Additional parental concerns included lack of information about ADHD and medication risks.

Study 2. Examination of treatment compliance rates revealed that over 70% of patients had begun pharmacological treatment within the first six weeks after assessment. By the six-month follow-up, over 90% of all patients were being treated. At the two-year follow-up, 95% of all patients were responding positively to medication. Significant reduction in rate of side effects was also noted, as approximately 10% of patients continued to demonstrate appetite loss, insomnia, or increased irritability by the two-year follow-up.

Discussion

Parental concerns about medication side effects, a lack of understanding about ADHD, and discomfort over administering medication without direct evaluation of attention pose significant impediments to the effective treatment of children with ADHD. A three-session intervention program that included neuropsychological and QEEG examination of

patients, provided information about the nature of ADHD, and addressed parental concerns, led to significant gains in treatment compliance and reduction in side effects. These results lend further support for the integration of QEEG procedures in the assessment of children suspected of ADHD.

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Expectation, Observation, and Understanding: Development of a Clinical Model of Neurofeedback (Invited Presentation)

Susan F. Othmer, BA

EEG Institute, Woodland Hills, CA

<sue@eeginfo.com>

Our clinical model of neurofeedback has evolved through a cycle of changing clinical approaches, changing clinical results, and a changing clinical model. Certain client populations have presented special challenges to our clinical approach, which then push us to improve our approach so as to improve our results. Efforts to understand the clinical results we observe have then led us to modify our model of efficacy. We have also been challenged by the results of functional brain imaging and theoretical models of brain function to try new clinical approaches and to rethink the clinical model.

This presentation outlined our path from simple beta and SMR training to a more client-centered and individualized approach to learned self-regulation. Significant clinical and theoretical challenges were discussed that have led to breakthroughs in clinical approach and results. We also discussed our evolving appreciation of each individual's unique experience of neurofeedback, and how we observe subtle shifts in brain state that allow fine-tuning of the clinical approach. We continue to be challenged by the power and specificity of neurofeedback and our evolving understanding of how the nervous system responds to this simple yet profound functional challenge.

TOVA Results for Inter-Hemispheric Training, a Historical Comparison, and Model Implications

Siegfried Othmer, PhD, Susan Othmer, BA, and John Putman, MA, MS
The EEG Institute at the Brian Othmer Foundation, Woodland Hills, CA
<siegfried@eeginfo.com>

Introduction

Protocol-based or mechanism-based training has recently moved toward the adoption of bipolar inter-hemispheric training at homologous sites as a mainline approach. In this presentation, recent continuous performance test results for such protocols are compared with earlier findings using standard lateralized approaches. Improved results mandate the consideration of models of efficacy that might explain the clinical improvement. Recently acquired TOVA data on over 100 clients were presented and compared to data acquired with earlier protocols in order to document that an advance in clinical efficacy has indeed been achieved.

Method

Reward and inhibit-based training using bipolar inter-hemispheric placement on homologous sites, principally on the sensorimotor strip, was evaluated in more than 100 participants and compared with earlier results using lateralized training optimized to each hemisphere. TOVA results were used as a measure. Principal site pairs were T3-T4, Fp1-Fp2, and P3-P4. The reward band was individualized on the basis of clinical response. Broadband inhibits were used.

Results

Success rates in achieving normalization of TOVA scores were shown to have improved with the adoption of the new protocols. In particular, saturation of inattention scores at zero omission errors is more routinely achieved. The numerical improvements have come despite extensions of this work to more severely deficated populations and to ostensibly more intractable conditions such as the autism spectrum.

Conclusion

The improved outcomes mandate the consideration of models of efficacy on the one hand, and a consideration of various possible contribu-

tors to the clinical improvement. Theoretical modeling indicates that bipolar training in general and inter-hemispheric training in particular, may reinforce phase changes even in standard amplitude-based training. Hence the efficacy of protocol-based training may be traceable to a very general modulation of cortical timing relationships.

Enhancement of Auditory Memory via Operant Conditioning of Electrocardiac Potentials

Roger H. Riss, PsyD

Madonna Rehabilitation Hospital, Lincoln, NE

<rriss@madonna.org>

Introduction

Compensatory strategy training for memory loss, while useful in reducing the practical impact of the underlying memory disorder, has demonstrated limited efficacy in terms of actual restoration of memory function (Cicerone & Dahlberg et al., 2000). Much has been learned in the past decade about the electrophysiological substrates of effective memory encoding and retrieval (Bastiaansen & Hagoort, 2003). Transient memory enhancement been demonstrated via rTMS-induction of specific EEG oscillatory patterns (Klimesch, Sauseng et al., 2003; Kohler, Paus et al., 2004), as well as via entrainment of EEG to a flashing visual target (Williams, 2001). Thornton has reported case series data in which EEG operant conditioning, guided by a task data base, yielded improved auditory learning and memory skills in brain injury survivors (Thornton 2001, 2002, 2005). However, his data has recently been challenged on statistical grounds (Callahan & Barista, 2005) and outcomes were not benchmarked via standardized neuropsychological test scores. We report independent replication of Thornton's methodology in a series of brain injury survivors. Subjects achieved statistically significant gains on norm-referenced measures of memory and learning, as well as clinically significant improvement in vocational functioning.

Method

Electrocortical correlates of memory performance were identified in a pilot group of brain injury survivors, greater than one year post injury. Pat-

terns associated with efficient encoding and recall were reinforced, via EEG operant conditioning, while subjects simultaneously engaged in an auditory learning and recall task. For the auditory learning and memory protocol, key correlates of memory efficiency include coherence and phase relationships originating from lateral left hemisphere sites. Pairing with T3 and F7 are particularly critical. However, we usually down train any excessive slow wave activity prior to beginning the coherence work. Pilot data for three cases were presented. Two of three cases achieved return of auditory memory values to average range in under twenty sessions. The third case, a young woman who sustained trauma to deep temporal lobe structures both due to aneurysm and subsequent craniotomy, demonstrated no benefit from more than 50 sessions.

Results

Subjects experienced gains on list learning and story recall of greater than 1 standard deviation, with greatest improvement at the retrieval stage. One subject, with a history of extensive traumatic injury to the left medial temporal lobe, demonstrated no benefit from training.

Conclusions

Preliminary data supports a promising role for direct modification of the functional electrophysiological substrates of memory via operant conditioning.

Neurofeedback and Cognitive-Behavioral Therapy Based Intervention in Dual Diagnosis: A Neurobiological Model

Tato Sokhadze, PhD

Department of Psychiatry, University of Louisville, Louisville, KY

<tato.sokhadze@louisville.edu>

Introduction

Comorbid psychopathology, and specifically PTSD which is highly prevalent among substance abusers is known to be associated with poorer treatment outcomes. Cognitive factors (e.g., craving, cue reactivity) and

level of their persistence are important predictors of relapse. Previously we reported effects of a behavioral intervention on behavioral measures and ERP during performance on cognitive tasks (selective attention, cue reactivity) in cocaine addicts (Sokhadze et al., 2004). On the basis of results and earlier pilot (Filkenberg et al., 1996) we propose a neurobiological model of factors contributing to aggravation of drug seeking in cocaine abuse co-occurring with PTSD.

Method and Results

In the study underway we tested hypotheses derived from this model, and in particular predictions that patients with dual diagnosis would show impairments in cortical inhibition, decision making, and over-reactivity to both drug- and trauma-related cues in a battery of cognitive (Go-NoGo, Iowa Gambling, cue reactivity) tasks before treatment and would improve performance after cognitive behavioral therapy and neurofeedback. Dense-array ERP components (P2a, N2b, P3b, ERN) were used in the study to elucidate the cortical neural substrates and specific cognitive processes affected by cocaine use and PTSD. We presented design of study, functional significance of ERP components and methods aimed to test predictions of the model.

Conclusions

The proposed model was aimed to outline cognitive factors that impact drug abuse treatment in dual diagnosis and to develop more effective treatment by integration of behavioral interventions under study.

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**Principles of Neurotherapy: What Are We Really Trying to Do?
(Invited Presentation)**

M. Barry Sterman, PhD
School of Medicine, UCLA
<msterman@ucla.edu>

Like all areas of investigation and treatment in the realm of the brain and behavior, the field of neurotherapy has evolved many differing methodological and conceptual perspectives. And all of these perspectives report positive clinical results. What appears often to be lacking however, is a convergent or coherent theoretical basis for these findings. Recent developments in cellular and molecular biology have begun to elucidate the probable synaptic mechanisms at the core of neuroplasticity. Of great significance to the field, these mechanisms share a common basis with the thalamocortical generation of the EEG oscillations that is the focus of neurotherapy. Of particular relevance due to timing and topography is the fast sensorimotor cortex rhythm known as the SMR and the somewhat slower post-response parietal rhythm termed the PRS. The functional basis and possible synaptic correlates of these and slower abnormal rhythms on cortical networks will be reviewed in the development of a rational theoretical framework for effective neurotherapy.

QEEG-Guided Neurofeedback in the Treatment of Children with Histories of Relational Trauma

Lark Huang Storms, MS (1), Richard Davis, MS (2), Janice Dunn, MA (1), and Eugenia Bodenhamer-Davis, PhD (1)
(1) University of North Texas, Denton, TX
(2) Private Practice, Hurst, TX
<genie@unt.edu> or <larktim@teleport.com>

Introduction

Poor self-regulation of arousal is central to the behavioral difficulties experienced by children with traumatic attachment histories. EEG biofeedback teaches children to self-regulate brain rhythmicity, which may in turn affect global improvements in the areas of attention, aggression, impulse control, and trust formation. Research literature supports the use of neurotherapy for children with ADHD (e.g., Lubar et al., 1995), autism (e.g., Sichel et al., 1995), asthma (e.g., Tansey, 1992), stroke (Ayers, 1995), and migraine (Siniatchkin et al., 2000). This study extended current

research by investigating the effectiveness of neurotherapy in reducing behavioral problems commonly observed in abused/neglected children.

Method

Fifteen children with histories of removal from the home by Child Protective Services received 30-40 individualized sessions of QEEG-guided neurotherapy treatment. Pre- and post-scores on the Child Behavior Checklist (CBCL) and the Test of Variables of Attention (TOVA) were compared to assess effectiveness of treatment.

Results

T-tests analysis of pre- and post-scores on the CBCL showed most significant changes in the areas of externalizing problems, social problems, aggressive behavior, delinquent behavior, and attention problems ($p < .05$). TOVA commission error and variability scores also improved significantly following neurofeedback training ($p < .05$).

Conclusion

This clinical sample of 15 children with traumatic attachment histories showed significant improvement in self-regulatory behaviors following individualized neurofeedback training, as measured by changes in scores on the CBCL and the TOVA.

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A Meta-Analysis of Neurofeedback and Epilepsy

Gabriel Tan , PhD (1), *D. Corydon Hammond*, PhD (2), and *John Thornby* , PhD (3)

(1) VA Medical Center and Baylor College of Medicine, Houston, TX

(2) University of Utah School of Medicine, Salt Lake City, UT

(3) Baylor College of Medicine

<tan.gabriel@med.va.gov>

Introduction

Since the publication of the first scientific paper applying EEG operant conditioning to the treatment of seizure disorder in 1972, many studies have been published in this area. Unfortunately, many of these studies were either case studies or employed very small sample size. In reviewing the research on the clinical efficacy of EEG biofeedback for epilepsy, Sterman (2000) found a total of 18 peer-reviewed articles between 1972 and 1996, which showed clinical improvement in 82% and EEG improvement in 66% of the subjects. An excellent discussion on the relevant physiology of epilepsy and a model on how neurofeedback might raise the seizure threshold for epileptics were recently presented by Walker and Kozlowski (2005). The purpose of this paper is to conduct a meta-analysis of the research on neurofeedback and epilepsy.

Method

A literature search of the Pubmed, MedLine, PsychInfo, and PsychLit databases between the years 1970 and 2005 was conducted with the search algorithms of EEG biofeedback or neurofeedback or neurotherapy for the treatment of epilepsy or seizure disorders.

Results

While over 40 studies were identified, only a handful of these studies were included due to the lack of control groups and the unavailability of data needed for the meta-analysis. The largest study with a control group design has an N of 34 and utilized slow cortical potential (SCP) training. Several studies using sensorimotor rhythm (SMR) training with control group were included. Several more studies with no control group were also included as long as they provide pre- and post-seizure rates.

Conclusion

At the time of this submission, the meta-analysis was still in process; therefore, effect size information was not yet computed. However, preliminary analysis indicated that EEG biofeedback in the form of SCP or SMR training is efficacious for the treatment of epilepsy based on the template developed by the Efficacy Task Force established jointly by the Association of Applied Psychophysiology and Biofeedback (AAPB) and the International Society for Neuronal Regulation (ISNR; La Vaque et al., 2002).

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LORETA and QEEG Correlations with the Alzheimer's Disease Assessment Scale

Alicia L. Townsend, PhD (1), and Leslie H. Sherlin, MS (2)

(1) University of North Texas Health Science Center, Roanoke, TX

(2) Nova Tech EEG, Inc., Knoxville, TN, Q-Metrx, Inc. Burbank, CA,

Southwest College of Naturopathic Medicine, Tempe, AZ

<pnpdralicia@yahoo.com>

Introduction

Alzheimer's disease (AD) promises to be a threat to the health system, making early detection and treatment imperative. Research has shown that quantitative EEG (QEEG) measures of AD patients show increased measures of delta and theta, and decreased alpha and beta, as well as decreased coherence (Jeong, 2004). The purpose of this study is to examine the relationship between memory loss and brain electrical activity.

Method

One hundred participants between the ages of 65 and 85 were administered the Alzheimer's Disease Assessment Scale-Cognitive (ADAS-Cog), a QEEG, and a clinical interview. Brain electrical activity was digitally recorded on a Lexicor NeuroSearch-24 system from 19 scalp electrodes, according to the International 10-20 system of electrode placement. The recording was digitized and edited to reduce artifact and subjected to quantitative spectral analysis using EureKa3 software.

The cross spectra was averaged and LORETA correlation maps computed and displayed using the LORETA Key viewer software. Correlations were computed for each individual's ADAS-Cog score compared to each voxel ($7 \times 7 \times 7 \text{ mm}^3$) of their baseline LORETA. The eyes closed data cross-spectral analysis was examined in nine bands.

Results

Initial overview of the data suggested a positive correlation between slower activity and elevated ADAS-Cog scores, with primary focus in the temporal lobes. The data were still being collected and calculated. Currently there are 85 subjects compiled for analysis. The entire study was scheduled to be complete by August 2005 and planned to contain 100 subjects.

Conclusion

This study expected to corroborate previous literature that indicated a decline of central, parietal, temporal, and limbic alpha 1 (low alpha) sources for more severe AD. It is expected for those who are less severe and may instead have vascular dementia distributed theta sources are expected to be more involved. If these findings are consistent the investigation can further validate that the level of EEG sources vary in AD patients having different severity of the disease (Babiloni et al., 2004). The clinical usefulness of this approach in early differential diagnosis, disease staging, and therapy monitoring could be critically relevant.

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Left Prefrontal NIRS Activation as Add On Treatment in Depression and Schizophrenia

J. C. Vouakouanitou, MD

EEG and Clinical Neuroscience Research, France

<bek@bek.fr>

Introduction

Different psychiatric disorders, such as schizophrenia, major depression, and obsessive-compulsive disorder are analyzed with functional brain imaging techniques such as fMRI and fNIRS. We used our own prototype CW-NIRS system (48 channels) to investigate the cortical information processing and to study therapeutic applications in psychiatry and neurology.

Methods

We measured concentration changes in cerebral hemoglobin oxygenation in the frontal and parietal cortex during performance of a verbal fluency task in patients with schizophrenia ($n = 10$), obsessive-compulsive disorder ($n = 10$), major depression ($n = 10$) and 10 healthy volunteers. All subjects participated in functional NIRS-imaging system experiments. While participants listened to classical and Gregorian music, they are invited to vigorously write in the air a large “1” by feeling the movement of the arm, by seeing the gesture, by pronouncing “1” mentally and by hearing it. In the present study, we evaluated the activity of the muscle and its local oxygen uptake (VO_2) induced by auditory (music) stimulation in the prefrontal cortex in the supplementary motor area. Cognitive functions were evaluated by neuropsychological tests.

Results

Results showed activation of the supplementary motor area, inferior frontal gyrus (Broca’s area) and a decrease in the left prefrontal areas reached significance ($p < .05$) and in COV; partial increase ($P < .005$) in CBV and COV with calculation tasks, and continuing increase in CBV and COV with verbal fluency tasks.

Conclusions

fNIRS is a non-invasive optical system useful for monitoring the regional cerebral blood volume (rCBV) dynamics coupled with neuronal

activities. This method applied to the prefrontal cortex has anti-depressive properties.

Billing and Insurance: What You Gotta Know and What You Don't Want to Do (Invited Presentation)

Bob Whitehouse, EdD

Former AAPB Insurance Chair; Colorado Center for Biobehavioral Change, Boulder and Denver, CO
<BobWhitehouse@gmail.com>

Experiencing reimbursement blues? Likely to get busted for your billing? Are you coding and billing right? Do you know what codes to safely use, who can use them, how to seek authorizations, and who gets investigated for fraud? This talk was a "quick and dirty" summary of this and how to handle denials. Even if you have a billing company, they may not know this info, and yet you're responsible ethically and legally for what is billed. This topic is boring to us all but essential to know, may keep you out of trouble, and may open some doors to better reimbursement. Know your codes, laws, ethics, and rights. The questions to ask insurance companies to get approvals were shared in this presentation.

QEEG and GSR Findings in a Community Sample of ADHD

David Wilensky, PhD

Jerusalem Child Development Center, Jerusalem, Israel
<Davidvil@012.net.il>

Introduction

While a number of studies have looked at GSR findings in ADHD, and other studies have reported QEEG findings, few have looked at both measures in the same population. Also many studies are based on referred clinical cases and not on community-based populations of ADHD.

Method

Four elementary schools were screened for children suffering from ADHD using teacher DSM4 questionnaires. For children above 85%, parents were also requested to fill out the questionnaire and those above the cut-

off on the second form as well were included in the study. Diagnostic data included a clinical interview, 5 WISC subtests, IVA, parent Achenbach questionnaire, reading and math achievement tests, and a general medical and neurological exam. QEEG was performed with Mindset and analyzed by the SKIL program. GSR was measured under four different sensory stimuli. A control group consisting of normal children from the same class as the clinical cases was tested by the same battery. There were 55 children identified with ADHD but not all of them had the full battery of tests. There were 25 with QEEGs and 23 with GSR recordings. The control group consisted of 25 children of whom 16 had QEEGs and GSR recordings.

Results

The difficulty in determining a “gold standard” for the diagnosis of ADHD was evident in the lack of correlation between the measures used. Significant learning disabilities and emotional comorbidities were noted. Unlike previous studies amplitude data and ratios on the QEEG did not differentiate the ADHD children from controls, nor did the GSR data. Comodulation is not quantifiable in the SKIL program but some impressionistic data will be presented.

Conclusion

Our hope for an objective diagnostic measure for ADHD was not realized. The nature of a community-based study population might explain some of the differences with previous QEEG studies, or perhaps the confounding effect of comorbidities that could not be factored out in a small study sample.