

# Changing Velocity Circumcerebral Magnetic Fields Produce Altered State Experiences and Lowered Delta-Theta Power over the Temporal Lobes

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**Abstract-** Weak physiologically patterned magnetic fields applied through the cerebrum have been associated with opiate-like effects and mystical experiences including sensed presences and out-of-body experiences. While sitting in a comfortable chair housed in an acoustic chamber volunteers were exposed to Murphy's Shiva Hat from which cerebrally rotating, angularly decelerating magnetic fields (about 1 microTesla) were generated from arrays of 64 solenoids for 20 min. The sham-field exposed group wore the same hat and sat in the same place for the same duration of time. Subjects exposed to the burst-firing pattern generated fields with the changing angular velocity reported more out of body and sensed presence experiences than did the sham field group. Unlike the sham field group who displayed relative increases in delta power over both temporal lobes during the sessions, those exposed to the field exhibited diminished power that was comparable to their original aroused state. These results suggest that the effects of weak, complex magnetic fields on cortical electroencephalographic activity are consistent with patterns of cortical activation during altered states.

**Keywords-** *Shiva Magnetic Fields; QEEG; Mystical Experiences; Delta-Theta Power*

## I. INTRODUCTION

One of the basic premises of modern psychology is that all experiences are generated by brain activity. Experiences that are ephemeral and profound, such as mystical experiences that include the sensed presence and out-of-body experiences (often reported during altered states) should be elicited within controlled experimental conditions. We have been pursuing the assumption that conscious experience involves relatively low energies, in the order of  $10^{-12}$  Joules (J) which would be equivalent to about 10 million neurons each discharging with 10 action potentials per second and each action potential generating about  $10^{-20}$  J <sup>[1, 2]</sup>. In fact according to the classical formula  $\text{energy} = (B^2 / (2 \cdot 4\pi\mu)) \cdot m^3$ , where B is the strength of the field,  $\mu$  is permeability, and  $m^3$  is volume, a 1 milligauss (0.1 microTesla) magnetic field within the volume occupied by the cerebrum (about  $10^{-3}$  m<sup>3</sup>) would be associated with between  $10^{-11}$  and  $10^{-12}$  J of energy. Such intensities are frequently encountered within the modern electronic world <sup>[3]</sup>.

Although there is replicable evidence that physiologically-patterned magnetic fields applied across the cerebral hemispheres produce experiences of sensed presences in double-blind experiments <sup>[4]</sup> when the software is properly applied, subjective experiences are extremely sensitive to context and the ability for the experient to label the experiences. Quantitative electroencephalographic analyses <sup>[1]</sup> employing coherence analyses found that during sensed presences the vector of right temporal lobe processes pointed towards the left temporal lobe. On the other hand during out of body experiences the vector was from the left temporal lobe to the right prefrontal region. These results were consistent with the hypothesis that the sensed presence is the left hemispheric awareness of the right hemispheric equivalent of the left hemispheric sense of self. On the other hand the out of body experience is the intrusion of left hemispheric (awareness) processes into right hemispheric cognitive operations involved with spatial location and reconstructed memories.

The Shiva series was developed by Todd Murphy employing a wave-file type technology to apply the patterns of magnetic fields. They differ from the format employed by Persinger et al <sup>[5]</sup> where point durations of 3 ms of voltages between -5 and +5 V were generated from custom-constructed digital-to-analogue converters that produced current within connected arrays of solenoids or coils to generate the magnetic fields. The Shiva system is a commercial device that claims to facilitate personal development. There are myriad on-line testimonials concerning the efficacy of the equipment. We decided to examine the Shiva experience within the appropriate laboratory condition and to discern if: 1) subjects endorsed mystical-like experiences during these altered states, and, 2) if there were discernable changes in the electroencephalographic power particularly over the temporal lobes which have been considered the primary source of these phenomena. We reasoned if the effects were as large as reported they should be evident with even a small sample size.

## II. METHOD

### A. Subjects

After approval by the university's Research Ethics Board, 9 university men and women volunteered to participate in the experiment. Their ages ranged from 20 to 25 years. Five (3 men, 2 women) of the subjects were exposed to the magnetic field condition while the other 4 subjects (2 men, 2 women) were exposed to the sham field condition. In the latter situation all procedures were identical except that no magnetic fields were activated.

### B. Procedure

Each subject was told he or she might or might not receive weak intensity magnetic fields. The subject sat in a comfortable chair in a quiet, dark room that was also a shielded acoustic chamber. An ELECTRO-Cap international electrode system with 19 AgCl electrodes was placed over the head and referenced to the ears for collecting monopolar EEG data. Impedance under 15 kOhms was verified and maintained for each sensor. The EEG cap was connected to a portable laptop outside the chamber employing a Mitsar 201 amplifier system. WinEEG version 2.84.44 working in Microsoft Windows XP was used to collect the EEG data.

A custom-constructed (construction worker) hat supplied by Professor Todd Murphy was placed over the EEG cap. Over the surface of the hat there were 8 columns of 8 (64) solenoids obtained from Radio Shack. The 8 rows of solenoids were separated at equal angles around the hat so that the entire cerebrum received focal, weak magnetic fields for pre-programmed periods (Figure 1). Signals were transmitted to the successive rows of solenoids on the surface of the hat using Shiva Neural Stimulation Software version 5E. This software was also designed by Professor Murphy and employs 4 USB audio devices to send weak-intensity magnetic fields to the solenoids. The signals were derived from patterns described by Richards et al.<sup>[6]</sup> For this technology the digital-to-analogue signals had been transformed to audio-equivalents or wave files. Each USB audio device delivered the signal to two successive solenoid columns.

The pattern selected for the present study was designated as "amygdaloid signal, normal speed". This pattern was derived from "burst-firing" neurons within the amygdala and when applied as whole body fields to rodents results in analgesia equivalent to about 5 mg/kg of morphine<sup>[7]</sup>. The signal is composed of 289 points each generating a voltage between - 5 and +5 V to each pair of rows of solenoids. The duration of the pattern for the left frontal row of solenoids was 100 ms. Each successive column (counterclockwise from the top) was activated for an additional 20 ms. The point duration of each of the 289 points was 3 ms with 4000 ms (4 s) between each cycle. The duration of the total exposure was 20 min. The strength of the time-varying magnetic field within the volume occupied by the subjects' heads was about 10 mG (1 microTesla).

The subject was instructed to maintain closed eyes during the duration of the experiment. At the end of the experiment each subject completed an exit questionnaire listing 20 items<sup>[8]</sup> of common experiences within the chamber. Each item was ranked according to the incidence of these experiences (0=no experience, 1=happened once, 2=occurred frequently). These experiences referred to visual, auditory, tactile, vestibular and spatial anomalies as well as the sensed presence, out-of-body experiences, and a variety of emotions including fear and sadness.

### C. Statistical Analysis

Raw spectral power was extracted from the EEG data within the WinEEG software. Two, 30 s samples were captured for each individual during baseline (before the fields were activated) and 5, 10, 15, and 20 minutes after the commencement of the treatment or sham field procedure. The spectral analyses partitioned the EEG data into delta (0-3 Hz), theta (4-7 Hz), alpha 1 (8 to 10.5 Hz), alpha 2 (10.6 to 13 Hz), beta (14-30 Hz) and gamma (30+ Hz) bands. All statistical analyses involved SPSS 19.0 operating by Windows 7. Mean scores for subjective experiences were assessed by a t-test. The responses to each item were discern by Pearson r correlations (0=sham; 1=field), such that positive correlations indicated more endorsements for subjects in the field applied group. The  $r^2$  value offers an approximation of the effect size. To accommodate individual differences in cerebral EEG power the raw values for each temporal increment for each band were divided by the baseline value. Within and between subject ANOVAs were completed.

## III. RESULTS

### A. Subjective Experiences

The proportion of positive responses to all experiences was significantly [ $t(7)=3.11$ ,  $p=.01$ ] greater for the field exposed group ( $M=35\%$ ,  $SD=14\%$ ) compared to the sham field (control) group ( $M=9\%$ ,  $SD=9\%$ ). The group exposed to the magnetic pattern displayed significantly [ $t(7)=2.73$ ,  $p<.05$ ] more ( $M=1.4$ ,  $SD=0.9$ ) feeling of being detached or "leaving" the body than did the sham group ( $M=0.0$ ,  $SD=0$ ) and more intense experiences [ $t(7)=3.09$ ,  $p<.01$ ] of being somewhere else ( $M=1.6$ ,  $SD=.55$  vs  $M=0.5$ ,  $SD=0.5$ ). Pearson r values for the correlations between conditions (0=sham, 1=field) and the range of occurrence of the experiences (0, 1, 2) reflected the effect sizes. They were: I felt dizzy or odd (0.60), I felt the presence of someone or something (0.58), I felt as if I had left my body or was detached from my body (0.74), I experienced terror or fear (0.60) and I felt as if I were somewhere else (0.76).

### B. QEEG Profiles

The major QEEG responses involved the attenuation of power within the delta and theta bands for the group exposed to this specific magnetic field configuration. The effect was time-dependent as shown in Figure 2. Whereas the group exposed to the sham field displayed increased relative delta power over the left and right temporal lobes only over the 20 min period those exposed to the Shiva amygdaloid field displayed power densities that did not change from baseline. A similar effect was noted for theta activity (not shown here) but was not evident for any of the higher frequencies except for alpha over the occipital lobes only.

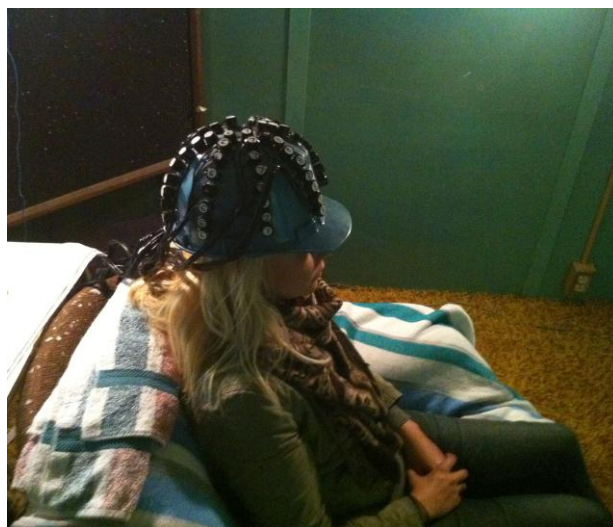


Fig. 1 The Shiva Device being worn by a volunteer while sitting within the experimental chamber

The device is controlled by computer programs and materials external to the chamber.

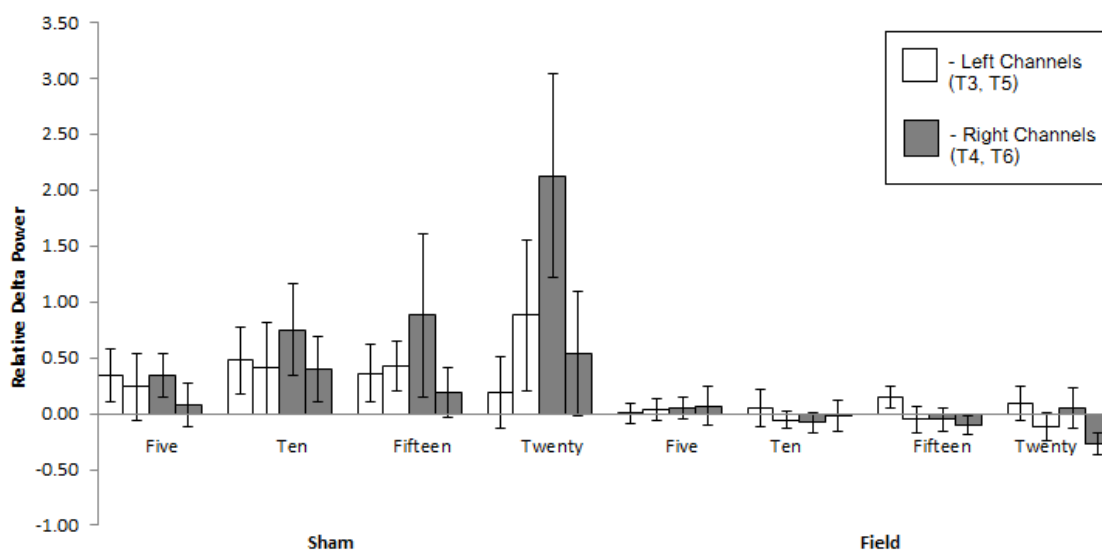


Fig. 2 Relative (to baseline) power within the delta band over time (5, 10, 15 and 20 min) for the subjects exposed to the sham field condition or to the amygdaloid burst pattern. Both groups of subjects wore the Shiva hat but a field was generated only for the field subjects. Vertical bars indicated standard errors of the mean.

### IV. CONCLUSIONS

There have been multiple reports that altered states and mystical experiences can be induced within controlled experimental conditions through strategic application of physiologically patterned weak magnetic fields whose temporal-spatial parameters are designed to interact with consciousness<sup>[4]</sup>. Rotational parameters that involve changing angular velocities around the head in a counterclockwise direction such that the fields are “colliding with the rostral-caudal transcerebral magnetic fields generated naturally are particularly effective for altering subjective experiences<sup>[9]</sup>. However the most valid measure of discerning if a “state” has been altered requires quantitative electroencephalographic measures.

In the present study the group exposed to this specific field did not display the usual increased power within the delta range as they sat within the quiet, darkened chamber. Instead they remained relatively activated compared to baseline conditions.

Whether or not this stability was associated with the subtle energy generated by the fields within the cerebral volume remains to be verified. That the effect was specific to the temporal lobes and not to the entire cerebrum indicates that the conspicuous consistency of power measures over time was not due to artifacts or confounding induction currents. Considering the circuncerebral rotation of the applied fields, the latter should have been diffuse.

The experiences of detachment and out of body experiences reported in this study were similar to the effects reported by Saroka et al.<sup>[10]</sup> with the same Shiva device but slightly different software and parameters. In that study there was also a marked relative increase in delta power (2 Hz in particular) over the left temporal lobe while the person was experiencing an out-of-body experience. We did not measure left temporal-to-right frontal coherence in this study. In the Saroka et al.<sup>[10]</sup> study this coherence during the out-of-body experiences was twice that of periods when the eyes were simply closed.

There are obvious advantages of measuring QEEG activity at the same time of the field applications or sham conditions. Although St-Pierre and Persinger<sup>[11]</sup> indicated that the incidences of a sensed presence during application of different but physiologically patterned magnetic fields were not related to the subjects' directly measured hypnotic induction profile, changes in specific power of EEG activity during field applications are more direct verifications of physical effects. As functional Magnetic Resonance Imaging data have shown, discrete enhancements of activity can occur in specific loci without the subject's awareness. Changes in power as a primary measure also minimize the dependence upon subjective report which can often be influenced by "analytical overlay", that is the person's interpretation and verbal labelling of experiential content evoked by the applied magnetic field configuration.

The results of these experiments do not prove that all experiences reported during exposure to the Shiva system or related devices are elicited by the physiologically patterned magnetic fields. However two separate experiments have shown that the out-of-body experience is predominately reported in this context compared to sham field exposures. Because all experiences are generated by or certainly very strongly correlated with brain activity, we would expect that synthesized patterns that are congruent with the neuronal electromagnetic substrate by which these natural experiences occur should reproduce very similar experiences.

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