Respiratory Sinus Arrhythmia Feedback Impact in Novices on Limbic Current Source Density in a Stressed Population Demonstrated by Standardized Low Resolution Electromagnetic Tomography

Authors

Leslie Sherlin, PhD

Nova Tech EEG; Q-Metrx; Southwest College of Naturopathic Medicine; University of Phoenix

Sarah Wyckoff, MA

Southwest College of Naturopathic Medicine; East Valley Neurofeedback & Peak Performance Center; Nova Tech EEG

Frederick Muench, PhD

Helicor

**This study was sponsored by Helicor, Inc*

Background

- The mind-body connection and its relationship to stress can be seen via the connection between, the limbic system, particularly the cingulate gyrus, and the autonomic nervous system and neuroendrocine system

- The cingulate gyrus largely comprises Brodmann areas 24, 23, 29, 30, and part of 31 and is thought to regulate bodily states of arousal to meet concurrent behavioral demands making it one of the mechanisms by which mental processes are integrated with bodily systems.

Background

- For example imaging studies have shown that behavioral stressors cause activation in the cingulate gyrus which is associated with blood pressure reactions and neuroendocrine activation.

- Particularly, the cingulate gyrus has been shown to be activated by unpleasant sensory-affective functions such as acute and chronic pain, negative emotions and memory , anxiety, anticipatory anxiety, respiratory dysfunction, and depression.

Background

- Patterns of general activity have also been found in the QEEG and LORETA of groups that have the presence of stress and/or anxiety.
- Previous studies illustrate:
  - alpha hemisphere asymmetries
  - excessive frontal and/or parietal beta
  - excessive beta along the midline (FZ, CZ, PZ)
  - LORETA stronger beta in right superior frontal gyrus

Background

- Previous investigations of QEEG during relaxation has identified:
  - Increases in slow wave (theta and alpha) band power,
    - Correlations between increased levels of alpha activity with lower levels of anxiety, and autonomic changes characterized by decreased sympathetic activity and increased parasympathetic activity.
- The present study seeks to determine the current source density impact of a single session of respiratory sinus arrhythmia biofeedback on the structures of the limbic system as seen by sLORETA.

Methods

- Participants were recruited and enrolled based upon response and completion of the State Trait Anxiety Interview.

- A total of 121 were screened; 80 were eligible based on the phone screen, 46 came in for an interview and 43 subjects completed the protocol (one sensor error, one computer problems, one reschedule never returned).

- Participants were randomized into both a control (placebo device) and experimental group based on STAI-S scores to stratify across groups.

- RSA feedback was performed using the StressEraser device.

- The study recorded 19 channel EEG, frontalis electromyography, electrocardiogram, blood volume pulse, respiratory rate, skin conductance and finger temperature under baseline, stroop task, biofeedback, post baseline and post stroop.

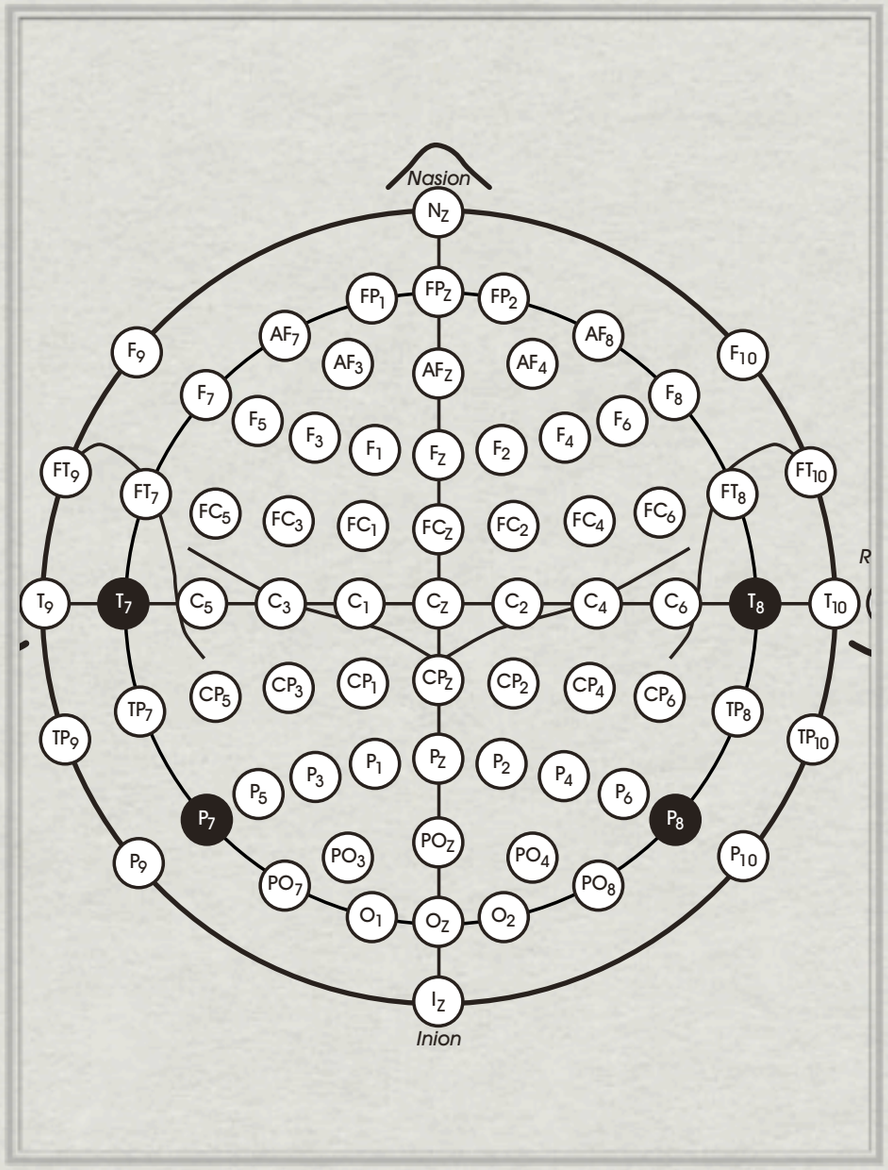
Methods

- Absolute and relative power amplitude changes of scalp electrode sites were examined and compared.
- Additionally a multiple stepwise regression analysis of device point production and amplitude changes was calculated.
- For each group sLORETA current source density was computed in 9 frequency bands in each of the conditions.
- To compare the current density amplitude of the control and experimental subjects between conditions and between groups we used t-tests (within and between groups) implementing the randomization–permutation multiple comparison approach.

QEEG

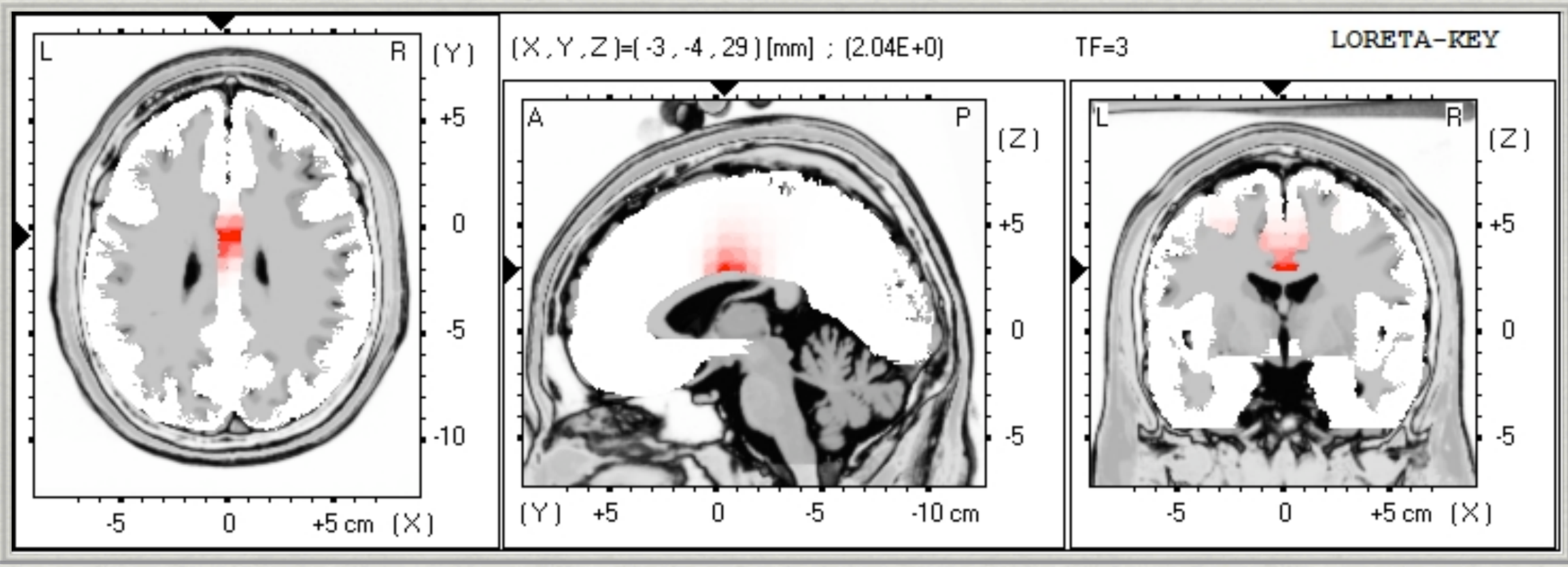
- Electroencephalograph output of scalp potential quantified in the spectral domain using filtering techniques.

- In this study recorded from 19 electrode sites referenced to linked ears.



sLORETA

- LORETA is a solution to the inverse problem of determining the localization of current source density cortically based upon scalp electric potentials.
- LORETA is restricted to cortical space (gray matter) divided into 2394 7x7x7 voxels.
- Standardized LORETA implements a statistical standardization procedure to localize with zero localization error.

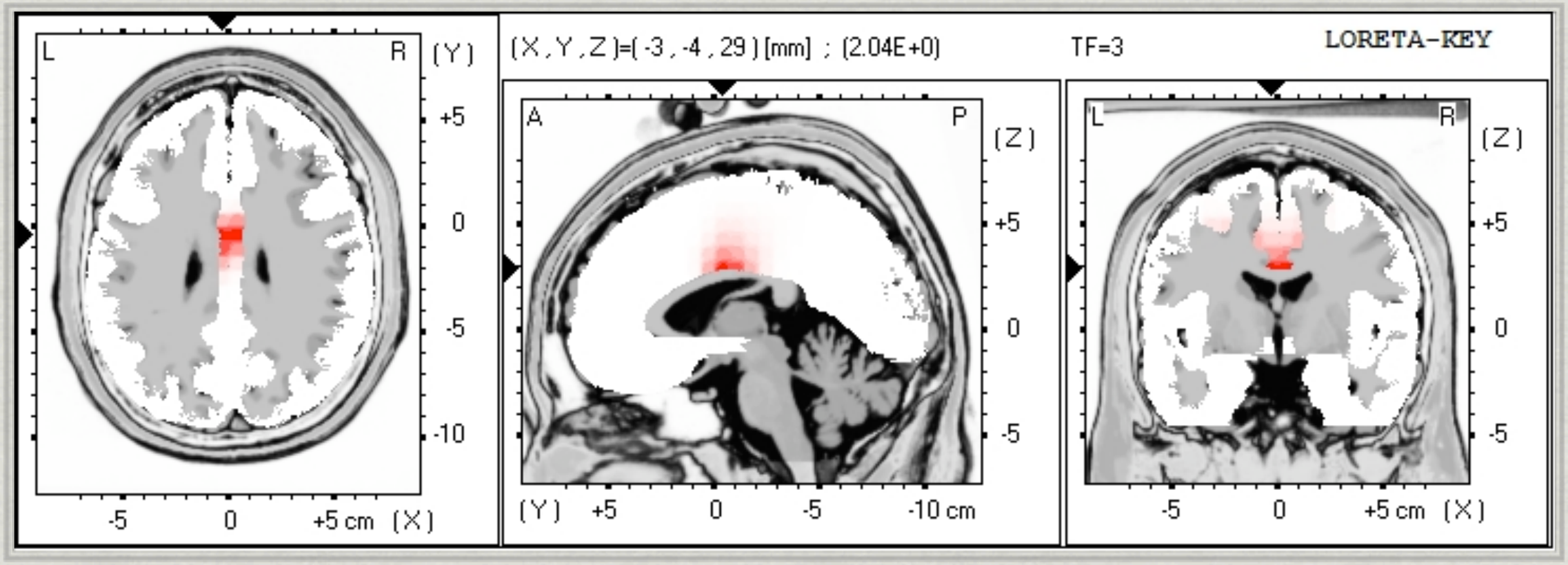


Results

- Statistically significant findings of the QEEG results revealed:
  - A significant overall increase in alpha from baseline to post intervention. [.56 (.14) to .66 (.23)] for the RSA group, while the control group decreased [.60 (.27) to .59 (.25), F (33) = 6.18, p <. 05].
  - Overall, 64.7% (11/17) of participants in the RSA group had amplitude increases compared to 11.8% (2/17) in the control group.
  - Results also indicate that there was a statistical trend for increased alpha relative power compared to the control, [F (33) = 3.04, p = .09], while no significant differences existed for theta or beta relative power.
  - Closer examination of the data revealed a significant difference between groups in relative alpha power, [F (31) = 7.72, p < .001].
  - Finally, a multiple stepwise regression revealed that the higher number of points obtained was significantly associated with decreases in beta power [F (14)=4.80, p<. 05].

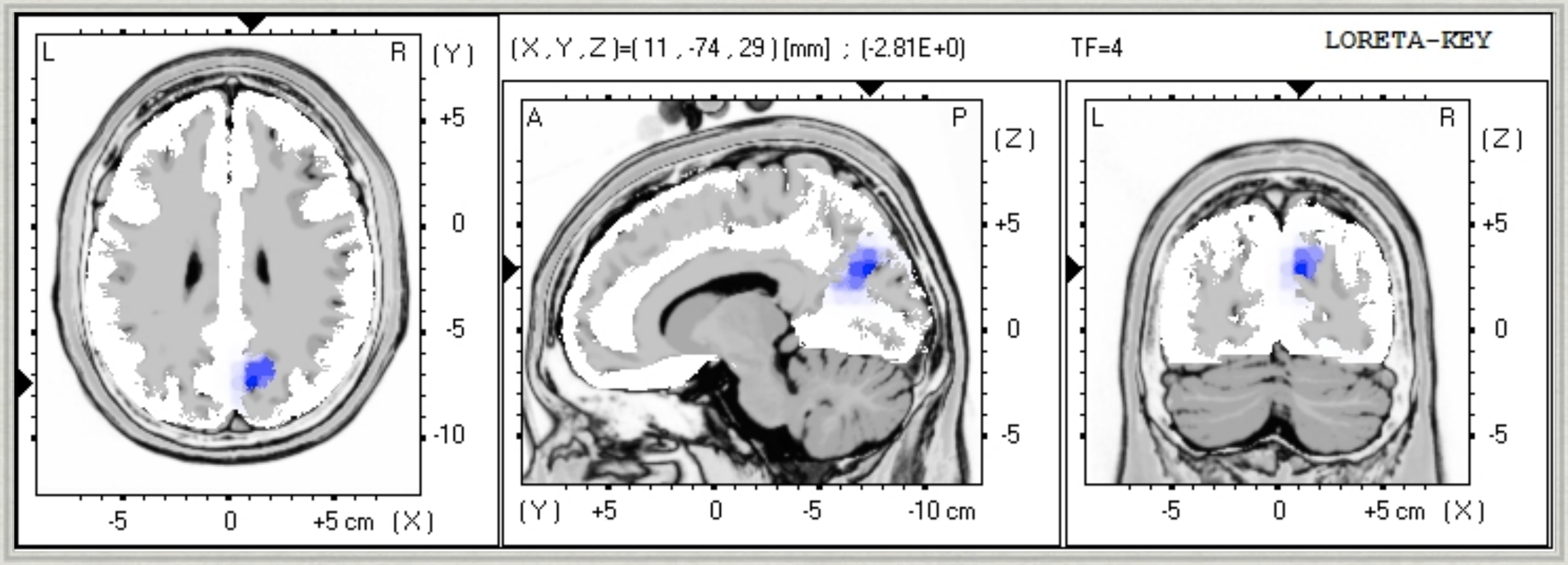
Results

- There were significant increases in relative current source density of alpha frequency in Brodmann's area 24



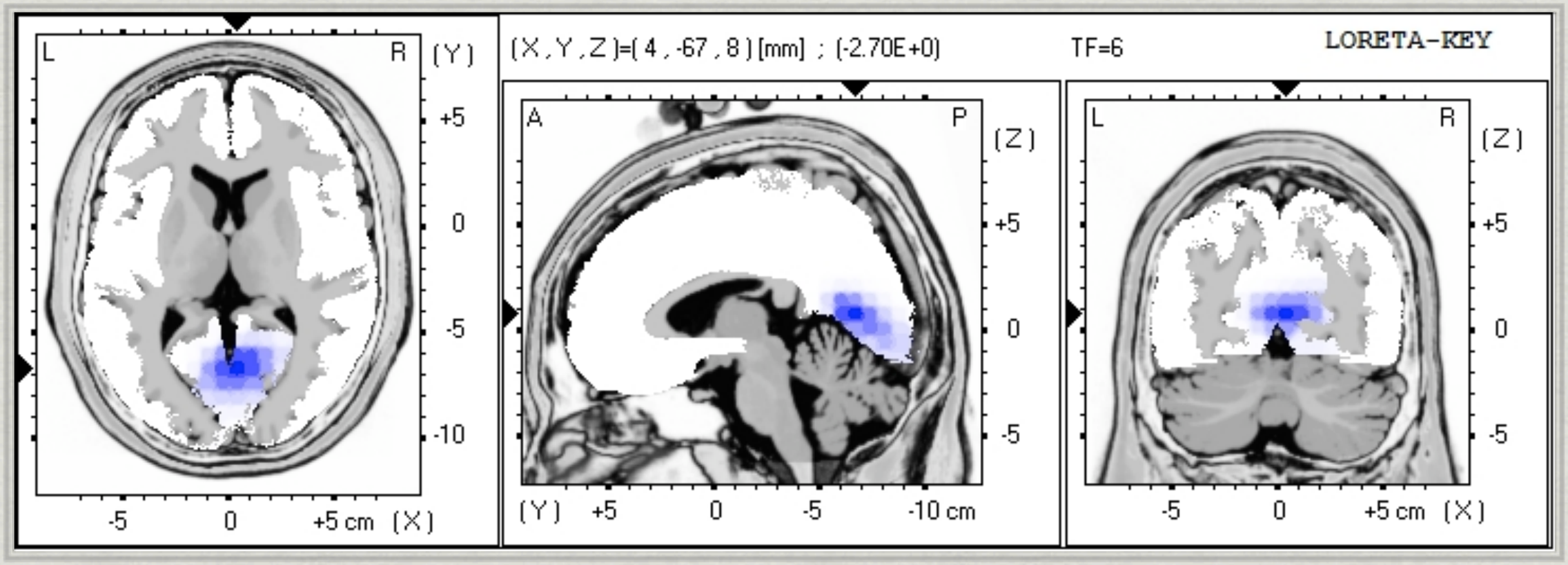
Results

- And significant decreases in relative beta current source density in Brodmann's area 31 for 13-21 Hz.



Results

- And significant decreases in relative beta current source density in Brodmann's area 30 for 13-32 Hz.



Results

- There were no significant differences in the sLORETA analysis of the placebo controlled group across conditions.

Conclusions

- Brodmann's Area 24, 30 and 31 are cortical components of the limbic system and are involved in emotional processing and the affective dimensions of pain.
- In combination with the decreases in state anxiety the findings illustrate the physiological evidence that RSA feedback decreases arousal in cortical areas critical to the experience of anxiety.

Conclusions

- The implication is that RSA feedback can regulate the cortical limbic structures as a non-invasive treatment modality for anxiety and/or stress.

Thank you

leslie sherlin@mac.com