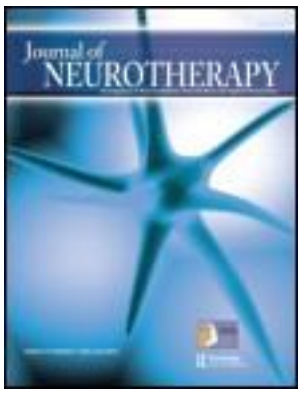

Journal of Neurotherapy: Investigations in Neuromodulation, Neurofeedback and Applied Neuroscience

Student Scholarship Presentation Abstracts

Published online: 08 Sep 2008.

To cite this article: (2005) Student Scholarship Presentation Abstracts, Journal of Neurotherapy: Investigations in Neuromodulation, Neurofeedback and Applied Neuroscience, 9:4, 73-89, DOI: 10.1300/J184v09n04_08

To link to this article: http://dx.doi.org/10.1300/J184v09n04_08

Student Scholarship Presentation Abstracts

Predictive Validity of Quantitative EEG Estimates of IQ and the Wechsler Abbreviated Scale of Intelligence Estimates

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Introduction

Correlations between EEG power spectra and intelligence were demonstrated as early as the 1980s (Gasser, Von Lucadou-Müller, Verleger & Bächer, 1983). Thatcher, North and Biver (2005) utilized discriminant analysis to determine specific quantitative EEG (qEEG) variables which could predict IQ. These variables had been implemented into the Thatcher, Biver, Walker, North and Curtin (2000) NeuroGuide database and software program to result in an IQ prediction from the qEEG. This study investigated the comparability of estimated IQ scores derived from the Wechsler Abbreviated Scale of Intelligence (WASI; Psychological Corp., 1999) and NeuroGuide's predicted IQ scores (Thatcher et al., 2005).

Methods

As part of the Early Trauma Project at the University of North Texas, resting eyes closed EEG was recorded from 19 scalp locations with a linked ears reference from 60 unmedicated adult research participants age 18 to 59 years. All participants subsequently were administered the WASI as well as other instruments that were part of the larger study. The EEG data was edited using the NeuroGuide software (Thatcher et al., 2000), and then analyzed to obtain the predicted IQ scores. All EEG data used in this analysis met split-half and test-retest reliability score criteria of 90 or greater.

doi:10.1300/J184v09n04_08

Results

Correlations between NeuroGuide's predicted Full Scale IQ, Verbal IQ, Performance IQ scores and the obtained WASI Full Scale IQ, Verbal IQ, and Performance IQ scores on a subset of the original sample (n = 39) were as follows: Full Scale IQ (.32), Verbal IQ (.18), and Performance IQ (.25).

Conclusions

The potential value of being able to predict intelligence from physiological data is immense and could potentially eliminate difficulties that psychologists often face when confronting the question of malingering. However, the obtained low correlations suggest caution should be used when applying the qEEG-based IQ predictions to adults.

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Cerebral Connectivities After Emotional Trauma

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Introduction

Childhood sexual abuse (CSA) has been the subject of much recent controversy as a result of Rind, Tromovitch and Bauserman's (1998) meta-analytic examination of CSA, which found a weak relationship between CSA and self-reported psychopathology in college samples. There have been few studies of CSA which look beyond self-report. The present study is an exploration of the relationships between CSA, qEEG, neuropsychological, and psychological measurements in 20 high-func-

tioning, unmedicated adults without posttraumatic stress disorder (PTSD) and in five like adults with PTSD. The objectives of this study were to (1) examine electroencephalographic (EEG) abnormalities associated with CSA, (2) investigate cortical coherence in the CSA and CSA with PTSD groups using coefficient of determination (CD) mapping methods (Hudspeth, 2004b) to describe and infer underlying functional disconnections, and (3) integrate personality differences associated with CSA to EEG differences.

Methods

As part of the Early Trauma Project at the University of North Texas, resting eyes closed EEG was recorded from 19 scalp locations with a linked ears reference from 60 unmedicated adult research participants age 18 to 59 years. All participants subsequently were administered the Clinician Administered PTSD Scale (CAPS; Nagy et al., 1989) as well as other instruments that were part of the larger study. The EEG data was edited using the NeuroRep software (Hudspeth, 2004a), and then analyzed to obtain the connectivity indices. There were three groups of participants, those who had experienced CSA by age 14 but were not currently experiencing PTSD (n = 20), those who had both experienced CSA and were currently experiencing symptoms of PTSD (n = 5), and those who had never experienced CSA (NCSA; n = 25). The NCSA group was matched to the CSA group for age, gender, and handedness.

Results

Coefficient of determination (CD) mapping methods indicated an overall pattern of disconnection, most evident in right fronto-temporal regions. Personality testing using the Minnesota Multiphasic Personality Inventory–Revised Version (MMPI-2; Butcher, Dahlstrom, Graham, Tellegen, & Kaemmer, 1989) indicated that the CSA groups exhibited poorer adjustment than NCSA adults, despite high average IQ for both groups. EEG abnormalities were not useful in differentiating the CSA group from NCSA adults.

Conclusions

While earlier research had uncovered evidence of damage to subcortical structures of the brain affecting cortical function (Bremner et al., 1997; Teicher, Glod, Surrey, & Swett, 1993), none had available Hudspeth's CD

mapping methodology to closely identify cortical-cortical intercommunication dysfunction. CD mapping data based on EEG coherence information were used to extend to non-clinical, unmedicated adults prior research by Black et al. (2002) with clinical samples suggesting CSA impacts cortical function resulting in lateralized differences.

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EEG Spectral Power and Coherence: LORETA Neurofeedback Training in the Cognitive Division of the Anterior Cingulate Gyrus

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Introduction

This study examined the EEG spectral power and coherence changes that occurred as a result of LORETA neurofeedback (LNFB) training, which is a recently developed spatial-specific neurofeedback protocol in which it has been demonstrated that human beings can learn to change activity in their own anterior cingulate gyrus. We trained individuals to increase low-beta (14-18 Hz) activity in the cognitive division of the anterior cingulate gyrus (ACcd).

Methods

This study was conducted with eight non-clinical students with a mean age of 22. The participants completed over 30 sessions of LNFB training in which they received auditory and visual feedback for increasing low-beta activity in the ACcd, while simultaneously decreasing EMG and EOG activity at selected frontal, temporal and occipital electrode sites. We utilized the complete WAIS-III for a pre training measure. We utilized the Working Memory and Processing Speed subtests for a post training measure.

Results

The data showed significant increases in both absolute power and coherence over sessions. The psychometric measures showed significant increase in the working memory and processing speed scores. There was significant increase in coherence between pre and post eyes-closed baseline recordings.

Conclusions

The anterior regions of the cortex increased in the low-beta frequency with the ACcd at significant levels. The superior prefrontal cortex and occipital regions increased in the higher beta frequencies, but not in the trained frequency. The improvements in the working memory and processing speed scores suggested that LNFB had an overall positive effect in attentional processes, working memory and processing speed.

Quantitative Electroencephalographic Analysis (QEEG) of a Visual-Stroop Task

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Introduction

A low-resolution electromagnetic tomography (LORETA) study was conducted to investigate the intercortical activation induced by visual-Stroop tasks. LORETA imaging allowed for measurement of intercortical areas real-time current densities (Pascual-Marqui, Michel, &

Lehmann, 1994). Preliminary findings showed trends of differing activation between baseline and Stroop conditions.

Methods

After eyes-open baselines were recorded, participants (N = 20) were introduced to the Stroop-discrimination task. The task was exhibited on a three-minute PowerPoint presentation–a progression of slides, containing four color words, changing every three seconds. In the congruent condition, words were written with the corresponding font color. In the noncongruent condition, words had a differing font color. The mixed condition had an even distribution of congruent and noncongruent stimuli. Participants were required to respond with the written word, not the font color. Latency differences have already been established (e.g., Swick & Jovanovich, 2002) so no measurement of this variable was implemented, although responses were monitored to ensure appropriate performance. Task arrangement was controlled to minimize order effects. All conditions were recorded with Deymed Truscan.

Results

The recordings were artifacted with Eureka3 to remove muscle contamination. The recordings were analyzed with Mhyt3! to establish LORETA differences between baseline and Stroop conditions. Finally, surface EEG was examined with NeuroGuide for absolute power and coherence differences.

Conclusions

While results are not concluded, findings may show evidence of cortical specificity produced by the differing conditions. Interesting comparisons may be available between LORETA and topographic values.

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LORETA Cortical Current Density Analysis of Distraction versus Hypnosis for Pain Analgesia: Implications for a Neurotherapy for Chronic Pain

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Introduction

Research has suggested that mental distraction and hypnotically induced analgesia suggestions engage structurally disparate brain mechanisms, with the latter utilizing more left frontal cortical structures and the former involving more posterior structures in the somatosensory cortex (Chen, 2001; Freeman, Barabasz, Barabasz, & Warner, 2000; Rainville, 2002).

Methods

In a counterbalanced, repeated-measures design, twelve participants were exposed to a standardized moderate pain stimulus while undergoing either (1) a no-treatment control condition, (2) a distraction condition (monitoring changing light patterns), or (3) hypnotically-induced suggestions for arm numbing. Nineteen-channel EEGs were recorded throughout each condition and were FFT power analyzed for selected waveforms. LORETA cortical current density images for representative cases and for group data were also generated.

Results

Analyses indicated (1) a significant decrease in perceived pain for hypnosis over distraction and for distraction over control, and (2) a shift in theta power from more anterior, specifically anterior cingulate cortex (ACC) regions during hypno-analgesia to more posterior, somatosensory regions during distraction. A series of 3-dimensional LORETA simulated MRI images of differential cortical involvement during each condition was also presented.

Conclusions

Results suggest the superiority of hypnotically induced, frontal theta-enhancing analgesia for pain management and clarified the specific

regions of cerebral involvement during hypnosis and distraction for the treatment of moderate pain. Implications for a neurotherapy, and for a LORETA neurofeedback treatment for chronic pain, were explored.

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Cognitive Switching Deficits Reflected in the EEG

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Introduction

Response inhibition is an executive function attributed to the prefrontal cortex thought to allow control over cognitive switching, or responding when there is a change in task content or demand. Impairment in response inhibition has been observed in a number of clinical populations. The purpose of the present study was an examination of the correlation between current source density and cognitive switching tasks in individuals who demonstrated attention deficits.

Methods

Participants were 18 individuals referred to an outpatient clinic for evaluation of attention problems. The Delis-Kaplan Executive Function System (D-KEFS; Delis, Kaplan, & Kramer, 2001) was administered and EEG was recorded for each participant. The four subtests purported to measure cognitive switching were utilized in this study. Brain electri-

cal activity was digitally recorded, edited, and subjected to quantitative spectral analysis with eyes closed awake condition. Cross spectra were averaged and LORETA correlation maps computed and displayed using LORETA Key viewer software.

Results

Three of the four subtests were positively and significantly correlated with each other. LORETA findings showed positive correlations between the following subtests and frequency band ranges: Letter-number sequencing and 4-7Hz (inferior parietal lobe); design fluency and 2-8Hz, 16-20Hz, and 20-24Hz (left temporal lobe); and color word interference and 2-4Hz and 4-8Hz (precuneus and right parietal lobe).

Conclusions

Based on the results of the present study, cognitive switching did not appear to be a single construct. Additionally, it was not localized, but mediated by multiple pathways. Slowing reflected in the EEG was common to the subtests with significant correlations.

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The Effects of Amplitude Training on Measures of Coherence in QEEG: A Preliminary Analysis

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Introduction

An important clinical research question that remains to be answered in the field of neurofeedback is whether amplitude training affects coherence/connectivity between cortical sites. There remains the theoretical question as to whether amplitude training causes a shift in the brain func-

tion that allows for an overall reorganization. This study hypothesized that neurofeedback amplitude training would significantly affect EEG coherence measures.

Methods

The study examined eleven adult clients from the University of North Texas Neurotherapy Lab who received neurofeedback training that consisted of only amplitude training (no coherence training) and who received both pre- and post-treatment QEEGs. The deviant z-score changes in coherence were compared by t-test. Frontal sites were selected since most of the subjects were treated for disorders involving frontal lobe dysfunction, such as attention and depression.

Results

Results indicated that most of the pre-treatment abnormal coherence sites moved toward the normative mean. Fp1-F3 theta, Fp1-F3 alpha, and Fp2-F8 beta reached borderline statistical significance, and F3-F4 beta reached statistical significance. Seventy-two percent of all frontal site pairs showing abnormal pre-treatment coherence moved toward the normative group mean following neurofeedback amplitude training. However, 28% of all frontal site pairs with abnormal pre-treatment coherence moved further from the normative group mean following neurofeedback amplitude training. In addition, frontal site effect sizes were in the high range.

Conclusions

Across subjects, most abnormal coherence sites moved toward the normative mean as a result of neurofeedback. Taking the results into account, amplitude training tended to shift brain activity and normalize connectivity between frontal sites. Given the small sample size, effect size gave a better description of the relationship between amplitude training and coherence measures. The effect sizes for most sites were within the medium to high range. That is, neurofeedback amplitude training had strong effects on pre- and post-coherence changes. It is recommended that future research include a larger sample size as well as control group.

Results of Neurofeedback Training in Clients with Asperger's Syndrome

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Introduction

Recognition of Asperger's Syndrome (AS) is on the rise, but effective interventions are few. Whereas drugs do little for the problems in social communication, neurofeedback (NFB) appears to be uniquely effective in reducing symptoms. To document results using NFB, a chart review was conducted recording pre- and post results of clients with AS. The hypothesis, based on results with clients who have ADHD (Thompson & Thompson, 1998), was that 40 NFB training sessions combined with metacognitive strategies (emphasis on emotional content) was associated with improved scores on measures of attention, behavior and performance. One purpose of this review was to demonstrate that a clinical center, without research funding or university statistical department backup, could use an established model of systematic data collection (Lubar et al., 1995; Thompson & Thompson, 1998) even though not all subjects would have complete data. This would encourage other clinicians to document their work, both successes and failures, to improve the clinical practice.

Method

Approximately 100 client files, age 6 to 50, who met diagnostic criteria for AS were reviewed. Each file had both pre- and post data for at least one of the following tests: Wide Range Achievement Test 3 (n = 83), Wechsler Intelligence Scales (n = 47), Test of Variables of Attention (TOVA; n = 76), Integrated Visual Auditory Continuous Performance Test (IVA; n = 55), theta/beta EEG ratios, questionnaire data (n = 51) and the Australian Scale for Asperger's Syndrome (Attwood, 1997; n = 38). Mean differences would measure the gains made on all tests and p-values would measure the statistical significance of the results. Internal validity with respect to therapist consistency was addressed by having all therapists follow the protocol as published by Thompson & Thompson (1998) adapted from Lubar et al. (1995). The model emphasized increasing

SMR at CZ/C4 with metacognitive strategies using materials with emotional content.

Results

Our hypothesis predicted improvements on measures of attention, social behavior, performance and questionnaires after 40 sessions of NFB and metacognitive strategies. Preliminary data analysis showed significant gains such as IQ increases of about 10 points.

Conclusions

The purpose of this study was to substantiate a clinical impression that these clients would benefit from training by looking at data from over 100 clients seen over 10 years.

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Effects of Mood States on Objective Measures of Attention

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Introduction

The notion that stress decreases cognitive capacity required for effortful processing was first introduced by Hasher and Zacks (1979). Computerized Continuous Performance Tests (CPT) were commonly used to assess the treatment progress of neurotherapy. The purpose of the present study was to demonstrate that performance on a test of sustained attention could be affected by transient mood states.

Methods

Thirty-five participants from a non-clinical population were administered the Integrated Visual and Auditory Continuous Performance Test (IVA; Sandford & Turner, 1995), and the Profile of Mood States (POMS; McNair, Lorr, & Droppleman, 1992), a self-report questionnaire.

Results

Participants who scored in the top 25% on the tension-anxiety subscale on POMS showed significantly lower performance on visual persistence than those who scored in the lower 25% of the subscale, $t(18) = 2.369$, $p = .029$. When compared to individuals who scored in the lower 25% on the depression-dejection subscale on POMS, those who scored in the top 25% on the subscale exhibited significantly lower performance on visual consistency, $t(16) = 2.467$, $p = .025$, visual persistence, $t(16) = 2.688$, $p = .016$, and preference for auditory rather than visual processing of information, $t(16) = -2.297$, $p = .035$.

Conclusions

Low scores on persistence reflected lack of motivation, mental and motor fatigue in participants whose responses to the POMS reflected moods of anxiety and depression. Lower consistency of response times exhibited by depressed individuals reflected decreased ability to stay on task. Greater auditory dominance in information processing was typically suggestive of ADHD, and reflected greater attention difficulties in individuals experiencing depressed moods. These results suggested that transient moods of depression and anxiety interfered with performance on measures of attention and need to be considered in the interpretation of CPT profiles.

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LORETA Analysis of Alzheimer's Disease

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Introduction

Researchers have estimated that 4.5 million individuals in the United States are currently afflicted with Alzheimer's Disease (AD), and they have projected that this number will triple by the year 2050 (Hebert, Scherr, Bienias, Bennett, & Evans, 2003). Advances in early detection and treatment are imperative to prevent an overwhelming public health problem.

Methods

Ten participants between the ages of 65 and 85 were recruited. Each was diagnosed by the Alzheimer's Disease Assessment Scale (ADAS) Cognitive, a medical history interview and a QEEG. The aim of the study was to identify any current source density markers in AD. EEG recording was performed on a Digital Cortical Scan (DCS) manufactured by Lexicor, Inc. The eyes closed data was imported into the EureKa3! software (Congedo, 2002) for artifact rejection and for computing the cross-spectral analysis for each subject. The group's cross spectra was compared using Multiple Hypothesis Testing software (Congedo, 2002). The procedure was a one-sample randomization test and the group mean is compared to a reference mean which was composed of equal normative subjects in the same age range. LORETA difference maps for nine frequency bands were displayed using the LORETA Key.

Results

Previous studies in Alzheimer's and LORETA have indicated that it is likely that increases in delta in the superior temporal gyrus of the temporal lobe will be found (Budzynski, Budzynski, & Sherlin, 2002). Data analysis was still being completed at the time of this writing.

Conclusions

If significant markers can be found and duplicated, the EEG and LORETA specifically may be crucial in the identification of AD. If these

markers are identified, alternatives such as LORETA neurofeedback could be utilized in the potential amelioration of symptoms.

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The Effect of Neurofeedback on Performance Anxiety in Dancers

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Introduction

Dancers are frequently sensitive and driven. They tend to be more introverted, higher in achievement motivation, and more emotional than non-dancers (Marchant-Haycox & Wilson, 1992). As the brain is closely tied to physiological states, adjusting the brainwaves from a highly aroused state to a more moderate state will affect the nervous system (Evans & Abarbanel, 1999). The purpose of this study was to examine whether neurofeedback can effectively help to reduce state and trait anxiety in dancers.

Methods

There were twenty 30-minute neurofeedback treatment sessions for each participant that included completion of the State-Trait Anxiety Inventory (STAI), a proven measure of state and trait anxiety, before each session as well as pre- and post-treatment (Spielberger, 1983). Sensors were placed on sites T3, T4, and the left earlobe. With both participants, 2-7 Hz and 23-38 Hz were inhibited, while the reward band

ranged between 11 and 16 Hz. The reward band was the only band adjusted during treatment. Adjustments were made based upon reports/interviews with the participants before each session.

The intent of choosing this protocol (bi-polar T3/T4) was to support the participants in improving their overall self-regulation. Rather than treating a given symptom, this protocol was intended to help facilitate a greater state of balance for the participants. In part this may have been an effect of more plasticity in their autonomic nervous systems. To conclude this, specifically more physiological testing would need to be performed.

The sites T3 and T4 were chosen specifically because of their proximity to the limbic area of the brain. This is an area from which much of one's deep, primal, and non-verbal/pre-verbal emotions are experienced. Through using neurofeedback to increase or decrease the participants' arousal levels via these sites, their overall systems responded accordingly.

In regards to the STAI, possible scores on the Inventory ranged from 20 to 80 (20 reflected low anxiety and 80 reflected high anxiety). The mean score from the normative database for a female was 38.25 for trait anxiety and 35.12 for state anxiety.

Another measure used in this study was interviewing of the participants. This was done pre- and post-treatment as well as prior to each treatment session. Some of the data from these interviews was included below in the Results section. A final measure which was not included in this abstract was the measure of flow. It became apparent to me during the interviewing process that the level of flow had greatly increased for both participants.

Results

Dancer A: BEFORE TREATMENT: The participant was anxious about auditions, workouts, lack of structure, and also experienced negative self-talk. AFTER TREATMENT: The participant was calmer, more coordinated, and at peace with her performance. She also had more confidence while being less reactive. Finally, she experienced less negative self-talk, was more in a state of "flow," and slept better.

STAI results: The participant's state anxiety was erratic. Her trait anxiety score decreased from 59 to 47.5.

Dancer B: BEFORE TREATMENT: The participant experienced anxiety regarding unexpected circumstances and her belief that she was too old to dance. She also reported that she did not sleep well. AFTER TREATMENT: The participant was more accepting of the process and her mistakes. She felt no more need to "control" everything while at the

same time she felt more joy in her dancing and in general. She reported much improvement in her sleep.

STAI Results: Her state anxiety score decreased from 56 to 36. Her trait anxiety had no significant reduction.

Dancer C: Dancer C dropped out of the study.

Conclusions

Post-treatment, Dancer A's life was less filled with anxiety. With the reduction in her trait anxiety she was now more able to deal with stress when dancing. Dancer B's decrease in state anxiety led to a very significant change in her performance experience and ability.

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