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RESEARCH ARTICLE

The Healing Connection: EEG Harmonics, Entrainment, and Schumann's Resonances

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Abstract—This study looks at interpersonal coupling or connectivity between healer and subject pairs using advanced signal processing approaches and instantaneous EEG phase coupling. Paired recordings of the healer and subject were done both with the subject at a distance and in the proximity of the healer. The EEG data were analyzed for cross-spectral coupling using the bispectrum, as well as the more traditional Fourier-based spectral analysis and EEG waveform analysis looking at phase. The healer's EEG data showed harmonic frequency coupling across the spectra, followed by between-individual EEG frequency entrainment effects, and then by instantaneous EEG phase locking. These results suggest the presence of a connection between the healer and subject. We observed the healer producing a pattern of harmonics, consistent with Schumann Resonances, with an entrainment of the subject's EEG by the healer's resonance standing waves, and with eventual phase coupling seen between the healer and subject–paired EEGs. We speculate that Schumann's resonance–based standing potential effect might serve as a connectivity mechanism underlying healing.

Keywords: EEG harmonics—entrainment—Schumann Resonances—bispectrum—EEG coupling—phase locking—distant healing

In the physical sciences, it is commonly understood that every material form has frequencies natural to it. When a form's natural frequency is applied with force, the form will also vibrate in harmonic frequencies, often in multiples of the primary frequency. When a bell is struck, harmonic frequencies fill the air, and, if it is hit hard enough, nearby bells will begin to resonate, with this effect enhanced if they share structurally determined harmonics.

In the social sciences, it is commonly understood that in all societies people experience the waxing and waning of a sense of connectivity with other people, places, and things. The language used to describe this connection often borrows from the physical science of mechanical resonance. People describe being "in tune" with someone or "on the same wavelength," even though no previous EEG research on pairs of individuals has shown "harmonized" brain activity where the EEGs were producing the same spectral content and were "ringing" together (more technically, if they were "in phase", or phase-locked).

Indeed, conventional scientific wisdom would dictate that in the case of people, any sense of connection is purely subjective and confined to the internal biological processes within the person. Over the last several decades, though, there have been increasing attempts to correlate such subjective experiences of connection with more objective physiological and physical measurements external to the person having that experience of connection.

In terms of the subjective sense of connection from human to machines, Jahn and Dunne have widely reported that volunteer operators can significantly alter the output of random number generators in accord with their stated intention, and that the more a person feels in a "resonant bond" with the machine, the stronger the deviation from expected chance is likely to be (Jahn & Dunne, 2005). Further, if two operators work together to try to influence the output of the random number generator, a feeling of resonant bonding between the operators will produce an effect on the RNG that is stronger than the sum of the two individual operators (Dunne, 1991).[1]

Researchers have measured correlations between the brains of spatially separated people with the hope that the subjective sense of connection will be mirrored by measurable alterations in brain activity. Duane and Behrendt (1965) studied extrasensory EEG induction between identical twins, and reported in *Science* that in 2 of 15 pairs, alpha rhythms were elicited in one identical twin as a result of evoking these rhythms in a conventional manner in the other, even as they were spatially separated and had no sensory perception of the other twin. Similarly, Wackerman et al. (2003) reported in *Neuroscience Letters* that six channel EEGs recorded simultaneously from pairs of sensory-separated subjects produce significant correlations between brain activities. Radin (2004) examined thirteen bonded pairs and found that in 3 of 13 pairs, a stimulus given to one of the bonded pair produced significant EEG correlations in the partner. Standish et al. (2004) reported that correlated EEG signals were recorded in 5 of 60 subjects tested in pairs when one member of the pair received visual stimulation and the other did not. They also produced significant results using fMRIs to detect correlations between distant brains (Standish et al., 2003).

Overall, Radin (2004) reports that a comprehensive review of the literature indicates that approximately 15% of pairs of people show non-chance EEG correlations.

In these previous studies, selected brain correlations are reported in some of those studied, even while the authors lament that the mechanism by which people might "connect" and a mechanism for information transmission remain a mystery.[2]

The present study seeks to broaden the scope of previous inquiries in several ways. First, while remaining within the "bonded pair" model, we examine the EEG correlations not between friends, but between healer and subject. Second, we use a 19-channel full-spectrum EEG to look more comprehensively and with more modern analytic tools than has been done in the past. Previous studies have used simple pairwise correlation techniques looking at predefined bands. None of these earlier approaches were designed to look specifically for frequency coupling or at harmonics, as we have done through the use of the bispectrum. The bispectral analysis displays spectral harmonic coupling at a single electrode across the frequency spectrum, without predefining any bands, thus the display shows the correlated modulation of various EEG frequencies. Third, we speculate about a possible mechanism by which connectivity can be established, and thus a mechanism for possible information transfer between brains may be documented.

Methods

Procedure

One of the authors (WB) has developed a healing technique based upon rapid imaging which has been demonstrated to reliably produce full cures of mammary adenocarcinoma in experimental mice (Bengston & Krinsley, 2000, Bengston & Moga, 2007). The healing techniques used in this experiment have been described elsewhere (Bengston, 2007). Basically, they involve a process of extremely fast visualization of disconnected images by the person doing the healing. Images are constructed based upon very specific outcomes of meaningful goals desired by the healer. For example, if one held the desire to have a book published, the image to be cycled might be of a celebratory toast of champagne among friends, which holds the meaning that the book had indeed been finally published. A minimum of 20 such outcome images about unconnected goals are mentally visualized or "cycled" through as quickly as possible, preferably while also experiencing emotion of any kind. With much practice over time, the string of images runs automatically in the mind as background, multi-tasking activity during healing. The accelerated mental visualization activity is going on while the healer gently imagines an "energy flow” moving between the healer and subject. It is interesting to note that these healing techniques are mechanical in nature, and do not require concentrated thought, or belief by either the healer or subject.

Three individuals known to Bengston volunteered to be subjects in this study, which would apply these healing techniques to human subjects. Two of the three had health concerns, one of whom had previously participated in brief healing sessions.

Two sets of identical full-spectra EEG amplifier instrumentation were acquired for the experiment; one for the healer and the other for the paired subject. These matched amplifiers were used to create the EEG recordings of the healer and subject pairs. We employed two separate contracted EEG technologists who were devoted to setting up and monitoring each EEG in the paired experiment. Two separate rooms were used in the experiment, a healer’s room and a subject’s room, which was located approximately 35 feet away. The computers in the rooms were connected via a 50 foot ethernet connection to synchronize the computers, though actual electrical contact between the healer and subject was not possible. The electrical contact via the computers or their components (via power supply) was precluded by the electrical isolation of the medical device preamplifiers and power supplies used. The medical devices are designed specifically to prevent electrical connection which could provide a potentially fatal shock hazard in hazardous medical environments (such as a “Class A electrically sensitive patient”). Both healer and subjects were fitted with individual surface scalp electrodes. The technicians used “Elefix paste” (a commercial adhesive and conductive product) and “lemon-prep” (a commercial skin cleaner/abrader) to prepare the participant’s skin at the standard 10–20 electrode locations. Twenty-one (21) electrodes (10 mm Ag/AgCl with Touch Proof (DIN 42-802) style connectors) were placed on the scalp in accordance with the 10–20 placement system. One electrode was placed on the available clavicular notch area for an EKG signal measurement. Each set of electrodes was connected to an EEG amplifier with a DC-100 Hz frequency bandwidth (Mitsar-202), which was connected to a computer with a Microsoft Windows operating system.

Each channel of EEG was sampled at 500 samples per second, and the two computers were synchronized to a millisecond accuracy by synchronizing the computer clocks, so the Nyquist principle establishes that the healing session datasets could be time-matched at least to the accuracy of the 500 per sec sample rate. Once electrodes were placed, they were not removed until that person’s recordings were finished. To accomplish this, an amplifier was sometimes disconnected from the computer and carried by the participant for session room changes as necessary. A wheeled cart was also used to transport the computer and amplifier when a room change occurred.

Each volunteer subject became an individual target of four sequential recorded sessions, each session lasting at least 10 min. Each subject first did a double-baseline session, one section with eyes closed, and another with eyes open. With electrodes still in place, the subject next met for a few minutes with the healer until a subjective feeling of connection and readiness was established. The subject was then taken to the experimental room for a distant healing session, where there was not even a line-of-site connection. Following this, the subject was brought back into the healer's room, for a hands-on healing session. Similarly, the healer did a baseline session of eyes closed and eyes open, followed by the three sets of healing, with both distant and hands-on sessions.

Analytical Techniques

Data from the subject who had previously experienced sessions with the healer were deemed most likely to show "connection", due to the earlier observation that closer relationships had more "connection", and thus one of the volunteer's data was examined first, starting with the session that was done at a greater distance. When this session revealed anomalous data, it became the target of analysis, and this session is the dataset examined in this paper. The other sessions remain to be evaluated at a later date, thus this is best viewed as a case study and demonstration of our technique and approach, and not a controlled study requiring statistical evaluation.

The EEG data on this session were processed with WINEEG software (version 2.82.30) by Luke Hendricks (Experimenter #1), under the blinded direction of Jay Gunkelman, QEEG-Diplomate (Experimenter #3). Experimenter #3 provided direction regarding what form of analysis to use, and initially instructed Experimenter #1 to look for episodes where the healer's EEG's bispectral analysis displayed visually discernible patterns of cross-spectral interaction, which would indicate the presence of harmonics.

The bispectral analysis graphic display allows easy visual identification of cross-spectral coupling. This measurement shows a correlational interaction of two or more frequencies at a single electrode site (Hagihira, Takashina, Mori, Mashimo, & Yoshiya, 2001). Bispectral analysis is ideal for displaying both harmonics and nested rhythms (the modulation of one frequency by another, even in the absence of a mathematical harmonic relationship).

The bispectral display is expected to have a 45-degree "line", which merely represents the same frequency on both the X and Y axes, which are obviously related as an "identity". When other frequencies are coupled or are interacting, they show the interaction based on the presence of non-45–degree line "nodes", such as 10 Hz coupled with 20 Hz and 40 Hz, where those nodal locations would all be simultaneously marked on the display.

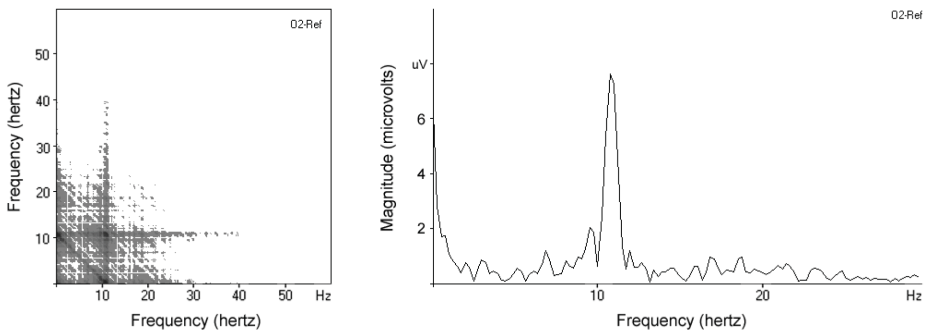

Figure 1. Typical Alpha spindle, bispectra and spectra.

(A) is the bispectral display, with the EEG frequencies from 1 to 60 along both the X and Y axes. The alpha spindle has a 10.74 Hz spectral peak, though there is no real cross-spectral "checkering" of the display which would indicate other frequencies that would be interacting with the alpha spindle.

(B) displays the spectral magnitude of the same EEG data, with the X axis displaying from 1 Hz to 32 Hz, showing the 10.74 Hz spectral peak magnitude, though no other related spectral peaks are noted. Peak values should be interpreted as midpoints of possible values of a given resolution. In this case, 10.74 is the midpoint of possible values within .125 Hz.

The precise time along the time series of the EEG where bispectral coupling was initiated was identified by Experimenter #1. Experimenter #3 then instructed Experimenter #1 to switch the display to the raw EEG wave morphology, and to observe the spectral characteristics of the EEG at those points in time. The onset of the cross-spectral coupling seen in the bispectral display was observed to be time-locked with the onset of an alpha-like spindling. A spindle is an EEG waveform that ramps up suddenly, exists for a period of time (spindle duration), and then wanes. The spindles seen associated with the bispectral harmonics were seen with an oscillatory frequency of 7.81 Hz, which can be seen either "manually" in the raw EEG (by counting the waveforms), or by looking at the peak of the power spectrum display derived from the Fourier. The Fourier represents a method of deconstructing the raw complex EEG waveform into component waveforms from across the frequency spectrum, and displays these results in power-by-frequency spectral plots (see Figures 1 and 2). The frequency of a given spindle is identified by its spectral peak, which should be interpreted as midpoints within a given resolution. The data in this paper have a resolution of 0.25 Hz, so values provided should be interpreted as ± 0.125Hz.

The Fourier analysis of a segment of the EEG spindle showed the 7.81 Hz tuning of the spindle. The Fourier also identified multiple harmonic peaks in the broader EEG spectra. These harmonics had a primary frequency at 7.81, and higher frequency harmonics were seen as mathematical multiples of the primary spectral peak. The peak magnitudes of the harmonics dropped to progressively lower levels, with each successively faster peak containing less

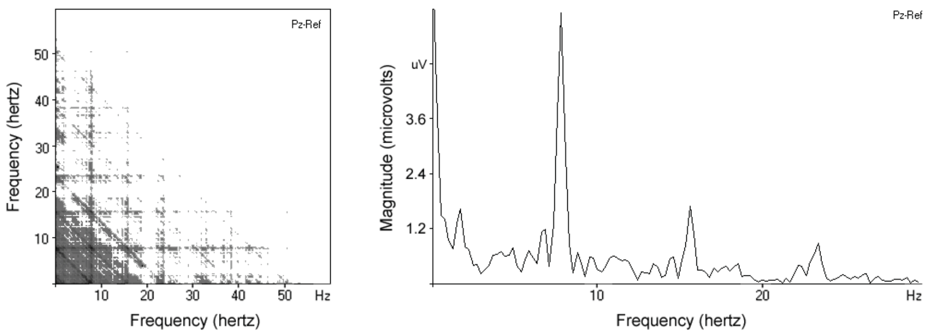

Figure 2. 7.81 Hz spindle with harmonics at 15.63 and 23.44 Hz, bispectra and spectra.

(A) is the bispectral display showing the cross-spectral interaction of the 7.81 Hz EEG activity and the other mathematically related harmonics, seen as a "checkering" of the display.
(B) displays the spectral magnitude peaks, seen with the 7.81 Hz primary peak, and then the progressively smaller magnitude responses as the doubling and tripling harmonic peaks are seen. Peak values should be interpreted as midpoints of possible values of a given resolution. In this case, 7.81 is the midpoint of possible values within .125 Hz.

"power" (power is the EEG magnitude squared). The power was observed to be more prominent parietally, so this is the topographic area we concentrated the analysis upon.

The mere presence of an EEG spindle does not indicate a standing potential, such as the presence of alpha spindles at 10 Hz. If a standing potential is not achieved, then the multiplicity of harmonics will not be seen in the bispectrum. A standing potential is indicated only when a spindle occurs *with the tuning of the resonant chamber it is oscillating within*, and only then are the harmonics seen in the bispectrum.

It should be noted that in the experience of Experimenter #3, the pattern seen in this healer–subject data, with the bispectral coupling and the Fourier with multiple harmonics, is an uncommon one, not previously seen in well over 30 years of clinical EEG experience.

Examining the raw waveforms revealed that these high amplitude waves happened in short bursts, with a spindle duration of 1 to 3.5 sec, with many spindles of shorter duration. These spindle bursts were observed to be distributed throughout the healing session's recording. The fourteen largest amplitude spindle bursts were identified by measuring the amplitude of frequencies in the 4 to 14 Hz range (with the aid of spreadsheet calculation).

EEG is evaluated in small time segments called epochs. We used an epoch length of 0.25 sec. A "burst" was defined as four or more consecutive epochs each exceeding 25 microvolts at parietal location Pz. Bursts were 1 sec or longer when selected by these criteria. Eye blink artifacts were eliminated using a standard artifacting formula (all quarter-second epochs with an amplitude at the Fp1 location exceeding 50 microvolts were rejected). Following artifact rejection, predefined bursts which had fewer than four epochs remaining were rejected, thus all remaining spindle bursts were of at least 1 sec duration.

Fourteen general bursts were seen in the EEG (see Table 1), and of these ten had a spectral peak frequency of 7.81 Hz. Seven of the bursts of 7.81 Hz had harmonic peaks at double their frequency seen in the Fourier. Two other bursts had a peak frequency of 8.3 Hz, with only one showing a secondary harmonic peak. The remaining two bursts had a peak frequency of 8.79 Hz, though neither of these bursts had a harmonic spectral peak. Thus the bispectral coupling and associated harmonics appeared to be predominantly seen during the 7.81 Hz bursts.

Since the 7.81 Hz bursts were seen with spindle durations of 1 or 2 sec, the low-frequency resolution was limited by the duration of the event to 1.0 Hz and 0.5 Hz, respectively. To achieve 0.25 Hz low-frequency resolution in a Fourier spectral analysis, 4 sec of continuous data is required as the epoch length. The use of this duration length analytically would extend the “edges” of the actually observed bursts. The spectral and bispectral images of the Pz electrode site are seen below. The Pz data were compared with the data from the five parietal sites, and the data from Pz were all found to be representative of the region.

TABLE 1
Summary of High-Amplitude Bursts

Start to End in Sec	Duration	Spectral Peaks	Notes
44.25–46.5	9	8.3, 16.6	
83–84.25	5	7.81, 15.63, 23.44	
120–121.5	4	8.79, 16.6	
134.75–136.5	7	7.81, 16.6	
186.75–190.25	14	8.3, 16.11, 24.41	
234–235	4	7.81, 15.63	
275.5–279.25	14	7.81, 15.63, 23.44	Blink in middle
287.75–288.75	4	8.79, 14.65	
349.5–353.25	10	7.81, 15.14	Blink in middle
366.75–367.75	4	7.81, 15.63	
416.25–417.25	4	7.81, 15.63	
473.75–475.75	8	7.81, 16.11, 23.93	
505–506	4	7.81, 15.63	
777–778.25	5	7.81, 15.63	

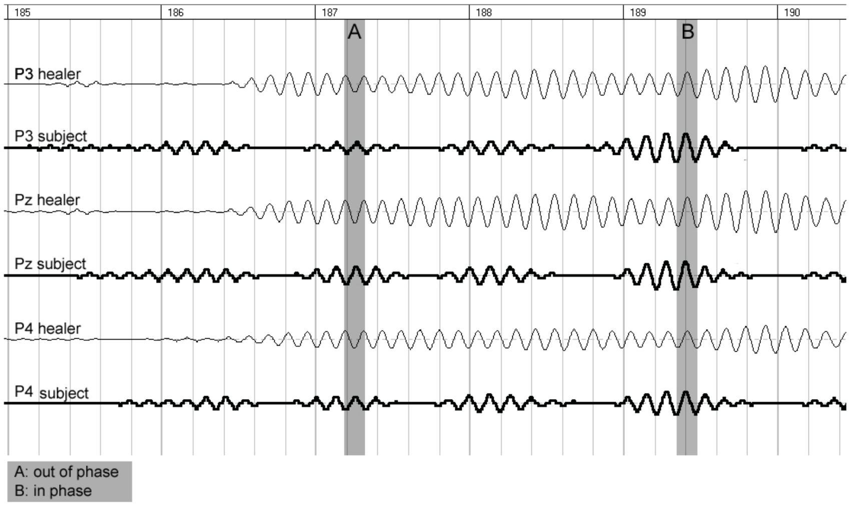

Figure 3. Spliced EEGs: healer and subject, example of entrainment to phase locking.

The figure shows waveforms revealing the 7.5 to 8 Hz frequency range in both healer and subject at three parietal locations. Early in the healer's sustained amplitude burst (A), the phase of the subject does not match the healer's. As the healer's burst continues, the subject's phase synchronizes with the healer's (B) as the subject's amplitude also increases to near its maximum for the entire 11-min session. Note: Given the healer's greater amplitude generally, the subject's entire waveform was amplified for clarity (50 vs. 15 microvolts/cm sensitivity).

When the healer produced these bursts of spindling 7.81 Hz activity, we looked at the time-locked data from the subject. The subject's EEG appeared to produce a similar spectral burst, though of a much lower magnitude, though with the magnitude amplified by the harmonic resonance once the EEG was in phase (phase-synchronous content is additive). The presence of generally similar spectral bursts allowed us to analyze the phase coupling (synchrony) between the healer and subject's EEG. The healer was seen to produce the primary spindle of activity first, with the subject subsequently producing the smaller bursts of similar frequency content. Though similar in frequency, the subject's EEG activity was initially out of phase with the healer's EEG activity (one waveform going up when the other is going down). The two bursts of similar frequency content achieved a phase locking within another few hundred milliseconds, with phase locking between individuals seen somewhere in the middle of the healer's sustained burst of EEG activity.

The healer's long duration burst shown below illustrates the phase "entrainment" of the subject to the healer's EEG pattern (see Figure 3).

Discussion

Previous studies were limited technically to looking at single predefined frequency bands, and how these bands were correlated in healer–subject or "interpersonal connection" research. In our study we used methods specifically designed to look for evidence of interaction between the healer–subject pair. The observation of bispectral harmonic coupling across the frequency spectrum provides evidence of an electromagnetic standing wave in the healer, with a primary tuning at approximately 7.81 Hz, and at harmonic multiples ascending the frequency spectrum.

The presence of a standing wave and the associated harmonics in the healer was observed to be stronger and to occur earlier in time than similar frequency bursts that were observed in the paired subject's EEG, though this was not initially seen with a phase-locked relationship to the activity in the healer.

A waveform that is produced at the harmonic frequency of a container will produce a "standing wave" when the resonant frequency of the container is matched, which will be seen as a stable waveform that appears not to even move or "travel". If this standing potential is present and another oscillator is available in the environment, it will be entrained into the same rise and fall time (frequency entrainment), and it will "synchronize" with the harmonic standing wave due to the reinforcement of synchronous potentials and the partial cancellation of other non-synchronous content, and this will be seen as a phase locking of the two wave oscillators.

Following the initial occurrence of similar frequencies, the phase of the subject appeared to be reset to be synchronized to the same phase relationship as the ongoing activity seen in the healer, and once tuned to the same frequency and phase, the waveform is augmented (amplified) by the identically tuned standing potential. This entrainment of the harmonics to be in-phase (or phase-coupled) was observed to occur during the healer's bursts of 7.81 Hz EEG activity seen with the bispectral coupling and spectral harmonics.

The observation from these data suggest that the standing potentials and harmonics produced by the healer make a connection between the healer and the subject, and thus provide a mechanism for phase coupling between the pair. The salient observation that merely showing a method for connectivity does not indicate the nature of the content that may be communicated via the connection cannot be overstated. The connection could be modulated (as in Morse Code), or it may be a "carrier" for higher or lower frequency spectral content (such as slow cortical potentials, DC Field potentials, or even Gamma or Tau rhythms).

With these preliminary observations having been presented in a public forum[3], it should be mentioned that others have seen similar harmonics in healer–subject paired data, but the observation had not been previously reported. Dr. Juan Acosta-Urquidi has collected 30 pairs of healer–subject data, and following the presentation of our data, looked at the spectral content in some of his pairs and saw the spectral peaks at about 7.8 Hz and the higher harmonic peaks, though his analysis displays did not allow for higher resolution of the frequency spectra.

If we are immersed in a chamber that has harmonic characteristics, and we resonate at the harmonic tuning of our chamber, a standing potential is created that can have a distant entrainment effect on other oscillators in the chamber. The frequencies we observed empirically were noted to be suggestively close to the classical "Schumann Resonances". The Schumann resonances represent the harmonic tuning of the "chamber", which is the atmospheric cavity bounded by conductive surfaces (the ground and the ionosphere). These resonances were defined as 7.83 Hz as the primary frequency, with mathematical multiples across the spectrum, and seasonal fluctuations are seen in the data tracked by the U.S. Geological Survey in Antarctica and Parkville, California, as well as in other locations.

We suggest this as a possible method of connectivity in healer–subject pairs where distant healing effects are observed. We further hypothesize that phase coupling across the frequency spectra may be the physical representation of the felt sense of "connectedness" that permeates societal descriptions of bonded pairs. We also encourage others to utilize our methodology of looking with the bispectral display to "see" these cross-spectral interactions, and to use phase analysis to look for actual spectral coupling, and not merely to rely on general correlation of spectral power of predefined peaks.

Notes

[1] Also, in a series of exposures to scalar wave generators tuned to 7.83 Hz, Dr. Juan Acosta-Urquidi found that healers were commonly sensitive to the presence of the signal during a resting period, and experienced it as a positive felt presence (personal communication, 2009).

[2] One further aspect of the phenomenon is seen in coupling between devices and humans. Dr. Juan Acosta-Urquidi shared the data from one of his experiments with us, where he exposed individuals to a scalar generator producing the primary Schumann resonance, and observed the spectral coupling of the humans with the device. This suggests the possibility that an artificial generator can cause the human EEG to spectrally match with that of the generator.

[3] Luke Hendricks presented some of these data at the 2009 Annual Meeting of the Society for Scientific Exploration at the University of Virginia.

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