

The Neuropsychiatry of Paranormal Experiences

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From the perspective of modern neuroscience all behaviors and all experiences are created by the dynamic matrix of chemical and electromagnetic events within the human brain. Paranormal experiences might be considered a subset of these neurogenic processes. Experiences that are labeled as or attributed to paranormal phenomena 1) are frequently dominated by a sensed presence, 2) appear to involve the acquisition of information from distances beyond those normally obtained by the classical senses, and 3) imply distortions in physical time.¹

Most paranormal experiences have negative affective themes with emphasis on some aspect of death to others or dissolution of the self. Experiences concerning death or crisis to others are reported to occur predominantly at night, particularly between 2:00 and 4:00 A.M. The sensed presence is also more common during this nocturnal period. We² have suggested that the hourly incidence of temporal lobe seizures (data collected in the late nineteenth century by W. P. Spratling before medication was available) and the circadian distribution of sensed presences attributed to paranormal sources reflect a shared source of variance within the human brain.

If structure dictates function and microstructure within the brain determines or directs microfunction, then one would expect classes of experiences to be associated with specific regions of the brain or the patterns of activity generated within these areas. Both the occurrence of paranormal experiences and their rates of incidence are associated with specific types of neuronal activity within the temporal lobes. This linkage does not verify the validity of the content of the experiences but simply indicates that specific patterns of activity within the temporal lobes and related structures are associated with the experiences. The sources of the stimuli that evoke the neuroelectrical changes may range from properties intrinsic to chaotic activity, with minimal veridicality, to external information that is processed by mechanisms not known to date.

That patients who display complex partial seizures with foci within the temporal lobes, particularly the amygdala and hippocampus, report more frequent par-

anormal-like experiences has been known for decades. Distortions in subjective time, the sensed presence of another sentient being, out-of-body experiences, and even religious reveries have occurred during spontaneous seizures.³ Direct surgical stimulation of mesiotemporal structures within the temporal lobes, particularly the right hemisphere, has been shown to evoke comparable experiences. As emphasized by Horowitz and Adams,⁴ the experiences during stimulation are not just memories, but enhancements or vivifications of the class of ongoing experiences (perceptions, thoughts, or memories) at the time of the stimulation.

There appears to be a continuum of temporal lobe sensitivity along which all human beings are distributed. Normal individuals who are highly sensitive, as defined by above-average numbers of responses to Persinger and Makarec's Personal Philosophy Inventory⁵ or above-normal scores on Roberts' inventory for Epileptic Spectrum Disorder, report more types of paranormal experiences as well as more frequent paranormal experiences. The correlation coefficients between the numbers of different paranormal experiences and scores for temporal lobe sensitivity, as inferred from responses to clusters of items from these inventories, range between 0.5 and 0.9. Individuals who have elevated scores for these inventories also show more prominent alpha rhythms over the temporal lobes⁷ and display elevated but not necessarily abnormal scores for the eccentric thinking and hypomania scales of the Minnesota Multiphasic Personality Inventory.⁸

Like patients who display complex partial seizures and limbic epilepsy, normal people with elevated numbers of temporal lobe experiences show variants of interictal behavioral patterns. The propensity to infuse sensory experience with enhanced meaning, presumably associated with more electrically labile amygdaloid functions, results in more frequent experiences of deep and even cosmic personal significance in response to infrequent or odd events.⁹ The convictions that the experient has been selected by some universal force, has a particular purpose in life, and must spread the message (often with unstoppable viscosity) are remarkably common themes. From this perspective the deep personal or emotional significance of a paranormal experience is a

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predictable property of a labile amygdala processing unusual perceptual events.

Paranormal beliefs and paranormal experiences are related. There is a moderate to strong positive correlation between the proportions of paranormal experiences that people report and their beliefs in the paranormal phenomena.¹⁰ Interestingly, paranormal beliefs appear to be substitutes for traditional religious beliefs. People who endorse the existence of extraterrestrial intelligence as the source for UFOs and the reality of reincarnation are less likely to accept traditional beliefs in the second coming of Christ or to agree to kill in God's name.

GEOMAGNETIC ACTIVITY AND PARANORMAL EXPERIENCES

One of the first observations that suggested specific classes of paranormal experiences were not exclusively derived from incorporeal or nonphysical sources, but were coupled to subtle changes within brain chemistry and brain electromagnetic activity, was the empirical association between global geomagnetic activity and the report of bereavement apparitions.¹¹ These occur most frequently within about three days after the death of a significant person during a time when the dream sleep of the experient has been disrupted and increased activity within the pathways for corticotropin-releasing factor (CRF), ACTH (adrenocorticotrophic hormone) and cortisol is typical.

The increase in geomagnetic activity associated with these reports in sensitive or vulnerable individuals is quite weak. Compared with the normal intensity of the earth's static magnetic field, which is about 50,000 nT (nanotesla) or about 0.5 gauss, the changes in magnetic field strength associated with increased geomagnetic activity are within the 40 to 50 nT range or greater. These changes usually require several minutes to occur but in some instances can peak within about 4 minutes.¹²

The impacts of increased geomagnetic activity, as defined by daily aa (average antipodal) intensities, on the sensitive populations are such that we have employed these indicators as predictors of sleep disruption and the subsequent enhancement of psychological or psychiatric symptoms. We are not the first clinicians to identify this important predictor. Friedman et al.¹³ during the 1960s and multiple European researchers during the 1930s¹⁴ had reported the association. Whereas a decade ago this information was available from restricted sources such as the National Geophysical Data Center (Geomagnetic Indices Bulletin, 325 Broadway, Boulder, CO 80303; tel. 303-497-6346), it is now available from several websites.

Increased occurrences of epileptic seizures when geo-

magnetic activity exceeds about 30 nT have been reported by many authors.^{15,16} The strength of the correlation ranges between 0.4 and 0.7. Obviously, the primary limit of correlational studies is the inability to easily isolate the causal variables. However we^{17,18} found that the experimental simulation for 2 hours of the type of 50 nT variations associated with geomagnetic activity (presented as amplitude-modulated 7 Hz fields) produced the same effect size for the production of limbic seizures in epileptic rats as that associated with natural stimuli.

Intermittent shifts in magnetic field strengths have been shown to decrease nocturnal melatonin levels¹⁹ and to increase the circulating levels of the epileptogenic neuropeptide CRF (corticotropin releasing factor). From this perspective, we hypothesized that the greater occurrence of the sensed presence and bereavement apparitions during the early morning hours reflects the decreased thresholds for the elicitation of paroxysmal activity within limbic structures, particularly during the functionally specific organization of dream sleep. However, instead of convulsions, the person experiences (after suddenly awakening) the sensed presence or its variations. The source of the stimuli that provoke the experiences may range from the individual's intrinsic lability, augmented by social factors, to a variety of external factors.

EXPERIMENTAL SIMULATION OF THE SENSED PRESENCE

About 15 years ago we were pursuing the neurophysiological correlates to the sense of self. We reasoned that to study complex experiences such as the sense of self or even consciousness within the laboratory, a technology and methodology must be developed to elicit these experiences. The history of science has clearly shown that the experiment is the most powerful tool we have to understand the organization of the causal variables that elicit a phenomenon. We intuited that the application of very complex, weak magnetic fields would have the potential to interact with the subtle but complex neuroelectromagnetic processes associated with consciousness and the subtle nuances that define human experience.

Very low frequency, very weak (similar to the intensity generated by a computer screen) complex magnetic fields applied with specific types of geometry through the temporoparietal regions of the brain were selected because of their penetrability. The metaphor for employing these fields, rather than the very intense simple sine-wave fields known to induce conspicuous currents,

was the following. If you and I were listening to a pure tone of 1,000 Hz, we would probably not respond unless it was about 100 dB; then we would leave because the amplitude would be aversive. However, if I whispered "help me" at 20 dB, a magnitude thousands of times less intense, you would respond to the pattern of this combination of simple sounds. The critical factors are the complexity and information rather than the intensity.

Our primary interest was to discover the major correlates of creativity and the sense of self. Formal measures of creativity and analyses of the vocations and preferences for people who scored highest on inventories of temporal lobe sensitivity indicated that creativity and a specific type of egocentricity loaded on the same factor. It was dominated by musicians, writers, artists, and individuals who infer novel or innovative connections between the same stimuli that others consider mundane.

However, we found that when we applied specific complex magnetic fields over the right hemisphere, most normal people who were not aware of the purpose of the experiment experienced a "sensed presence" or sentient being.²⁰ Many individuals felt the presence interact with their thinking and "move in space" as they "focused their thoughts" on it. The strengths of these fields were between 1 microtesla (10 milligauss) and 5 microtesla (50 milligauss) at the surface of the skull. Many experiments indicated that the temporal morphology of the applied field, rather than the intensity, was responsible for these experiences.

The results of these studies strongly suggested that the sensed presence, a phenomenon that had been the subject matter of paranormal experiences and mystical elaborations for millennia, could be evoked experimentally. The predominance of the experience during or just following stimulation of the right hemisphere was considered strong support, but not proof, that the sensed presence was the experience of the awareness of the right hemispheric equivalent of the left hemispheric sense of self.²¹ Other neuroscientists had frequently indicated that the sense of self is primarily a linguistic process (or from Buddhist perspectives, a social fiction) associated with functions classically attributed to the left hemisphere and is one of the reasons that cognitive therapies can have such powerful effects.

Although the sense of a presence could be evoked in most individuals,²² it was more prominent in people who had elevated scores on inventories from which temporal lobe sensitivity (or lability) was inferred.²³ The experiences were most easily evoked if a frequency-modulated pattern (tailored after a "chirp" sequence from standard signal generators) was applied over the right hemisphere for 20 minutes and then a bilateral burst-

firing pattern (designed after the discharge of amygdaloid neurons from an epileptic patient) was applied bilaterally over the temporal lobes for an additional 20 minutes. These experiences occurred with equal vigor in dozens of reporters accompanying television film crews who have visited the laboratory during the last 10 years. The sensitivity of the functions of the right hemisphere to complex magnetic fields even within the picotesla range has been shown repeatedly by Sandyk.²⁴

The experimental data also suggested that the sensed presence was the prototype for all of the other experiences that include spirit visitations: alien "abductions," the Greek Muses, incubi and succubi, and perhaps even the god experience itself. Many of these experiences occur during periods of rapid eye movements (dreaming), when cerebral processing shifts toward limbic sources and memory consolidation and when right hemispheric functions are more predominant.²⁵ During the day, these experiences are more likely to occur following periods of right hemispheric activity such as singing or chanting within large groups. Religious ceremonies are constructed to enhance these conditions. The label, such as the spirit of god or an alien encounter, that is applied to the sensed presence at the time of the experience strongly affects the details of this autobiographical memory when it is reconstructed minutes to hours later.²⁰

HAUNTS AND PRESENCES AS EVOKED EXPERIENCES

A large proportion of paranormal experiences occur in specific places. They are associated with a sensed presence, fear, odd smells, apparitions along the peripheral (usually left) visual field that "disappear" when directly (foveally) viewed, and auditory experiences (loud noises). Continuous measurements within these areas reveal bursts of low-frequency magnetic fields, ultrasound, and other physical anomalies that can directly affect objects within the space as well as the human brain.²⁶ Because the source of the experiences is usually not known to the experient, they are usually attributed to the available cultural explanations of demons, ghosts, and aliens. Usually it is the aversive experiences that lead people to contact our research group.

We have simulated and reproduced these experiences by applying complex frequency-modulated magnetic fields through the brains of normal people who have experienced haunts. For example, a middle-aged journalist who had experienced an apparition in his habitat reported brief "rushes" of fear within a few minutes of the application of the frequency-modulated magnetic

field over the right temporal region.²⁷ At the time he was sitting in a quiet, darkened room. Each "rush" was associated with paroxysmal electroencephalographic activity over the temporal lobes (Figure 1). Towards the end of the exposure, he "re-experienced," with concomitant paroxysmal activity and terror, the "haunt." Applications of other configurations of magnetic fields, with similar intensities, did not evoke this powerful presence.

Because of the complexities of modern technology, the occurrence of the resonant structures of magnetic fields in the environment that evoke these experiences may be more common than suspected. In one case a young man and woman, both of whom displayed elevated scores on the Roberts scale for temporal lobe sensitivity, reported suddenly awakening between 2:00 and 4:00 A.M. The man experienced an apparition moving through their bed. Both individuals experienced odd sounds (breathing), marked apprehension, and the feeling of a presence. Continuous monitoring of their electronically dense house revealed repeated transients of complex magnetic fields with peak strengths between 15 and 30 mG, similar to those that evoke the sensed presence in our experimental studies. These peaks were concurrent with the reports of the paranormal experiences. The fields were generated by less than optimal grounding of the house.

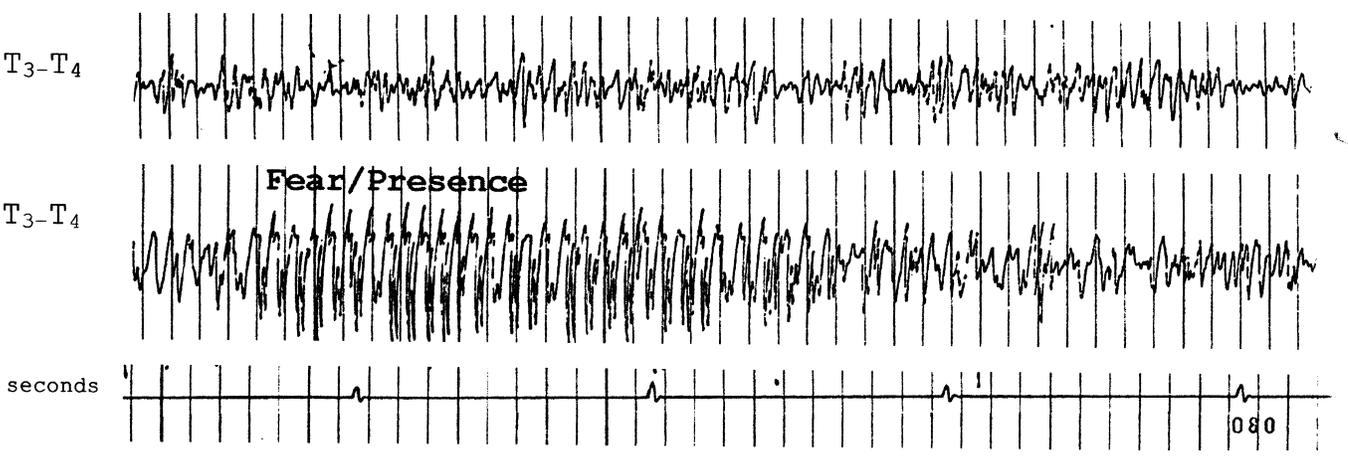
In another case, a female adolescent²⁸ had been referred to a psychiatrist because she had seen an apparition, experienced a presence, felt this presence stimulate her inner vagina and uterus, and sensed the outline of a baby over her left shoulder. She felt as if she had been chosen. We interpreted these experiences as most

likely emerging from paroxysmal activity within the temporal stem that shares fibers from the insular and temporal cortices within the right hemisphere. The religious context resulted in a different interpretation by the girl. The experiences would occur in the early morning hours, usually between about 2:00 and 4:00 A.M. local time. The girl had sustained a left frontal injury as a child but had been normal and quite successful scholastically. Direct measurement around her bed showed the occurrence of a pulsed magnetic field whose structure was similar to those we employ to evoke the sensed presence in the laboratory. The source was an electronic clock. She frequently slept with this clock within a few inches from her head. The intensity would have been sufficient to suppress nocturnal melatonin levels and to evoke electrical seizures.

CLINICAL POPULATIONS

The possibility that the "sensed presence" was actually the awareness of the right hemispheric equivalent of the left hemispheric sense of self had immediate application to our clinical research with patients who have sustained mild brain injury. Patients who sustain brain trauma associated with impacts of mechanical energy to their bodies or brains, even without loss of consciousness or significant neurological sequelae, often reveal a loss of the sense of self.²⁹ They exhibit a grief response during which time they attempt to return to the preincident state, then exhibit periods of aggression and frustration (with invariable family conflicts), and ultimately enter a period of depression that is frequently resistant

FIGURE 1. Bipolar electroencephalographic activity over the temporal lobes during applications of weak (1 μ T) frequency-modulated (the "Thomas pulse") magnetic fields over the right hemisphere of a professional journalist who had experienced a "haunt." Top panel: normal activity; Middle panel: paroxysmal discharges concomitant with subjective experiences of intense fear and the sensed presence. Bottom panel: seconds marker.



to pharmacological treatment with antidepressants. The latter may occur months to years after the impact. According to R.J. Roberts⁶ and our research,³⁰ many of these patients respond more effectively to low dosages of anticonvulsants such as carbamazepine or gabapentin.

We have found that the majority of patients who have sustained mild brain injury and who feel as if they are “not the same people as they were before the injury” experience increased incidence of paranormal experiences, including the feeling of a presence of a sentient being. The characteristics of most of these presences reflect the function of the right hemisphere. They are deeply affective, spatially clear but visually diffuse phenomena. Neuropsychological profiles of these patients suggest a relatively enhanced activity within the right hemisphere, particularly within the parietal and temporal regions in conjunction with markedly elevated indicators of anomalous hippocampal/amygdaloid activity. The presence is so intense and “real” that the patients think they are “going crazy” and will not reveal these experiences even to their families. Only after we have predicted when and where the presence has likely occurred does the patient, usually with tearfulness, discuss the experience. The details of the phenomenology and the relief reported by the patients strongly indicate that the reconstructions are not contextually induced. Clinical indicators of suggestibility, such as upward eye roll and sway, administered during our routine neurological screening of patients are not correlated with the presence or absence of the sensed presence.

Sensed presences attributed to the left side are usually considered negative or aversive. They are often so terrifying that the person may be reluctant to sleep because of the fear of the “dissolution” of self, experiences that are moderately and positively correlated with suicidal ideation.³¹ When the sensed presence is attributed to the right side, the affect is neutral or positive and often attributed to a dead relative such as a husband or wife or to a cultural icon such as an angel or Christ. Without challenging the beliefs of the patient, we have found that explaining the source of the sensed presence as a phenomenon created within the person’s brain markedly reduces the apprehension and physiological stress associated with these experiences.

Our traditional solutions for reducing or stopping the occurrence of the unwanted presences usually involve procedures that activate the left hemisphere. For example, patients who awake suddenly and experience the sensed presence find they can stop the experience by activating a tape that vocally specifies the time or generates a reassuring statement. However, exposing the patient to complex magnetic fields and inducing the

presence so that the patient can experience the “being” in a safe, clinical setting and realize it is a brain process that can be controlled has been more effective.

Our clinical trials³² indicated that 30-minute treatments, once per week, for 6 weeks markedly reduced depression in these patients as defined by both psychometric measurements, such as the Beck Depression Inventory, and personal reports. Bilateral temporal lobe stimulation appears to be more effective than application over the left prefrontal region. The strength of these fields is about one million times smaller than those employed for transcranial magnetic stimulation (TMS). The difference involves the complexity of the temporal and spatial structure of the applied fields.

EXPERIENCES OF GOD

When I first observed epileptiform activity over the right temporal lobe of a stable, normal, middle-aged woman who reported (with that typical radiant smile) she had just experienced God’s presence,³³ the possibility that the brain correlates of this culmen of all paranormal experiences might be experimentally studied became evident. Slater and Beard³⁴ and Bear and Fedio³⁵ had clearly shown that experiences of God might not always be the preoccupation of a patient with classically disorganized thoughts.

The formal study of the brain mechanisms and electromagnetic patterns within the brain that generate the god experience might be considered one of the most important challenges to which neuroscience must respond. God experiences, which are often employed as proofs of god beliefs, are likely to have been responsible for more human carnage in the history of civilization than any single pestilence. Peoples have been killed in the name of a god by others because they did not believe in the same god. If this propensity for group aggression is coupled to the same or similar processes as the god experience, then we as a species might wish to discover all of the stimuli, endogenous and exogenous, that can unleash these behaviors within a group.

Although the creation of the sensed presence is likely to be the prototype for all visitation experiences, from aliens to gods, the content of these cosmic episodes may involve altered states of consciousness. Edelman³⁶ has suggested that consciousness is an emergent phenomenon that is recreated every 20 milliseconds. Empirical measurements by Llinas and Pare³⁷ have shown that large-scaled cohesive electroencephalographic fields over the cortical manifold are phase-shifted by about 10 to 20 ms, suggesting that waves of consciousness are constantly generated in a rostral to caudal direction.

We wondered what would happen if the timing of these recurrent creations of “quanta” of consciousness were modified experimentally. Magnetic fields were generated through eight equally spaced solenoids within the epicanthal-meatal plane in a counterclockwise direction. This resulted in the movement of the field that was against the rostral-caudal fields generated over the right hemisphere. The configurations of the fields were organized to produce rates of change (derivatives) that overlapped with these 20-ms increments.

In addition to demonstrating enhanced power within the theta band over the entire brain, with specific effects over the right hemisphere, people who were exposed to these fields experienced a distortion in subjective time.³⁸ Most individuals experience a “blackness” and various imaginal spaces for which they employ terms that have usually been reserved for religious states and shamanic traditions. The feeling of quiescence and resolute harmony are common experiences.

These results, in conjunction with our sensed presence studies, suggest that the neurofunctional conditions precipitating the experience of a sensation of contact with an infinite and eternal source and the subjective feeling of inner peace, the antithesis of death anxiety, is subject to experimental manipulation and testing. The human brain has the potential to generate these experiences when it is exposed to relatively weak energies if the information is sufficiently complex. The critical question is, what sources within and without the brain can create these experiences?

PARANORMAL EXPERIENCES WITH POTENTIAL VALIDITY

Science is the pursuit of the unknown. Although most reports of paranormal experiences reflect intrinsic changes within the experient’s brain, due to the consequences of sudden changes in life style or trauma, there is evidence that some paranormal experiences may be transformations of information not normally accessible. We have employed the approach that measurement rather than dismissal of claims is more beneficial for neuroscience and for the patient.

If I told you 150 years ago that you could be in two places at once (separated by thousands of miles), you would have considered the statement irrational, even crazy. However, if I told you today that you can talk on a telephone and be functionally a few thousand miles away, simultaneously, interacting with the neurocognitive processes of another person, you might consider the revelation pedestrian. The difference between your re-

sponses to the two statements is understanding mechanism and the process.

EXPERIENCES ABOUT OTHERS

Most paranormal experiences classically labeled as telepathy, precognition, or clairvoyance occur during dream sleep or a related state. If changes in the functional organization of the brain affect its capacity to discern stimuli, then the state of REM sleep²⁵ may have the potential to discern stimuli typically ignored or not detectable during the waking state. Spontaneous cases involve death or crisis to significant others. Analyses of several collections of these experiences, even those that were reported during the late nineteenth century, have shown they occurred when the geomagnetic activity was significantly less than the days before or after the experiences.³⁹ The equivalent correlation coefficients for most of these analyses ranged between 0.3 and 0.5. The strength of the correlation does not imply causality for the reports. Even if the association were much higher, it would not demonstrate validity.

Attempts to experimentally imitate these experiences during the 1960s by M. Ullman, a psychiatrist, and S. Krippner, a psychologist, at the Dream Laboratory of the Maimonides Medical Center in Brooklyn had been variably successful.⁴⁰ The study was designed to discern if the dream contents of experients sleeping within the laboratory were congruent with the randomly selected and affectively loaded paintings viewed simultaneously by other individuals at a distance. On some nights the congruences were remarkable, whereas on others there was no apparent similarity between the content and theme of the dreams and the pictures.

Decades later when these data were reanalyzed, we found that the nights in which the geomagnetic activity was quietest (less than 20 nT) were associated with the greatest congruence between the themes of the stimuli and the themes of the dreams.⁴¹ They were ranked under double-blind conditions. Both the experimental and epidemiological results suggest that experiences traditionally attributed to mystical or nonphysical processes are modulated by environmental variables that are known to influence brain activity. In light of the explosion of experiments in Japan concerning the direct effects of *toate*, a form of martial art,⁴² the possibility of affecting the brain activity of others at a distance has the potential for empirical examination.

SPECIAL CASES

If structure dictates function, then one would also expect that certain individuals with different intracerebral or-

ganizations, due to congenital or childhood anomalies, should display specific functions that could be qualitatively different from the normal population. Adult-onset anomalies, because there is less plasticity for novel ontogenetic arrangements, would be expected to be more coupled to functional or transient neuroelectrical states. One is not surprised if only a few members of the human species can paint with the sophistication of Michelangelo or derive mathematical formulae with the creativity of Einstein. Some paranormal experiences may not simply manifest the intrinsic noise of the organization of the brain. Instead, they may reflect the detection of stimuli or the organization of stimuli to which the normal brain is oblivious. There are myriad stimuli, such as radio frequencies, that occupy the same space as our brain; however, we do not detect them.

We have measured two individuals who have been considered the best examples of psychics. The first, Sean Harribance, is a middle-aged man who sustained at least two brain traumas as a child and adolescent. Several neuropsychological assessments have indicated he displays deficits for tasks that typically involve the right parietal and occipital regions. Mr. Harribance states that he perceives quick images, usually in the upper left visual field, about the person with whom he is speaking or the picture that he is touching. The pictures are touched face down. The information, which he reports spontaneously, contains extremely detailed as well as general statements that far exceed a cold reading.

In one study we asked 3 different people to supply 10

photographs, each, of single individuals of their family. Mr. Harribance generated narratives while holding each of these pictures, face down. The narratives were then typed and given to the person who supplied the pictures. Under double-blind conditions, the person read each narrative and indicated who he or she thought it might be. Whereas chance expectancy would be 1 out of 10, the participants accurately identified between 6 and 8 of the 10 narratives as the specific people.

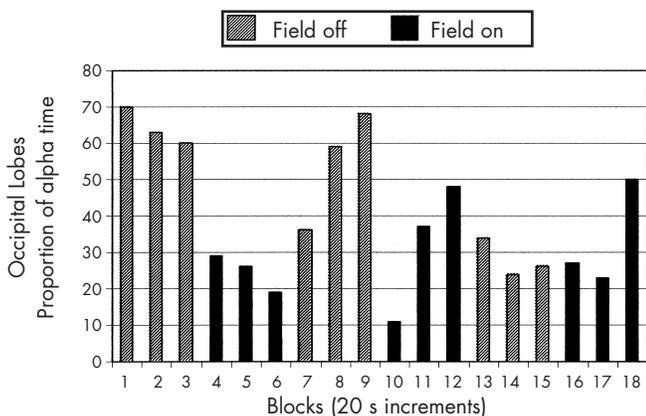
The neural mechanism by which this information, which is highly specific, is extracted by Mr. Harribance remains to be identified. What is clear is that when he engages in this behavior there is an increased uptake of tracer as inferred from ^{99m}Tc [SPECT within the paracentral and superior lobule of the parietal lobe of the right hemisphere. As first discovered by Cheryl Alexander (unpublished data), focal enhancements of electroencephalographic activity within the alpha band were conspicuous over his right parieto-occipital region during these activities. The ranked accuracy of each statement is weakly but persistently correlated with the proportion of alpha rhythms generated during bipolar measurements over the occipital lobes.

Additional experiments have shown that Mr. Harribance, like many individuals who report paranormal experience, valid or otherwise, shows a marked sensitivity to application of complex magnetic fields over the right hemisphere. Harribance attributes his experiences to a spiritual deity whom he senses as a presence. The repeated application of a complex magnetic field over the right hemisphere, without his awareness, was associated with an increase and decrease in the numbers of these intrusions. During these periods there was a transient increase in power within the gamma band (of comparable magnitude) over the left and the right parietal lobes, resulting in a marked attenuation of the usual hemispheric asymmetry.

The sensitivity of this man's brain to complex magnetic fields that have been shown to enhance long-term potentiation in hippocampal slices and to affect hippocampally mediated learning and memory in rats⁴³ can be seen in Figure 2. During the presentation of the long-term potentiation pulses over the right hemisphere, the proportion of alpha rhythms was reduced, but it returned to the previous level when the field was terminated. After several presentations of the field, the response habituated. We also found that the accuracy of his images, as ranked by independent experimenters, decreased when these fields were present and returned to baseline when they were removed.

The second individual with special abilities we have examined was Ingo Swann, a middle-aged artist who developed the process of remote viewing. The proce-

FIGURE 2. Suppression of the temporal proportions of alpha rhythms over the occipital lobes (bipolar measurements) of Sean Harribance during alternating 1-min applications without the subject's knowledge of weak ($1\ \mu\text{T}$) long-term potentiation magnetic fields over the right hemisphere. The presence of alpha rhythms was positively correlated with the blind-rated accuracy of his concurrent statements concerning details for photographs within envelopes.



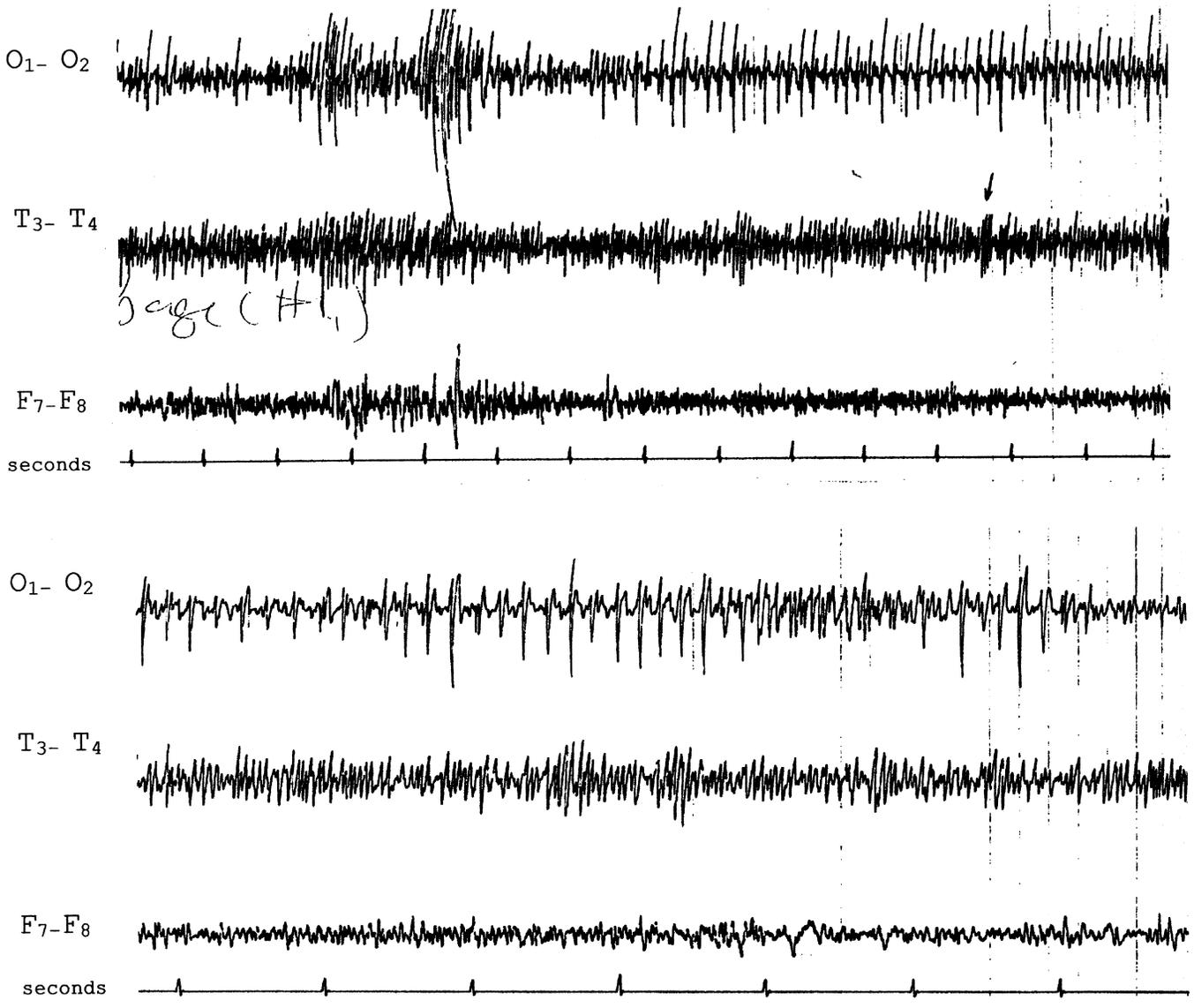
ture was very simple. Pictures from magazines were placed in envelopes and stored in another room. One envelope per trial was selected by a person not involved with the experiment and placed on a table in this room. While Mr. Swann was sitting with another experimenter in an acoustic chamber and drawing his images about the hidden stimulus, electroencephalographic activity was recorded. In our experiments over several days, more than 20 stimuli were employed.

Blind rankings by other researchers indicated significant congruence between the stimulus and Mr. Swann's drawings and comments. However, from a neuroscien-

tific perspective the more important discovery was the correlation (r 's of about 0.6) between the numbers of unusual 7 Hz spike activity over his occipital (primarily right side source) region and the accuracy of the congruence between the stimuli and his comments (Figure 3). These paroxysmal discharges occurred only when he was engaging in "remote viewing." Later magnetic resonance imaging showed anomalous signals, not expected for his age or history, in the subcortical white matter within the parieto-occipital interface of the right hemisphere.

The results with Mr. Harribance and Mr. Swann sug-

FIGURE 3. Bipolar electroencephalographic activity over the occipital, temporal and frontal lobes of Ingo Swann during remote viewing. Upper and lower panels indicate two different paper speeds (different sessions). The durations of the conspicuous 7 Hz spike activity over the occipital lobes per trial were positively correlated with his accuracy.



gest that even the most challenging of phenomena that appear to violate known mechanisms of information detection and processing by the brain are still associated with measurable changes in brain activity. The sagacious W.G. Roll, many years ago, had the courage to suggest that more than half of people around whom poltergeist events were reported also exhibited complex partial seizures with temporal lobe foci. The concept that unusual, measurable phenomena might be associated with actual changes within the brain that deserved systematic and skilled study was rejected. Perhaps the proliferation and relative ease by which we can now access imaging technology will allow the required categorization of paranormal experiences as well as the establishment of the appropriate nosology.

From the perspective of modern neuroscience, all ex-

periences are generated by brain activity, or at the very least strongly correlated with brain activity. As the complexity of this brain activity is mapped and described mathematically, the nuances of thought and the idiosyncratic noise that define us as individuals will be quantified. To date there has not been a single type of paranormal experience that is not understandable in terms of known brain functions. The consideration of these experiences as predictable components of brain activity will allow the differentiation between the illusions of intrinsic stimulation and the validity of information obtained through mechanisms yet to be explained.

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References

- Persinger MA: The Paranormal. Part I: Patterns. New York, MSS Information, 1974
- Persinger MA: Psi phenomena and temporal lobe activity: the geomagnetic factor, in Research in Parapsychology 1988, edited by Henkel LA, Berger RE. Metuchen, NJ, The Scarecrow Press, 1989, pp 121-156
- Gloor P, Oliver A, Quesney LF, et al: The role of the limbic system in experiential phenomena of temporal lobe epilepsy. *Ann Neurol* 1982; 12:129-144
- Horowitz MJ, Adams JE: Hallucinations on brain stimulation: evidence for revision of the Penfield hypothesis, in Origin and Mechanisms of Hallucinations, edited by Keup W. New York, Plenum, 1970, pp 13-20
- Persinger MA, Makarec K: Complex partial epileptic signs as a continuum from normals to epileptics: normative data and clinical populations. *J Clin Psychol* 1993; 49:33-45
- Roberts RJ, Gorman LL, Lee GP, et al: The phenomenology of multiple partial seizure-like symptoms without stereotyped spells: an epileptic spectrum disorder? *Epilepsy Res* 1992; 13:167-177
- Makarec K, Persinger MA: Electroencephalographic validation of a temporal lobe signs inventory in a normal population. *Journal of Research in Personality* 1990; 24:323-327
- Persinger MA: MMPI profiles of normal people who display frequent temporal lobe signs. *Percept Mot Skills* 1987; 64:112-114
- Bear DM: Temporal lobe epilepsy: a syndrome of sensory-limbic hyperconnectionism. *Cortex* 1979; 15:357-384
- Persinger MA, Makarec K: Temporal epileptic signs and correlative behaviors displayed by normal populations. *J Gen Psychol* 1986; 114:179-195
- Persinger MA: Increased geomagnetic activity and the occurrence of bereavement hallucinations: evidence for melatonin-mediated microseizuring in the temporal lobe? *Neurosci Lett* 1988; 88:271-274
- Campbell WH: Introduction to Geomagnetic Fields. Cambridge, UK, Cambridge University Press, 1997
- Friedman H, Becker RO, Bachman CH: Geophysical parameters and psychiatric hospital admission. *Nature* 1963; 200:626-628
- Persinger MA: The Weather Matrix and Human Behavior. New York, Plenum, 1980
- Rajaram M, Mitra S: Correlation between convulsive seizure and geomagnetic activity. *Neurosci Lett* 1981; 24:187-191
- Long T, O'Donovan C, Cabe C, et al: Relationship of daily geomagnetic activity to the occurrence of temporal lobe seizures in an epilepsy monitoring unit (abstract). *Epilepsia* 1996; 36:94
- Michon AL, Persinger MA: Experimental simulation of the effects of increased geomagnetic activity upon nocturnal seizures in epileptic rats. *Neurosci Lett* 1997; 224:53-56
- Persinger MA: Enhancement of limbic seizures by nocturnal application of experimental magnetic fields that simulate the magnitude and the morphology of increases in geomagnetic activity. *Int J Neurosci* 1996; 86:271-280
- Reiter RJ: Static and extremely low frequency electromagnetic field exposure: reported effects of the circadian production of melatonin. *Journal of Cell Biochemistry* 1993; 51:394-403
- Persinger MA: The UFO experience: a normal correlate of human brain function, in UFOs and Abductions: Challenging the Borders of Knowledge, edited by Jacobs DM. Lawrence, KS, University Press of Kansas, 2000, pp 262-302
- Persinger MA: Vectorial cerebral hemisphericity as differential sources for the sensed presence, mystical experiences and religious conversions. *Percept Mot Skills* 1993; 76:915-930
- Cook CM, Persinger MA: Experimental induction of the sensed presence in normal subjects and an exceptional subject. *Percept Mot Skills* 1997; 85:683-693
- Cook CM, Persinger MA: Geophysical variables and behavior, XCII: experimental elicitation of the experience of a sentient being by right hemispheric, weak magnetic fields: interaction with temporal lobe sensitivity. *Percept Mot Skills* 2001; 92:447-448
- Sandyk R: Improvement of right hemispheric functions in a child with Gilles de La Tourette's syndrome by weak electromagnetic fields. *Int J Neurosci* 1995; 81:199-213
- Braun AR, Balkin TJ, Wesensten NJ, et al: Dissociated pattern of activity in visual cortices and their projections during rapid eye movement sleep. *Science* 1998; 279:91-95
- Persinger MA: Geophysical variables and behavior, XXII: the tectonic strain continuum of unusual events. *Percept Mot Skills* 1985; 60:59-65
- Persinger MA, Tiller SG, Koren SA: Experimental simulation of a haunt experience and elicitation of paroxysmal electroencephalographic activity by transcerebral complex magnetic fields: induction of a synthetic "ghost"? *Percept Mot Skills* 2000; 90:659-674

28. Persinger MA, Koren SA: Experiences of spiritual visitation and impregnation: potential induction by frequency-modulated transients from an adjacent clock. *Percept Mot Skills* 2001; 92:35–36
29. Persinger MA: Personality changes following brain injury as a grief response to the loss of sense of self: phenomenological themes as indices of local lability and neurocognitive structuring as psychotherapy. *Psychol Rep* 1993; 72:1059–1068
30. Persinger MA: Subjective improvement following treatment with carbamazepine (Tegretol) for a subpopulation of patients with traumatic brain injuries. *Percept Mot Skills* 2000; 90:37–40
31. Persinger MA: Sense of a presence and suicidal ideation following brain injury: indications of right hemispheric intrusions from neuropsychological profiles. *Psychol Rep* 1994; 75:1059–1070
32. Baker-Price L, Persinger MA: Weak but complex pulsed magnetic fields may reduce depression following traumatic brain injury. *Percept Mot Skills* 1996; 83:491–498
33. Persinger MA: Striking EEG profiles from single episodes of glossolalia and transcendental meditation. *Percept Mot Skills* 1984; 58:127–133
34. Slater E, Beard AW: The schizophrenic-like psychosis of epilepsy. *Br J Psychiatry* 1963; 109:95–150
35. Bear DM, Fedio P: Quantitative analysis of interictal behavior in temporal lobe epilepsy. *Arch Neurol* 1977; 34:454–467
36. Edelman GM: *The Remembered Present: A Biological Theory of Consciousness*. New York, Basic Books, 1989
37. Llinas RR, Pare D: Of dreaming and wakefulness. *Neuroscience* 1991; 44:521–535
38. Cook CM, Koren SA, Persinger MA: Subjective time estimation by humans is increased by counterclockwise but not clockwise circumcerebral rotations of phase-shifting magnetic pulses in the horizontal plane. *Neurosci Lett* 1999; 268:61–64
39. Persinger MA: Geophysical variables and behavior, LXXI: differential contribution of geomagnetic activity to paranormal experiences concerning death and crisis: an alternative to the ESP hypothesis. *Percept Mot Skills* 1993; 76:555–562
40. Ullman M, Krippner S: *Dream Studies and Telepathy: An Experimental Approach*. New York, Parapsychology Foundation, 1970
41. Persinger MA, Krippner S: Dream ESP experiments and geomagnetic activity. *The Journal of the American Society for Psychological Research* 1989; 83:101–116
42. Kawano K, Yamamoto M, Kokubo H, et al: EEG alpha waves of a receiver in a remote action experiment. *Journal of the International Society of Life Information Science* 2000; 18:395–397
43. McKay BE, Persinger MA, Koren SA: Exposure to a theta-burst patterned magnetic field impairs memory acquisition and consolidation of contextual but not discrete conditioned fear in rats. *Neurosci Lett* 2000; 292:99–102