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## Student Scholarship Presentation Abstracts: 12th Annual ISNR Conference, 2004

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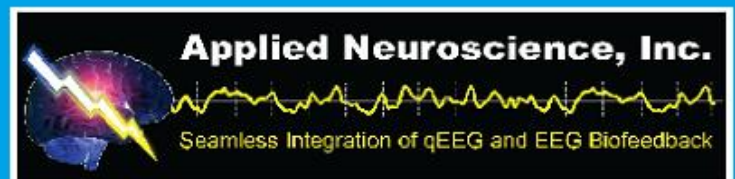
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## Student Scholarship Presentation Abstracts: 12th Annual ISNR Conference, 2004

### **Executive Function: A Possible Circuit of Attention, Cognition and Motivational Brain Processes**

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#### ***Introduction***

The anterior cingulate gyrus is suggested to have involvement in numerous executive processes. It has been the topic of extensive research and continues to be a focal point for understanding cognitive, affective and attentive brain processes. The anterior cingulate circuit is suggested to involve sub-cortical, limbic, and prefrontal areas. This study examined structures involved in the executive processes of cognition, reward acquisition, motivation, short-term and long-term memory. The region of interest for this study is the anterior cingulate gyrus cognitive division (ACCd), dorsolateral prefrontal cortex and laterality in the supramarginal gyrus, and parietal areas. The data were extracted from LORETA neurofeedback sessions in which participants were rewarded for increasing 14 to 18 Hz beta activity in the ACCd (Talairach coordinates -3, 31, 29).

#### ***Method***

This study was conducted with eight non-clinical students, four male and four female, with a mean age of twenty-two, at the University of Tennessee, Knoxville. All recordings and feedback were provided through

the Deymed Truscan Acquisition System employing 19 active channels, linked ear references, and ground.

### ***Results***

The preliminary data suggests that the anterior cingulate gyrus, dorsolateral prefrontal cortex, supramarginal gyrus and parietal areas increase with apparent uniformity. Regression models and statistical data support the correlation of activity in the specified frequencies for the region of interest.

### ***Conclusion***

The anterior cingulate gyrus is involved in a circuit involving executive function. The cognitive division of the anterior cingulate gyrus, dorsolateral prefrontal cortex, supramarginal gyrus and parietal areas appear to have relative involvement in the executive functions elicited by this study.

### **Frontal Alpha Asymmetry: A State or Trait Measure of Affective Response**

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### ***Introduction***

Research has demonstrated differential patterns of anterior cerebral activation during the experience or expression of positive and negative emotions (Tomarken, Davidson, & Henriques, 1990). Prior studies have examined whether resting alpha asymmetry predicts individual affective response to film clips (Tomarken et al. 1990; Tomarken, Davidson, Wheeler, & Doss 1992). The present study examined whether anterior encephalographic alpha asymmetry pattern would reliably shift in response to elicited affective state over an extended period of time.

### ***Method***

Frontal alpha asymmetry was recorded in 17 right-handed female students during a 116-minute video selected to elicit both happy and sad affects (Return to Me, 2000).

### **Results**

Alpha asymmetry score (A) was stable across conditions with correlation across scores significant among all scenes at the .05 level ( $df = 3D 15$ ). There was no significant difference between A scores during conditions,  $t = 3D .519$ ,  $p = 3D .303$ . The A score did not correlate with self reports of mood during scenes. The first A score correlated with self-reported sad moods prior to viewing the film,  $r = 3D -.612$ ,  $p < .01$  level. According to self-reports, conditions impacted mood. Sad scores were compared to happy scores during sad scenes,  $t = 3D 13.12$ ,  $p < .001$  (mean sad score 6.25,  $SD = 3D 2.5$ , mean happy score .81,  $SD = 3D 1.41$ ).

### **Conclusion**

The alpha asymmetry ratio appears to be a stable physiological phenomenon within a sample of non-depressed, well-adjusted individuals.

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### **QEEGs of Dissociative Identity Disorder (DID) Subjects**

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### **Introduction**

For decades dissociative identity disorder (DID) has been a controversial diagnosis. This study did brain mappings of three subjects with DID

and three matched subjects without any dissociative disorders (DD). An analysis of the FFT (Fast Fourier Transform) power spectrum was done *within* DID and non-DD subjects and *between* the DID group and non-DD group.

### ***Method***

Four QEEG recordings were made of each subject using the Lexicor NeuroSearch-24 with eyes-closed in a linked-ears montage. The FFT power spectrum analysis consisted of FFT absolute power, FFT amplitude asymmetry, FFT coherence, and FFT phase lag for five frequency bands (delta, theta, alpha, beta, and gamma) using NeuroGuide software. For each subject a comparison was done between the host/alter ego states of DID subjects and similar cognitive states of non-DD subjects using the NeuroStat program. Finally, all 12 QEEG recordings of the DID subjects were compared to the 12 QEEG recordings of the non-DD subjects using the NeuroBatch program.

### ***Results***

Significant differences ( $p < 0.001$ ) were found between the alter ego states of the DID subjects compared to the differences found between the cognitive states of the non-DD subjects. The most notable differences were found in the variation (range of signals) in all aspects of the FFT power spectrum. The DID subjects were found to have variations approximately seven times the range of non-DD subjects for absolute power, amplitude asymmetry, and coherence. However, non-DD subjects had variations in phase lag four to five times that of the DID subjects.

### ***Discussion***

The results of this study indicated differences in neuroactivity *within* and *between* DID and non-DD subjects. These findings indicate distinct and enduring differences in the mental processing of DID subjects and thus contribute to the evidence that dissociative identity disorder is a real psychiatric condition and is not the result of play acting.

## **Low Resolution Electromagnetic Tomography (LORETA) in Monozygotic Twins Discordant for Chronic Fatigue Syndrome**

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### ***Introduction***

Chronic fatigue syndrome (CFS) is an illness characterized by profound fatigue lasting at least six months accompanied by disturbances of sleep, mood, musculoskeletal pain, and other symptoms. A study using EEG has demonstrated brain activity differences between CFS and healthy control subjects. Low Resolution Electromagnetic Tomography (LORETA) has been used to show differences between normal subjects and those diagnosed with depression and schizophrenia. This study addressed the potential utility of LORETA as a clinical tool for CFS. Because many EEG features appear to be heritable, the co-twin methodology provides a powerful control for non-genetic characteristics.

### ***Method***

A comprehensive research project by Budzynski et al. (2004) provided the raw data for this study. Eighteen pairs of monozygotic twins discordant for CFS were selected for comparative analysis. Brain electrical activity had been digitally recorded in various conscious states. For this study, the eyes-closed data was visually edited for artifacts, and the cross-spectral analysis for each subject was computed in nine bands. Each group's cross spectra was computed and the two groups compared using a within subject T-sum multiple comparison procedure based on a combination of test statistics.

### ***Results***

When compared to their matched twins, individuals diagnosed with CFS have significant differences in current source density. The twin group diagnosed with CFS has higher delta in the left uncus and parahippocampal gyrus and higher theta in the cingulate gyrus and right superior frontal gyrus.

### ***Discussion***

These results demonstrate that underlying neurophysiological activity in certain areas of the brain differentiates normal individuals from those with CFS. Because the EEG is trainable and LORETA is a derivative of the EEG, we might hypothesize that neurofeedback treatment could be beneficial. Further study should address the specificity of these findings when comparing CFS to a more heterogeneous population sample.

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### **EEG Gamma Coherence and Other Correlates of Subjective Reports During Ayahuasca Experiences**

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### ***Introduction***

The most common findings in the psychedelic EEG studies from 1951 to 1972 were small increases in posterior modal alpha frequencies, global power decreases, and relative increases in beta. Recent studies with the Amazonian beverage ayahuasca did not correlate EEG with subjective reports and did not use single Hz power or coherence analysis.

### ***Method***

QEEG power and coherence of ayahuasca experiences were examined with two experienced participants in a Brazilian jungle setting. An exploratory case series design was adopted for naturalistic field research. Medium to intense visual imagery was compared to eyes-closed baselines.

### ***Results***

Overall power decreases in all bands support the Riba et al. (2002) findings, but the 36-44 Hz band results did not support the Don et al.

(1998) findings of increased power. Single Hz analysis revealed a 10 and 11 Hz power increase in one participant that was hidden within the standard 7-13 Hz band analysis. Global EEG coherence increases were found in the 36-44 Hz and 50-64 Hz frequency bands for both subjects and within one subject in a repeated session.

### **Conclusions**

The 3.5-7.5 Hz power decrease reflects an increase in arousal, but the 13-16 Hz and 16-20 Hz power decreases suggest the opposite. Widely distributed cortical hyper-coherence is expected given the intense synesthesia during ayahuasca experiences. Binding theory was discussed in this context.

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### **LORETA Neurofeedback and Automaticity**

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### **Introduction**

Expert students, skilled at acquiring knowledge, may have automatized basic neural processes which allow fast, efficient, low effort access to component processes supporting cognitive activity (Schneider & Chein, 2003). Consistent practice with stimuli may reduce the cognitive task load and result in decreased processing speed, attention demands, and energy usage. Alpha frequency has been associated with highly skilled cognitive functioning. High IQ individuals may produce greater levels of alpha during cognitive tasks (Jausovec, 1996). Automaticity, a form of cognitive efficiency, may be accessible to LORETA neurofeedback.



### **Method**

Eight college students, four males and females (Mean age = 22), performed more than 30 LORETA neurofeedback sessions. EEG was recorded for pre-and post-study baselines, session baselines and neurofeedback tasks. Alpha frequency changes were examined between EEG pre- and post-baselines and selected neurofeedback tasks. WAIS-III was administered before and selected subtests were administered post 30 sessions to provide a measure of pre-study Full Scale IQ (FSIQ), and post-cognitive measures of working memory (WMI) and processing speed (PSI).

### **Results**

Average FSIQ (Mean IQ = 125, Range = 119 to 139) was in the Superior range (Wechsler, 1997). Preliminary paired t-test analysis of psychometric data suggested an increase in the averaged standard scores for the PSI ( $p = .0028$ ) and WMI ( $p = .0033$ ). Alpha band (8-12 Hz) activity was reported.

### **Discussion**

These students are skilled learners. After neurofeedback, increases in the PSI and WMI, which tap cognitive processing transmission speed, mental strategies, and memory processes, suggest refinement of already strong abilities. The relationship of the alpha frequency to changes in psychometrics was discussed.

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