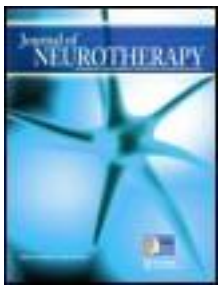

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Student Scholarship Presentation Abstracts

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Student Scholarship Presentation Abstracts

Effects of Childhood Sexual Abuse on Brain Function as Measured by Quantitative EEG, Neuropsychological, and Psychological Tests

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Objective

Childhood sexual abuse (CSA) has become epidemic in the United States. Estimates from grouping studies of prevalence indicate 25 to 30% of females and 8 to 10% of males have experiences of childhood sexual abuse that meet legal definitions of sexual abuse (Finkelhor, Hotaling, Lewis, & Smith, 1990). It has been associated with the development of a host of maladies including depression, anxiety, substance abuse, sexual dysfunction, suicidal ideation and attempts, as well as other self-destructive behaviors (Beitchman et al., 1992). More specifically, research indicates six categories of impairment are associated with CSA: (a) emotional reactions which are aversive, (b) perceptions of the self which are distorted and negative, (c) physical complaints, (d) somatic complaints, (e) difficulties with development of positive sexuality, (f) interpersonal relationship difficulties, and (g) difficulties in social functioning.

In addition to these psychological symptoms associated with CSA, researchers have begun to look at the cerebral concomitants by examining the impact of CSA on brain structures and functions (Bremner et al., 1997; Ito et al., 1993; Schiffer, Teicher, & Papanicolaou, 1995; Townsend, Black, & Bodenhamer-Davis, 2001). Collectively these studies suggest neuropsychological effects on the left hemisphere with possible limbic system involvement and inadequate frontal lobe regulation of posterior sites. There have been few cerebral measurement studies related to CSA with adults, though this population is often included in posttraumatic (PTSD) groups. Therefore, the present study is an exploration of the relationships between CSA, QEEG, neuropsychological, and psychological measurements in adults.

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This study extends Black, Hudspeth, Townsend, and Bodenhamer-Davis' (2002) research which compared two clinical groups, 15 adults with a history of CSA and 15 adults with no history of CSA (NCSA), by comparing two unmedicated non-clinical groups.

Method

Twelve adults from the general community with a history of CSA were matched for age, gender, and handedness with 12 NCSA adults. The objectives of this study were to: (a) examine electroencephalographic (EEG) abnormalities associated with CSA, (b) investigate cortical coherence in the groups using neuroelectric eigen image (NEI) connectivity indices in four bands as well as the unfiltered cross correlation (Hudspeth, 1999), (c) integrate personality differences associated with CSA with EEG differences, and (d) better understand left versus right hemisphere functioning in CSA using intelligence testing.

Results

Consistent with CSA research with children (Ito et al., 1993; Ito, Teicher, Glod, & Ackerman, 1998), the CSA group showed a greater preponderance of EEG abnormalities when compared with the NCSA group. Cortical coherence and personality testing using the Minnesota Multiphasic Personality Inventory-Revised Version (MMPI-2) were found to be important factors in distinguishing the groups, while verbal versus performance intelligence scores using the Wechsler Abbreviated Scale of Intelligence (WASI) was not. These findings are compared with previous findings (Black et al., 2002).

Conclusions

This research confirms prior research by Black et al. (2002) that bands other than alpha (particularly theta) are important in CSA brain functioning, having important implications for treatment and future research. Also, NEIs were found to be a parsimonious method for data reduction, preserving important functional and anatomical relationships inherent in the EEG signal.

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Limbic Activation and Low Resolution Brain Electromagnetic Tomography: Can Hippocampal and Other Limbic Lobe Activity Be Recorded Accurately and Changes Differentiated by LORETA in Affective Memory Acquisition?

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Introduction

Few studies have been conducted on the hippocampal region and associated limbic structures, and using LORETA during active memory processes with an emotional context. Research on the hippocampus and these associated sub-cortical structures has been significant yet due to the location deep in the brain, these structures and their functions have been difficult to visualize. The subject of this study was to determine if changes in the hippocampus and other limbic structures could be recorded and examined using LORETA methodology.

Method

This study was conducted with twelve subjects: eight female and four male students at the University of Tennessee, Knoxville (average age 23). A pre-study screening was performed. Subjects were excluded under the conditions of previous head trauma, history of epilepsy, drug or alcohol use and any emotional or psychiatric diagnoses. Eyes-open baselines were obtained employing 300 epochs or five minutes using nineteen-channel acquisition with link ear reference.

The experimental condition was obtained following the baseline. The subjects were asked to allocate and retain a memory that created anger and hold the experience as long as possible. It is important to note that the subjects, with the hypothesis that a spontaneous memory would be more valid than a planned or suggested memory, did not know the experimental condition. The data were collected using Lexicor NRS-24 EEG acquisition system. All recordings were rigorously artifact rejected using Eureka-3 software. All files were not less than 100 total epochs upon editing. The data was analyzed in both individual and group conditions with LORETA imaging software. Differences between baseline and experimental conditions were evaluated and statistical data was computed and transformed into LORETA images.

Results and Conclusions

The results revealed significant differences between eyes-open baselines and the study condition. The differences confirm activation in the hippocampal formation-perhaps in the amygdala, parahippocampal gyrus, cuneus, uncus, subcallosal gyrus, and frontal areas including the inferior frontal gyrus. Statistical differences between conditions were evaluated for significance, then computed and transformed into LORETA images.

Increasing Individual Upper Alpha Power by Neurofeedback Improves Cognitive Performance

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Introduction

From previous EEG studies (Klimesch, Doppelmayr, Pachinger, & Ripper, 1997; Doppelmayr, Klimesch, Stadler, Pollhuber & Heine, 2002), it is known

that high alpha power and low theta power in a resting condition is related to good cognitive performance. This study investigated the hypothesis whether an increased absolute alpha power or a decreased absolute theta power is capable of increasing cognitive performance.

Method

Twenty-one healthy subjects where instructed to increase their absolute upper alpha power, or decrease absolute theta power with neurofeedback training. Mental rotation tasks where presented before and after neurofeedback training.

Results

Subjects performed better on mental rotations after upper alpha training, but not after theta training. Training success, as measured by an increase of power, on upper alpha neurofeedback training was positively correlated with the improvement in cognitive performance. Additionally it could be demonstrated that the pre-stimulus power in the upper alpha band increases after training.

Conclusion

This is well in line with other studies (Klimesch, Gerloff, & Sauseng, 2003) which showed that high upper alpha power in the pre stimulus interval is related to good cognitive performance. This study shows that neurofeedback training can be used to increase cognitive performance by way of those factors which are known to underlie good cognitive performance under normal conditions.

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QEEG Analysis of Cranial Electrotherapy: A Pilot Study

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Introduction

Cranial electrotherapy stimulation is the use of low level electrical current applied to the head for therapeutic purposes. Cranial electrotherapy stimulation (CES) is also known as electrosleep, cranial electrotherapy (CET), cranial stimulation (CS), transcranial electrotherapy (TCET), neuroelectric therapy (NET), cranial TENS and auricular electrical stimulation. The FDA authorizes the production and sale of medical devices for cranial electrotherapy in the United States for the treatment of pain, depression, anxiety, and sleep disorders. To date 112 of 126 published studies in the United States on CES have had positive outcomes, involving 4,541 subjects (in all 126 studies) without significant side effects from the treatment (Kirsh, 2002). The current study was conducted to determine the effect of cranial electrotherapy on cortical activity as measured by QEEG before and after a single 20-minute use of cranial electrotherapy. This pilot study is being followed up by a double blind placebo controlled study of cortical activation changes from baseline with three and six weeks of CES treatment.

Method

Digital EEG for QEEG analysis was obtained from 30 research volunteers using a Neurodata-24 digital EEG system. Cranial electrotherapy was providing with Alpha-Stim 100 cranial electrotherapy units set to .5 Hz. QEEG data was processed and analyzed with the NeuroGuide system. Statistical analysis of the data was conducted with the NeuroGuide, SPSS and JMP statistical packages. Digital EEG, blood pressure, heart rate, electrodermal activity and finger temperature was acquired during a baseline condition, during cranial electrotherapy, immediately after electrotherapy, and after three weeks of daily use of cranial electrotherapy.

Results

During cranial electrotherapy stimulation at .5 Hz significant increases were seen across the entire cortex in delta and gamma frequencies. This effect was uniform for all volunteers. After a single 20-minute session of electrotherapy decreases were seen in delta and theta frequency activity with concomitant significant increase in alpha activity. The study volunteers generally

reported feeling more relaxed after 20 minutes of CES. Some volunteers reported feeling as if their head had cleared and they felt more awake. Research volunteers who reported pain or anxiety before the single session of CES treatment reported significant reductions in pain and anxiety after the 20-minute treatment.

Conclusions

This pilot study indicates that cranial electrotherapy at .5 Hz entrains delta and gamma frequencies during active stimulation. After a single 20-minute treatment with CES there is a significant increase in alpha frequency activity and a significant decrease in delta and theta activity. The post treatment maps indicate the effect of single session cranial electrotherapy treatment on QEEG is congruent with the reports of the research volunteers of decreased anxiety, increased alertness and increased relaxation.

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Anterior Cingulate Activation During Randomized Pseudo-Stroop Interference Trials Using Low Resolution Electromagnetic Tomography

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Introduction

There have been few studies of the Stroop Task using the LORETA methodology and fewer still using a pseudo-Stroop procedure. By using a trial that mixes the incongruent and congruent stimuli the interference that normally occurs during classic interference conditions should occur during both of the trial conditions. Activation of the anterior cingulate has been associated with the Stroop Effect, and the aim of this study was to note any differences or similarities across conditions using the LORETA methodology.

Method

This study was conducted with eleven participants, seven female and four male psychology students at the University of Tennessee, Knoxville (mean

age 21). Participants were screened and excluded for previous head trauma, history of epilepsy or cerebrovascular disease, drug or alcohol abuse, and any psychiatric disorders. Eyes-open baseline recordings were obtained at a sample rate of 256 for 180 epochs, or three minutes, using 19 channel acquisition with linked ear reference. The experimental condition, obtained after baselines, asked the participants to respond to a pseudo Stroop program on a computer by clicking the mouse button corresponding to the stimulus condition, either congruent (left click) or incongruent (right click). The trial conditions were either a predominantly congruent or incongruent trials with the predominant stimuli presented 85% of the time. The test employed presented one of nine possible pairings of the color/word sets, those being red, blue, and green. The stimuli were presented one at a time for five seconds with a one-second interval between stimuli. Each participant completed six randomly assigned trials of 184 epochs (three minutes), and was blind to the order of conditions. Data collection was performed using Lexicor NRS-24 EEG acquisition system. All recordings were thoroughly artifact rejected using the Eureka! 3 software. All files were no less than 90 epochs in length after editing. The data was analyzed in both individual and group conditions with LORETA imaging software. Differences between the two experimental conditions, as well as between both of the conditions and the baselines. Statistical data was computed with MyHT program which is a statistical package which allows for between group comparisons specifically for LORETA.

Results

The results showed differences between the congruent and incongruent conditions, and significant differences between each of the trials and the baselines. Both the congruent and incongruent conditions showed significant activation in the anterior cingulate, as well as in areas associated with visual perception. Statistical differences between conditions were corrected for all multiple comparisons using a non-parametric randomization technique. The full scope of the results is still being analyzed, both statistically and for meaning. The most significant results were increased activation of the anterior cingulate during incongruent presentation compared to the congruent.

Conclusions

The Stroop Task is a sensitive indicator of frontal lobe function. In particular the anterior cingulate is more activated in high frequency bands during the more difficult incongruent tasks. The pseudo Stroop nature of the task, with the mixed stimulus trials, is prone to show increased frontal lobe activation in both of the conditions. The congruent trials may have proved more difficult for

some of the participants because the expectation of receiving a congruent stimulus was strong, and 15% of the time an incongruent stimulus was presented. As the results are further investigated it is expected to see activation of the ACC during the congruent trials as compared to baselines. This suggests that the role of expectation during the randomized trials is important in producing the interference that results during Stroop Tasks.

Obsessive Compulsive Dimension Localized Using Low Resolution Brain Electromagnetic Tomography (LORETA)

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Introduction

Electroencephalographic mapping techniques have been used to show differences between normal subjects and those with various mental diagnoses. Studies have been conducted previously on depression (Pizzagalli et al., 2002), attention deficit disorder (Chabot & Serfontein, 1996) and other more potentially debilitating disorders such as schizophrenia (Pascual-Marqui, 1999). Quantitative electroencephalographic (QEEG) mapping techniques have traditionally been used (Chabot & Serfontein, 1996) whereas others have also incorporated Low Resolution Electromagnetic Tomography (LORETA; Pascual-Marqui, 1999; Pizzagalli et al., 2002). Combined, these studies have illustrated the usefulness of such mapping techniques in the diagnosis and treatment of these disorders. Previous QEEG research on obsessive-compulsive disorder (OCD) has indicated an excess of Alpha and Beta activity in the central channels when analyzed using QEEG techniques (Prichep et al., 1993). However, to date there is no current research using the techniques of LORETA with the OCD population. The current investigation compares current source density measures of persons with OCD symptoms to an age matched control group.

Method

The data for this study were selected from an archived database of 108 clients who had presented for evaluation of various complaints. All clients had completed an SCL-90-R and had an electroencephalograph (EEG) recording scalp electrical potentials as part of the assessment. To be included in the clinical group the subject must have scored a T-value of a T-value below 63 (90th percentile). There were eight subjects from the sample of 108 that fit these criteria. The requirement for inclusion in the control group was that the subject could not have a T-value of 63 (90th percentile) or higher on any dimension.

Eight subjects who met this requirement were age matched to the clinical group.

Brain electrical activity had been digitally recorded on a LEXICOR NeuroSearch-24 system from 19 scalp electrodes, according to the International 10-20 System of electrode placement. Electrode impedances were reduced to below 5Kohms. EEG was recorded continuously in the awake state with eyes closed and open and during active task conditions.

For this study, the eyes closed data was imported into the EureKa3! software (Congedo, 2002) for precise artifact rejection and for computing the cross-spectral analysis for each subject, in 9 bands. These bands were Delta (2-3.5 Hz), Theta (4-7.5 Hz), Alpha1 (8-10 Hz), Alpha2 (10-12), Beta1 (12-16 Hz), Beta2 (16-20 Hz), Beta3 (20-24 Hz), Beta4 (24-28 Hz), and Beta 5 (28-32 Hz). Each group's cross spectra was computed and the two groups compared using a T-sum procedure, which is a multiple comparison procedure based on a combination of test statistics. LORETA difference maps for the nine frequencies were displayed using the LORETA Key software (Pascual-Marqui et al., 1999; Pascual-Marqui, Michel, & Lehmann, 1994).

Results

There are three primary findings. First, stronger current density power is seen in the cingulate gyrus in all frequencies above Alpha. Second, excess Beta is primarily located in the middle cingulate gyrus and in adjacent frontal and parietal-occipital locations. Finally, progressing from Beta1 (12-16 Hz) through Beta5 (28-32 Hz), significant voxels within the cingulate gyrus migrate in a posterior direction as frequency increases.

Discussion

This study was aimed at finding the location of current source density differences between two groups that differed on the obsessive-compulsive dimension of the SCL-90-R. Other dimensions were not considered except that they have a T-value of less than 63 (90th percentile). For this study, OCD is defined and measured by the SCL-90-R as "symptoms that are often identified with the standard clinical syndrome of the same name." This measure focuses on thoughts, impulses, and actions that are experienced as unremitting and irresistible and that are of an ego-alien or unwanted nature (Derogatis, 1994).

The finding is that individuals who subscribe to symptomatology of OCD have excess beta activity in the cingulate gyrus when compared to a non-OCD control group. This is consistent with the Prichep et al. (1993) QEEG finding of excess central beta, but is not corroborative of their finding of excess central alpha. A probable explanation is that clinical symptoms may be present within the groups used in this study, which may not be measured by the SCL-90-R. As measured by this scale, the control group is a normal group and the OCD group had no other dimensions of clinical significance. Further studies should explore other scales measuring OCD symptoms to evaluate the specificity of these findings using the SCL-90-R. Despite the limitations, this preliminary study demonstrates the potential utility of LORETA as a clinical tool.

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QEEG and MMPI-2 Profiles of Adults Reporting Childhood Sexual Abuse: Determining Differences and Predictor Models

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Introduction

This research is an extension of a pilot study that looked at QEEG and MMPI-2 patterns of adults with a history of childhood sexual abuse, as compared to adults who denied a history of abuse (Townsend & Black, 2001). The pilot study participants included 12 adults with a history of childhood sexual abuse matched for age, handedness, and gender with 12 adults who denied a history of abuse. Data was obtained through archived files of MMPI-2 and QEEG data. MMPI-2 results were similar to findings of previous research in the literature, showing floating profiles, high F scales, and a 4-5-6 configuration (Scarlet O'Hara V) for the abused group. Although it was hypothesized that abused individuals would show higher alpha patterns, QEEG data showed

that the non-abused group showed significantly higher alpha relative power. Exploratory analysis in the pilot study suggested possible differences between the groups in alpha as it compares to other bandwidths and also in alpha differentiation between frontal and posterior sites. Also in the pilot study, two predictor models were developed based on clinical and statistical significance. The first model was based on deviant thinking and included two predictors: scale 4 of the MMPI-2 and alpha relative power at T6. The second model was based on depression and included scale 2 of the MMPI-2 and alpha relative power at sites F3 and Fp1. This research further explored differences in the MMPI-2 and QEEG patterns of adults with a history of childhood sexual abuse as compared to adults who deny a history abuse.

Method

Participants included the original 24 pilot study participants, plus an additional 26 newly-recruited participants (13 in each group). The two groups were matched for age, handedness, and gender. Each participant was given a QEEG and MMPI-2. Because the QEEG provides a large number of variables, potential predictors were selected by using a principal components analysis. Predictors were then inserted to models and logistic regression was performed. A bootstrapping technique of validation and calibration was used to account for the large number of variables.

Conclusions

Models were chosen based on clinical and statistical significance. Significant differences were found between the two groups, and findings showed similar results as the pilot study in both MMPI-2 and QEEG patterns. Early trauma, such as childhood sexual abuse, appears to have longstanding effects on both personality and brain function. Further exploratory research examining the effects of early trauma will likely prove to be valuable.

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