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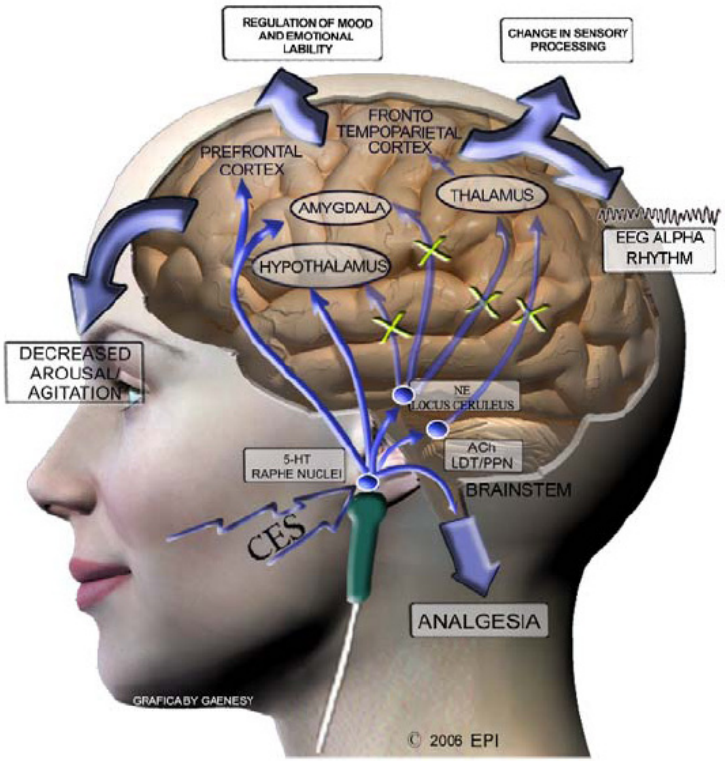
How Alpha-Stim® Cranial Electrotherapy Stimulation Works

by James Giordano, Ph.D.

How does Alpha-Stim® cranial electrotherapy stimulation (CES) work? The exact mechanism by which Alpha-Stim® produces effects is not fully known. However, based on previous and ongoing studies, it appears that the Alpha-Stim® microcurrent waveform activates particular groups of nerve cells that are located at the brainstem, a site at the base of the brain that sits atop of the spinal cord. These groups of nerve cells produce the chemicals serotonin and acetylcholine, which can affect the chemical activity of nerve cells that are both nearby and at more distant sites in the nervous system. In fact, these cells are situated to control the activity of nerve pathways that run up into the brain and that course down into the spinal cord. By changing the electrical and chemical activity of certain nerve cells in the brainstem, Alpha-Stim® appears to amplify activity in some neurological systems, and diminish activity in others. This neurological 'fine tuning' is called modulation, and occurs either as a result of, or together with the production of a certain type of electrical activity pattern in the brain known as an alpha state which can be measured on brain wave recordings (called electroencephalograms, abbreviated EEG). Such alpha rhythms are accompanied by feelings of calmness, relaxation and increased mental focus. The neurological mechanisms that are occurring during the alpha state appear to decrease stress-effects, reduce agitation and stabilize mood, and control both sensations and perceptions of particular types of pain.

These effects can be produced after a single treatment, and repeated treatments have been shown to increase the relative strength and duration of these effects. In some cases, effects have been stable and permanent, suggesting that the electrical and chemical changes evoked by Alpha-Stim® have led to a durable re-tuning back to normal function. Electromedical Products International, Inc. is dedicated to using exciting new research technology and advanced, innovative methods to study the exact mechanisms through which Alpha-Stim® can be beneficial to patients with pain, anxiety, depression and sleep disorders.



Alpha-Stim® CES engages the serotonergic (5-HT) raphe nuclei of the brainstem. 5-HT inhibits brainstem cholinergic (ACh) and noradrenergic (NE) systems that project supratentorially. This suppresses thalamo-cortical activity, arousal, agitation, alters sensory processing and induces EEG alpha rhythm. As well, 5-HT can act directly to modulate pain sensation in the dorsal horn of the spinal cord, and alter pain perception, and cognition and emotionality within the limbic forebrain.

Legend

Blue arrows: inhibitory interactions
Purple arrows: excitatory interactions
X : suppressed pathways/interactions

Abbreviations

ACh: actetylcholine; LDT: laterodorsal tegmental nucleus of the brainstem; PPN: pediculo-ponitne nucleus of the brainstem; NE: norepinephrine; LC: locus ceruleus, 5-HT: serotonin

Note: Diagram not to scale

James Giordano, Ph.D. is Director of Science for Electromedical Products International, Inc. of Mineral Wells, TX, and is Scholar in Residence at the Center for Clinical Bioethics, Georgetown University Medical Center, Washington, DC. Dr. Giordano is also Visiting Scholar at the Center for Ethics, Dartmouth Medical School, Hanover, NH, and Invited Lecturer at the Roundtable in Arts and Sciences, Oxford University, UK. As a neuroscientist, Dr. Giordano's ongoing work is focused upon neural mechanisms of pain, the philosophy of pain research and practice of pain medicine, and the neuroethical issues inherent to the development and use of emergent technologies in neurology and psychiatry. Dr. Giordano received a Ph.D. in biological psychology from the City University of New York. He was an NIEHS post-doctoral fellow in neurotoxicology and neuroscience at The Johns Hopkins University, Baltimore, MD, served as Visiting Scientist in the Department of Clinical Neuropharmacology, Max Planck Institute for Psychiatry, Munich, Germany, was an American Psychological Association Visiting Fellow in neuroimaging at the Martinos Center for Advanced Imaging, Harvard University Medical School/Massachusetts General Hospital, and completed post-graduate training in bioethics at the Neiswanger Institute for Bioethics and Health Policy, Loyola University/Stritch Medical School, Chicago, IL. The author of over 65 refereed publications on pain, ethics and medical philosophy, Dr. Giordano serves as Neuroscience Section Editor for the Pain Physician journal, Bioethics Editor for the American Journal of Pain Management, and Ethics Section Editor for the journal Practical Pain Management.

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Quantitative EEG Brain Map After CES

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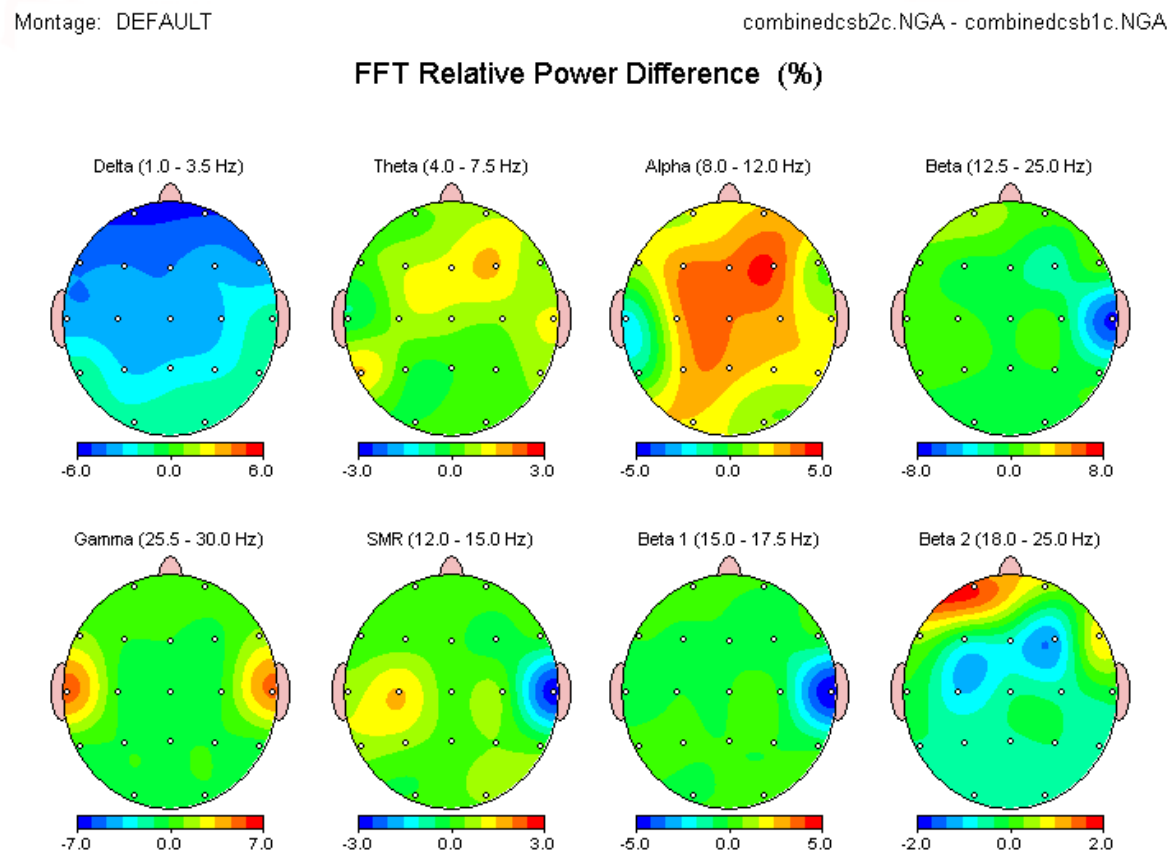
This is a quantitative EEG brain map (QEEG) showing the changes in brain activity by traditional EEG bands of 30 volunteers after a 20 minute treatment with Alpha-Stim® CES at 0.5 Hz. Blue shows a decrease in activity after Alpha-Stim® while red shows an increase in activity. There is an increase in alpha activity (relaxation brain waves) with a simultaneous decrease in delta activity (sleep brain waves) after using Alpha-Stim® for 20 minutes. The changes near the ears were found on raw EEG to be artifact.

Kennerly, Richard (2004). QEEG analysis of cranial electrotherapy: a pilot study. *Journal of Neurotherapy* (8)2:112-113.



Methods: Digital EEG for QEEG analysis was obtained from 30 research volunteers using a Neurodata-24 digital EEG system. CES was providing with Alpha-Stim 100 cranial electrotherapy units set to 0.5 hertz. 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 CES at 0.5 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 CES 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 CES at 0.5 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.