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A CRITICAL TEST OF THE EMF-PARANORMAL PHENOMENA THEORY: EVIDENCE FROM A HAUNTED SITE WITHOUT ELECTRICITY-GENERATING FIELDS

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ABSTRACT. Previous research in electromagnetic and geomagnetic fields (EMF and GMF) and their relationship to paranormal phenomena has been performed under the theoretical assumptions of hallucination due to GMF fields. The current study tests the possibility that nonhallucinatory paranormal phenomena are also associated with EMF/GMF fields. EMF and GMF perturbations were examined in context of collected potential phenomena with data logging equipment at a haunted site with no electricity. Overall results indicate that EMF and GMF fields were significantly greater in both magnitude and variability inside-the-location compared to outside-the-location baseline measurements. Differences in GMF magnitude were small compared to EMF. Through correlation, EMF/GMF fields were demonstrated to change in range and location throughout the duration of the investigation. Results involving individual reviewed phenomena indicate that phenomena are strongly and significantly associated with serial EMF and GMF spikes, that both increases and decreases in EMF/GMF fields are not differentially predictive of phenomena, and that increases in the number (i.e., duration) of serial spikes do not differentially predict phenomena.

Keywords: anomalous phenomena, electromagnetic fields, haunting

Although electromagnetic and geomagnetic field detectors (i.e., EMF and GMF) are commonly used within ghost-hunting organizations, field research on the ability of EMF to predict haunting activity is very limited. This lack of research is troublesome, as the assumption that variation in EMF activity predicts anomalous phenomena is commonly accepted within amateur field research. Even more, research examining any relationship between EMF and haunting phenomena has been based on individually perceived and sensed internal events that occur in a haunted locale. Indeed, the literature dedicated to EMF and anomalous phenomena has theoretically assumed that variation in EMF/GMF fields must induce hallucinations that are interpreted as anomalous phenomena (Booth, Koren, & Persinger, 2005; Gearhart & Persinger, 1986; Persinger, 2003; St. Pierre & Persinger, 2006; Roll, Persinger, Webster, Tiller, & Cook, 2002; Tsang, Koren, & Persinger, 2004). Whereas a "hallucination" explanation seems viable when accounting for subjective or personal experiences, it cannot logically account for anomalous phenomena that are captured with external recording devices. While literature exists that addresses EMF/GMF with internal psychological perception, there is little work examining EMF/GMF with phenomena that occur as observable external events. As such, there is a neglected avenue of research in field parapsychology, where EMF and GMF fields are examined with events that are not internally perceived, but represent some type of external event (e.g., RSPK; Roll, 1972).

Specifically, this paper focuses on the gap between explaining subjective (e.g., internally and personally perceived) and objective (e.g., external captured via a recording device) anomalous phenomena within haunted locales in context of EMF and GMF. However, to examine any hypothetical relationship that exists between haunting phenomena and electromagnetic fields, we must clarify several methodologically difficult issues. First, and in context of Persinger's (Booth et al., 2005; St Pierre & Persinger, 2006) work, we address existing research involving varying EMF/GMF fields in purported haunted locales. Second, we address potential confounds in EMF/GMF measurement, including the variable of distance, and assumptions underlying an EMF/GMF phenomena hypothesis. Finally, we address the considerable limitations in the evaluation of "paranormal phenomena."

EMF/GMF Thus Far in Haunted Locales

Previous research involving fluctuation of EMF/GMF has been strongly influenced by Michael Persinger. The work by Persinger and his colleagues has demonstrated that low-level magnetic fields can induce perceived "haunting phenomena" in laboratory settings (St. Pierre & Persinger, 2006). Laboratory research demonstrated that application of 1 to 3 hertz magnetic fields applied to the parietal-temporal lobes produced a "sensed presence" in about 80% of subjects (Booth et al., 2005). Per these researchers' work, the sensed presence is described as "the personal proximity of a Sentient being, a presence, or 'another consciousness'" (St. Pierre & Persinger, 2006, p. 1080). These fields not only seem to facilitate hallucinations involving the presence of nearby entities but have also been shown to affect memory recall. Healey and Persinger (2001) demonstrated that participants placed in a low-level EMF field reported 3 times as many false memories when recalling a narrative as those who were not exposed to EMF. In the context of both meta-analysis and multiple experiments (e.g., St. Pierre & Persinger, 2006), these researchers hypothesize that geomagnetic fields occurring naturally in certain locales might induce hallucinations that can account for haunting phenomena (Gearhart & Persinger, 1986). In essence, GMF-induced hallucinations may account for the bulk of what witnesses report as paranormal phenomena, and worse, may alter memory to create nonfactual memories in haunted locales.

As a result of Persinger's work, field research examining haunting sites has focused primarily on the presence of abnormal EMF and GMF fields. Several researchers have demonstrated significantly different degrees of both field strength and variation between haunted and nonhaunted locales (Braithwaite, 2004, 2006; Braithwaite, Perez-Aquino, & Townsend, 2004; Braithwaite & Townsend, 2005; Maher, 2000; Nichols & Roll, 1998; Roll & Persinger, 2001; Wiseman, Watt, Greening, Stevens, & O' Keeffe, 2002; Wiseman, Watt, Stevens, Greening, & O'Keeffe, 2003). For instance, Nichols and Roll (1998) demonstrated EMF fields with Tri-Field meters that were significantly greater in areas of reported phenomena compared to locations with no reports of phenomena. Wiseman et al. (2002) found that field strength and variance of EMF/GMF were associated with the location where haunt experiences had been reported. Later research by Wiseman et al. (2003) demonstrated significantly greater variation in EMF/GMF as a whole, but not in magnitude. Braithwaite et al. (2004), with the use of the Magnetic Anomaly Detection System (MADS) which he designed, compared a "hot-spot" to a nonactive area. Their results demonstrated that GMF variability and magnitude were not only significantly different in a test and hot-spot area but also that fields significantly varied during the investigation. In the above studies, Braithwaite and his colleagues were also able to distinguish "pulses" or spikes of GMF that were significantly stronger than baseline readings in the dataset. Of more detailed interest, Braithwaite et al. (2004) demonstrated both substantial magnitude and variability effects within a one-room area and demonstrated that these EMF fields occurred in the 8 to 10 hertz range.

In context of Wiseman et al. (2002) and the findings of Braithwaite et al. (2004, 2006), a "field picture" of EMF/GMF begins to take shape. In general, variability and magnitude of GMF/EMF appear greater within haunted locales but vary over time and location within the site. What is essential with the above studies is that external phenomena, such as recorded sounds or video, were not examined with any type of EMF/GMF readings. Thus, the previous research suggests that "haunted" sites show greater variation in EMF/GMF fields than "un-haunted" sites. As a result of this variation in EMF and GMF, these fields could account for such experiences as hallucinations (e.g., Braithwaite & Townsend, 2005) that individuals interpret as haunting phenomena.

This leaves an entire area of haunting phenomena unexplored within an EMF/GMF hypothesis. Persinger's research can account for almost any type of subjective (i.e., internally and personally perceived) haunting experiences. Likewise, previous research has demonstrated, at least in part, that EMF/GMF fields in haunted locales seem to fit conditions that could induce a Persinger effect due to variability in EMF/GMF fields (Braithwaite et al., 2004,). Where Persinger's model does not fit, hypnagogic episodes (e.g., Cheyne, Newby-Clark, & Rueffer, 1999; Furuya et al., 2009; Kampanje, 2008; Sherwood, 2002) or contagion effects (e.g., Hart et al., 2009; Lorber, Mazzoni, & Kirsch, 2007; Merckelbach, Van Roermund, & Candel, 2007; Peker & Tekcan, 2009) can account for other subjective haunting experiences due to social influence.

However, what about those instances when anomalous phenomena occur and are documented with recording devices? Amateur ghost hunting groups of all shapes and sizes report thousands of videos and audio clips each year of allegedly anomalous phenomena. Although many of these events can be explained with careful evaluation, a percentage remains difficult to explain by conventional means. It follows that if an anomalous event is captured on either audio or video, then this type of occurrence cannot be due to a hallucination. Tradition in ghost hunting has maintained that EMF/GMF perturbation is associated with external phenomena. The purpose of the current research is to examine this particular claim above and beyond any events that are subjective and therefore could be due to Persinger fields or psychological conditions. Thus, the goal of the current research is to test if there is a simple association between objective phenomena (i.e., recorded phenomena of human-shaped entities, captured psychokinesis, or quality electronic voice phenomena) and EMF/GMF.

Critical Issues in Testing the EMF/GMF Phenomena Hypothesis

In order to examine a potential relationship between EMF and objective phenomena, it is essential to examine several difficult issues involved in testing and sampling EMF and evaluating phenomena that occur. We have divided these issues and their potential confounds into three primary experimental concerns. First, we address the conditions regarding how EMF would theoretically perform in the context of anomalous phenomena. Second, we discuss two variables related to EMF that have not been addressed by previous research—EMF vectors and fields—and the confound of distance. Finally, we attempt to deal with the controversial issue of the evaluation of anomalous phenomena as “anomalous” as opposed to environmentally explainable events.

The Hypothetical Nature of EMF/GMF in the Context of Paranormal Phenomena: Issues of Time and Occurrence

Given Braithwaite et al., (2004) and the findings of Wiseman et al. (2002, 2003), EMF/GMF fields are stronger and persistent within a haunted locale. These researchers’ findings also suggest that variability and magnitude of magnetic fields can change over time in small spaces. However, it is one thing to demonstrate that overall field magnitude will vary over time in a given area; it is a different thing to analyze EMF/GMF and phenomena that occur in the context of time. In order to test this type of relationship, certain assumptions must be made. First, while EMF/GMF fields change in magnitude and variability (e.g. Braithwaite et al., 2004), the current research makes no claims about the degree of variability, magnitude, or duration of EMF/GMF expected as a result of anomalous phenomena. The research of Braithwaite et al. (2004) indicates that individual spikes occurred during his measurement periods; however, the magnitude of these spikes was not large (+/-60 nT/.6 mG) and typically occurred for no longer than 0.5 seconds. Beyond the above researchers’ findings which do not address any type of anomalous objective event, no evidence exists to provide guidance on how these hypothesized field changes occur with anomalous phenomena.

As such, to test openly an EMF/GMF phenomena hypothesis, small perturbations of EMF/GMF fields should be examined in detail. It is an assumption that large changes (positive or negative) in variability or magnitude occur in relation to anomalous phenomena. Frankly, this may not be the case. It is equally likely that small perturbations in EMF/GMF fields may predict anomalous phenomena. In either event, data have not been examined to verify or rule out any of these claims.

The Intervening Variables of EMF Fields, EMF Vectors and Distance, and Their Effects on Measurement

In addition to the above issues that involve a lack of data regarding the EMF/GMF phenomena hypothesis, it is also the case that previous research has not addressed a fundamental confound involving the measurement of EMF/GMF fields. This confound involves the important variable of distance. The distance of a field, or the individual vector of a large field in relation to an EMF/GMF meter's distance, is what determines the recorded measurement of magnitude (Tipler, 1987). However, the magnitude of the field, and therefore its area of detectable effect, its location, and the number of other fields present will all affect the readings of a receptive EMF/GMF meter. What is crucial to understand is that the registered strength of a field decreases as a function of distance of the meter from the source of the field. In fact, the field strength of EMF follows the inverse power law, which in terms of a meter's detection of magnitude practically decreases at a factor of about 10 per 1 foot of distance between the source of the field and the meter (Tipler, 1987).

In a study in which anomalous phenomena are hypothesized to relate to EMF/GMF variation, specific EMF readings become problematic, as a researcher cannot reliably determine what is potentially causing a field, and more importantly, the specific location of its source. Because field sources are difficult to determine, it is never clear whether or not changes in EMF or GMF are due to singular or multiple fields or a large field vector. Likewise, if one entertains the possibility that these fields may be mobile or spontaneously generated (as is the tradition in haunting investigations), then location of a particular field in relation to the meter becomes even more problematic. Because specific location of an EMF field cannot be easily determined, the specific output readings of EMF/GMF meters are substantially confounded by the fact that the location of the EMF source cannot be determined, and therefore, the reading of a meter is going to change as a function of that distance. In essence, EMF/GMF changes recorded from a meter will vary as a function of the distance of the meter from the hypothesized field(s).

As such, two important conditions exist in conducting research in which EMF/GMF is compared to time-dependent potentially anomalous events. First is the understanding that the sensitivity of the meters is crucial in their ability to detect a field as far as 6 to 8 ft away from a meter. This is part of the justification for examining small perturbations in EMF/GMF data around potential events. A small perturbation in the data could theoretically represent a strong generated field as close as 10 feet away from the meter. The fact that the field is far away from the input source will weaken the received reading. As such, taking distance into account with EMF/GMF readings illuminates an important fact about EMF/GMF data measured in either raw volt input, milligauss, or microteslas. Essentially, if the distance of the source of the EMF field is indeterminable, then both the increment of measurement and specific magnitude (in milligauss or microtesla) of the reading are useless aside from comparing a reading to the distributions that are collected. As the distance of the field from the meter (or frequency changes) will alter EMF/GMF magnitude, then a specific magnitude reading is only approximate at best. Thus, field research of this design can only determine if an event produces readings that are significantly different from specific times and distributions of the collected EMF/GMF meter readings, but cannot provide accurate information about the actual strength of the particular field that is being measured because of the confounding variables of distance and location.

Collecting the Observable: Observable Anomalous Events, Their Evaluation and Interpretation

One of the fundamental problems in a research project of this nature involves the anomalous evidence collected. When anomalous events are hypothesized to be related to EMF/GMF fields, the bulk of critique falls on a critical approach to the operational definition of an anomalous event. Whereas EMF fields can be measured in context of the equipment used to detect it, heated debate can occur over whether a particular captured event can be reliably viewed as paranormal or anomalous.

Research in social and cognitive psychology provides good reason for individuals to be skeptical of both subjective and objective anomalous evidence. In terms of the personally experienced events that are reported at haunted locations, the demonstrated effects of Persinger fields (Gearhart & Persinger, 1986; St. Pierre & Persinger, 2006) or hypnagogic hallucination episodes of perceived phenomena around sleep (Cheyne, Newby-Clark, & Rueffer, 1999; Furuya et al., 2009; Kampanje, 2008; Sherwood, 2002) make certain personal events very suspect in terms of their anomalous origins.

However, the effects of Persinger fields and hypnagogic episodes can be controlled by simply mandating that the criterion for objective evidence must be recorded by either audio or video devices. But, objective events are still subject to interpretation, which leads investigators toward several cognitive biases. For instance, contagion effects can change memories (Merklebach, Van Roermund, & Candel, 2007), as well as emotions and behavior (Barsade, 2002), and create stronger biases when individuals are familiar with each other (Peker & Tekcan, 2009). Any of these effects could create bias in qualifying an anomalous event, even when recorded on audio or video. Likewise, research in belief perseverance (Lepper, Ross, & Lau, 1986; Ross, Lepper, & Hubbard, 1975) demonstrates a tendency for people to persist in beliefs in the face of contradictory information. Thus, cues indicating the likelihood of an anomalous event can be ignored if contrary to previous information or beliefs. Similarly, confirmation bias (Drake, 1983; O'Brien, 2009)—the tendency to remember and prefer information that supports one's existing beliefs—can also easily confound the assessment of evidence.

For the sake of the current research, and in a Popperian vein (e.g., Amini & Caldwell, 2010; Machado & Silva, 2007), we suggest that there is never a situation in which an anomalous event is considered fully proven as paranormal. Instead, it seems more scientifically reasonable to claim that some events are much more likely (in terms of probability) to be anomalous compared to other events. However, while physical objective evidence may stand "as is" with human perception, there is always the concern of interpretation. To minimize effects of belief perseverance and confirmation bias, a consistent set of criteria should be used to rate each event as either very unlikely to be paranormal or very likely to be paranormal. Consistently applied, this set of rules, while not definitive, reduces the likelihood that an individual investigator will accept evidence as anomalous that can be easily explained.

The criteria should involve minimum requirements by which an investigator can rule out an event due to environmental or psychological factors. It should also contain criteria that make an event more persuasive in terms of its paranormal validity, such as phenomena that can be perceived as a repeated intelligent response to an investigator. To that extent, the current research employs an Evaluative Model for Paranormal Evidence (EMPE); that is, a set of criteria in which all events are examined for likely environmental explanations. Through the use of this procedure, phenomena can be assigned additional points based on optional, but contributing, factors that would suggest that an event is more likely to be anomalous. All of the EMPE criteria are designed to eliminate psychological and environmental conditions that could lead to the misinterpretation of a nonanomalous event as anomalous.

Summation and Hypotheses

In summation, we propose that more analyses of haunted locations are necessary, beyond the research that establishes EMF/GMF variation and magnitude differences within haunted locations. We make the general claim that a detailed but open-ended study is necessary to determine how EMF/GMF may behave in the context of anomalous phenomena. Specifically, we target the possibility that nonsubjective haunting phenomena, namely anomalous noises and events physically viewed via camera may have perturbations of EMF/GMF that are significantly different than the contextual EMF/GMF readings. Our exploratory hypotheses are as follows:

1. We expect that both magnitude and variability of EMF/GMF readings will significantly differ inside the location compared to baseline readings taken outside the house.
2. As an exploratory function, we examine correlations of meters placed inside the investigation site to determine if any patterns can be explored to understand EMF/GMF fields within a "haunted" location.
3. We hypothesize that better verified anomalous phenomena will occur during significant increases or decreases in EMF and GMF readings.
4. We will explore any differences between increases, decreases, and variability of EMF and GMF in

relation to the occurrence of phenomena, and investigate whether the duration of a given *increase or decrease* of EMF/GMF magnitude is in any way associated with anomalous events.

Method

Participants and Sample

With the help of the Ivy Tech Paranormal Organization (ITPO) and the Association for the Study of Anomalous Field Phenomena (ASAFP), an investigation was conducted at Black Moon Manor (BMM), a site considered to be known for haunting activity by many previous paranormal investigative groups. Ten members of ASAFP participated in the investigation of the site which occurred from 2:30 p.m. to 1:30 a.m. in the Spring of 2011**.** All members were briefed in protocols for the current study, and have had previous training on data collection methods on previous investigations.

Brief History and Details of Location

Black Moon Manor was built by John C. Eastes in Hancock County, Township of Buck Creek, Greenfield, Indiana, in 1862. However, the current owner purchased the property in 2009 to open a Halloween attraction. The owner relates that the history of the home he obtained was told to him by a woman who claimed to have previously lived at the location. One story contends that the manor was once used as a house for smallpox patients during an outbreak of the disease. The current manager reports more than 200 deaths at the home, and there is an unmarked cemetery in the back of the manor where Eastes family members are interred, including a girl named Racheal Eastes, who was 5 years old at the time of her death. Other claims of deaths include several members of the Eastes family, a woman/girl drowning in the well, and an elderly woman who froze to death while sitting in a wheelchair during the blizzard of 1977. There are also reports of a child named Martha who haunts the home, along with another entity named Henry or Larry (A. Hansford, personal communication, June 18, 2011).

Historical research uncovered partial support for these accounts. The house was a home of the Eastes, a founding family of the area of Hancock County (Richman, 1916). The house was a grand manor that townspeople would visit to hear the storytelling of John Eastes (Richman, 1916). There is a documented drowning of a young girl named Rachael, who was a niece of John Eastes. Similarly, another young girl in the family line named Nettie also died in her childhood; she was nicknamed Martha by family members. Additionally, a farmhand, Henry Beckner, also lived at the location with the Eastes family (Eastes Family History, n.d.; United States Federal Census, 1880). However, evidence of the house being used for smallpox patients and the accounts of 200 burials on the location were not verified with historical records.

Regardless of its history, Black Moon Manor was selected due to reports of and evidence for active external phenomena that have occurred there. Reports of activity made by many investigative groups and the owner of the property included: disembodied voices, psychokinetic events such as objects being thrown or teleported, physical injuries (e.g., scratching, being pushed down stairs), and multiple recorded EVPs of varying quality. The source of the activity has been attributed to both the deceased family members and to the smallpox victims that were reported to have died at the location.

With regard to physical details of the location, the house is situated approximately one quarter mile from a traveled road, in an area approximately three quarters of a mile in all directions away from the nearest residential housing, thus limiting human interference. The house is a two-story dwelling of approximately 2,000 square feet. It was determined that the building lacked electricity based on the following indicators:

1. There were no wires leading from the electricity pole to the building or fuse box, nor any wires leading from the pole to the main electricity poles along the road. Investigation of the outside of

the building demonstrated no generator sources of electricity, and no wires above ground leading to the house. Inspection of the basement, including the underside of the house, indicated no heavy gauge wires or electrical connections.

2. A room-by-room investigation was conducted in search for wires, speakers, or any type of electrically powered equipment that could assist in hoaxing.
3. An Alpha Lab Tri-Field 100XE meter was carefully run along the walls and floor of every room including along electrical outlets so as to verify an absence of electricity. No readings or spikes were detected.

Equipment

Generator An 800–900 watt maximum load gas-powered Chicago Electric generator was placed 25 feet from the investigation site to power all equipment. Power was provided through a 12-gauge extension cord to an equipment table set up on the porch of the building.

Real Time Investigative Ghost Hunting System (RIGS) At the beginning of the investigation, four Alpha Lab Tri-Field 100XE meters with company-installed jacks for output, 100x coils, and four Alpha Lab Natural EM meters with company-installed output jacks were placed in pairs (one Tri-Field and one Natural EM meter) in locations inside the building. One additional Tri-Field 100XE and Natural EM meter (per specifications above) were placed outside the home to collect ambient EMF and GMF magnitude for baseline data. Tri-Field 100XE meters are reported to have a resolution/sensitivity of .2 mG without coils (with coils, .002 mG). Natural EM meters report a resolution/sensitivity of 10 mG. Additional field tests of the meters demonstrate that both types of meters have an approximate range of 8 feet in diameter in terms of detecting a 100 mG+ field. These meters were also immune to fluctuation due to footsteps or general movement around the range of the meter.

For both meter types, the manufacturer claims that calibration is reliable and that drift of readings due to loss of meter calibration over time is not possible. Placement of meters inside the structure was dictated by the owner, who rated each room in terms of the most frequent activity experienced by investigators. With use of Data Q analog connector (DI-205) and digital converter (DI-700), these meters' readings were logged in real-time to a computer system running WINDAQ software. Tri-Field meters were calibrated to detect variation in the EMF field (magnetic setting) from 3 to 100 hertz, which centers on "mains" frequency commonly calibrated for normal electricity and EMF production. In addition, Tri-Field meters in the current study were attached to magnifying coils, which increased sensitivity to detect very small perturbations within the 0–1 mG range. These coils do, however, convert the normally three-axis Tri-Field meter into a single-axis meter. Therefore, readings from our EMF meters represent one-axis assessments. Natural EM meters did not have coils and were calibrated on the magnetic setting, thus measuring the natural geomagnetic field of a location (0–3 Hz) with a range of 0–100 mG. The result was a collection of EMF (detecting 0–1 mG) and GMF (detecting 0–100 mG) field readings that were sampled at 24 times per second in their raw volt output. Consultation with Alpha Lab verifies that analog meters of this type can produce reliable readings at this level of sampling, although a delay or suppression of magnitude can occur at this sample rate. As our analysis examines extreme readings of the meter, this fault in the equipment emphasizes conservative readings, and would not confound EMF spikes in a manner similar to Type I error. Rather, it would make them more difficult to occur; thus, underestimation is more likely. Recordings of these data were collected in anywhere from 2-hour to 4-hour increments and time-synced with other equipment according to the protocol described below.

DVR system. A computer system was specifically set up to record real-time PAL-resolution infrared video and audio of all sites where the meters were placed. These videos were collected continuously in 15-min intervals for each camera for the duration of the investigation. Each video channel was time-stamped to EMF and GMF readings.

AVR units. Battery-powered digital audio voice recorders (AVRs) were also placed where both meters and video had been placed in the location. These battery-powered units were set to "conference" setting in order to record as much area as possible. The AVRs were time-stamped in order to determine EMF and GMF readings when specific noises or phenomena occurred.

Protocol

Setup. Several steps were taken to minimize human contamination during the course of the investigation. First, only investigators were present on site during the time of data collection. Second, two separate teams, with the use of Tri-Field meters, examined the house for any signs of trickery, including wires, trap-door access, as well as sources of electrical power as mentioned above. In both examinations, no signs of trickery or sources of electricity were present. Access to the site was only available from one side of the house, where non-investigating members could observe entrances or exits from the building across the duration of the investigation.

After setting up room numbers for areas of interest, one Tri-Field XE100 and one Natural EM meter were placed approximately 3 feet apart apart from one another in the middle of each room, and then connected to the RIGS system. At least two video cameras were placed in each area, positioned from 8 to 10 feet away from any individual meter so as to prevent EMF contamination. Battery-powered AVR units were placed between the meters. However, in previous testing, the electrical output of these units were shown not to register on either type of meter. The combination of audio, video and meter placement within these four specific areas created "data collection traps" by which multiple audio, video, and EMF/GMF readings could be sampled at the same time. Key to this strategy was a precise log of the start and stop times of all three components based on a common time unit. The result of this procedure was that audio, video, and EMF/GMF readings were synchronized, allowing for accurate comparison of all three within a common time frame. This type of meter layout allowed for four hot-spot areas where data could be reliably collected, and for one set of baseline meters placed approximately 7 feet outside of building. Cameras and audio recorders were not placed with baseline meters. Note that any phenomena that occurred in other areas were deemed interesting, but invalid for the purposes of this study.

Once the devices were set up and time-stamped, a log of the individual movements and location of all investigators was maintained at all times. Data collection periods were of two types: interactive and noninteractive. Noninteractive sessions involved all members removing themselves from the site, allowing the meters' audio and video to run without any human involvement. Interactive sessions typically involved one team of two to four people interacting within the recorded environment, in order to attempt to facilitate PK (e.g., knocking or movement) or EVPs within that location.

Classifying objective and subjective haunting events. Although many personal experiences were common over the investigation, these events were deemed to be subjective, and not of interest to the current study. However, evidence captured on either audio or video was held to a standard set of criteria for evaluation referred to as the Evaluative Model for Paranormal Evidence (EMPE). Eight possible points could be assigned to phenomena based on the following criteria. Points 1–3 are granted to address the basic quality of recorded evidence criteria such as "Is the event external?" "Is the picture clear?" "Is the audio clear?" and "Has the entire event been captured?" Points 1–3 also address common natural phenomena that are mistaken for anomalous activity (e.g., grunts, knocks, thumps, bumps, moans, animals, dust, mist, distant shadows, or light reflection that are likely due to the environment). Any of the aforementioned events were automatically relegated to Class 1 as due to multiple environmental causes that could not be reliably ruled out. Point 4 is granted if any reliable or probable alternative means can be ruled out for a particular phenomenon. For example, this point was granted if other sources of video or audio could not explain the event and/or if the event could not be re-created. Point 5 was granted when human interference or hoaxing could be reliably ruled out (e.g., physical contact with objects, whispering, or subvocalization). An additional point was granted for: events that had no human interaction component; phenomena that were captured and were very clear and distinct in terms of audio or video, thus making subjective interpretation less likely; and phenomena that appeared to be repeated, rational, and intelligent responses to a human agent.

In terms of evaluation, potentially anomalous events were given a rating representing an estimate of the likelihood that each event may or may not have been anomalous. From that rating, the quality of evidence could be examined and understood as either: Class 1, likely to be environmental (EMPE score 1–3); Class 2, possibly environmental, but also possibly anomalous (EMPE score 4–5); and Class 3, more likely to be anomalous (EMPE score 6–8). Events that were clearly environmental (e.g., car, bird, animal, or investigator) or events that demonstrated the presence of additional concurrent noise in other audio sources were labeled as Class 0. Please note that in order for EVP to be considered of quality for the current study mandated, the noise must not have been present at the same time in any of the other audio recorders placed in the house. Thus, the audio event was isolated to one particular recorder, greatly reducing the probability that the voice was due to either the investigators or the environment. Similarly, any video event of note was examined for investigators in the principal video but also checked against additional cameras to ensure that investigator contamination was not present.

Classification occurred in three phases. First, three reviewers did an evaluation of all captured events and assigned them a rating according to the EMPE system. Any individual event that reached Class 2 was compared against all relevant additional audio and video sources by at least two of the three reviewers. Thus, error was minimized by independently performing a full audio or video comparison twice. Reviewers had strict instructions about the acceptance of the captured phenomena as Class 3, based on the lack of presence of additional investigators, or the lack of audio noise on other recorders. Re-creation attempts were also performed on site prior to the designation of Class 3. As such, any event reaching Class 3 represents an event that, to the best of our knowledge, was not caused by human or environmental contamination.

However, initial reviewers were aware of what events were occurring on an EMF spike. Thus, a second group of three evaluators who were naïve as to whether or not an event had triggered a spike, and who had not been present during the data collection period, performed a second review. During the second analysis, the new reviewers were provided only with the core audio and video evidence and did not engage in the full multiple camera or audio comparison process described above. Thus, the second review process served as a simple manipulation check against possible rating bias due to spike knowledge. Congruence between these two series of ratings was 80%. To address the differences in comparison, and to ensure that ratings were not affected by knowledge of a spike occurring with the remaining events, an additional two individuals who were also naïve performed a complete review, following the protocol described above, of all comparison audio and video sources. These new reviewers gave a final rating for any disputed event that reached Class 2 or Class 3. Disputed Class 0 or Class 1 events maintained their original review status. This was due to the fact that all Class 0 events had been factually ruled out as contaminated regardless of spike, and that Class 1 events, due to multiple environmental causes, could not be safely classified as anything reliably anomalous. Thus through this three-step process, the event dataset was fully analyzed against all relevant audio and video sources to ensure a lack of contamination for events, and that the ratings either corresponded to naïve review, or if in contention, were fully vetted through a naïve review.

Analysis and coding of EMF/GMF. As the goal of the current article was to be consistently thorough, the statistical analysis approach to the EMF/GMF data is somewhat unorthodox. Again, the reading of a meter is determined in part on the distance of one or multiple fields. Because of our inability to determine the location(s) of the fields, and of our equipment being limited to magnitude only (and not frequency), we chose to report magnetic data in the raw volt input of the meters themselves. We are aware that it is traditional to convert magnetic readings to mG or nT; however, the mapping process is approximate, and use of mG converted from volt input could add significant error to the analysis. As our main hypothesis involved the simple association of variation in EMF/GMF as a result of potential phenomena that occurred, and our equipment is unable to give us information beyond an increase or decrease in magnitude of the meter, it seemed most honest to present the data as simple volt input distributions. Thus, standard statistical analysis is presented with raw volt input, with the understanding that variation of volt input EMF through the Tri-Field 100XE meters represents a range of 0 to 1 mG, and that volt input of the

Natural EM meters represents a range of 0–100 mG. Again, of primary concern is a change in magnitude that occurs in association (through time) with recorded events in the environment that are independent of the data-logging EMF/GMF system.

Whereas baseline tests and descriptive analysis are performed using standard inferential statistics based on a normal distribution, our hypotheses involving individual phenomena and EMF/GMF behavior were examined differently. For the current study, three or more spikes of EMF and GMF fields within 1 second were isolated from the dataset at either 2.5 or 3 standard deviations above or below the session mean. Each of these spikes (which represent 1/24th of a second) was time-stamped, and investigators then examined audio and video based on the second where a series of three or more 2.5 or 3 standard deviation serial spikes occurred within one second. Each of these data points where EMF/GMF spikes occurred were identified as positive (e.g., increase in magnitude), negative (e.g., decrease in magnitude), or mixed (e.g., both 3-SD increases and decreases in magnitude, indicating extreme variability). Potential phenomena that occurred within the 1-second boundary were considered associated with the spike. However, for clarity, a 0.5-second time lag was allowed for human errors in timing, and potential suppression from the input of the analog meters at 24 samples per second. Other phenomena that did not occur within the 1-second window were also collected and noted.

Of interest in the current dataset were the number of serial spikes (i.e., more than three spikes within 1 second) that occurred. As such, analysis focused not on general significance, but on the number and count of probabilistically unlikely spikes that occurred around the time of analyzed phenomena. The rationale for this method, although unorthodox, is one of precision. Previous research has not explored either the degree or frequency of EMF/GMF fluctuation as a function of paranormal phenomena. Thus, there is no way to know how frequently or how strongly EMF/GMF might rise or decline, should the hypothesis prove to be supported. Looking at the data backwards allows for a precise analysis of EMF/GMF spikes and how often they occur. This process also prevents masking of the data by examining a mean average where three to five spikes over the course of a second are hidden by the overall average.

Results

Social science researchers traditionally worry about having a large enough data set to test hypotheses reliably. The current research has the opposite problem. Sample sizes in some cases are so large due to the collection of 24 samples per second over hours of time that very small mean differences and covariation appear statistically significant, but have no practical significance. In large mean difference tests, we addressed this by calculating the Cohen's δ which provides an effect size statistic for the size of the mean difference. In cases of correlation, we encourage the reader to focus on the effect size statistic and not necessarily on the statistical significance of the test.

Descriptive Statistics and Replication: General EMF/GMF Baseline Comparisons

In order to examine and test the overall means of EMF and GMF over a period of time, means and standard deviations for each meter are provided for each recorded session in Table 1. Baseline meters (i.e., meters placed 7 feet outside the location) were meters 9 and 10. In order to test whether EMF/GMF fields significantly differed in either magnitude or variability in the haunted location as compared to outside of the building, independent-sample *t* tests, and Levene's tests for inequality of variances were conducted for both EMF and GMF fields across all of the sessions. These findings serve as a partial replication of previous research conducted by Braithwaite et al. (2004) and Wiseman et al. (2002, 2003). Results are provided in Tables 2 and 3.

Table 1
Means and Standard Deviations for the 10 Meters in Each of the Four Sessions

	Session 1 (*n* = 176,586)				Session 2 (*n* = 165,778)				Session 3 (*n* = 361,936)				Session 4 (*n* = 54,019)			
Meter	*M*	*Min*	*Max*	SD	*M*	*Min*	*Max*	*SD*	*M*	*Min*	*Max*	*SD*	*M*	*Min*	*Max*	*SD*
Ch1 T	.16	.12	.20	.01	.17	.13	.21	.01	.19	.11	.26	.02	.22	.18	.27	.01
Ch2 G	.01	-.18	.21	.10	.01	-.18	.21	.11	.01	-.25	.29	.14	.01	-.27	.31	.17
Ch3 T	.27	.23	.30	.01	.27	.22	.31	.01	.30	.20	.37	.02	.34	.30	.38	.01
Ch4 G	.01	-.03	.06	.01	.01	-.03	.06	.01	.01	-.04	.06	.01	.01	-.05	.42	.02
Ch5 T	.17	.10	.22	.01	.17	.10	.22	.01	.18	.10	.25	.01	.19	.13	.25	.02
Ch6 G	.01	-.03	.05	.01	.01	-.03	.05	.01	.01	-.04	.07	.01	.01	-.04	.07	.01
Ch7 T	.07	.03	.10	.01	.07	.03	.10	.01	.07	.03	.11	.01	.08	.03	.12	.01
Ch8 G	.01	-.01	.03	.00	.01	-.01	.03	.00	.01	-.01	.33	.01	.01	-.01	.04	.01
Ch9 T	.11	.07	.14	.01	.11	.07	.13	.01	.11	.07	.14	.01	.12	.09	.15	.01
Ch10 G	.01	.00	.02	.00	.01	.00	.02	.00	.01	.00	.03	.00	.01	.00	.02	.00

Note. Data displayed in millivolts. Numbers are in volt input. Approximate mapping of millivolts to milligauss for Tri-Field: .000–.075 mV= .000–.037 mG;.075–.150 mV = .037 to .085 mG; .150-.225 mV = .085–.250 mG; .225–.300 mV = .250–1.0 + mG. Approximate mapping of millivolts to milligauss for Geomagnetic Meters: .000–.075 mV = .000–3.7 mG; .075–.150 mV = 3.7– 8.5 mG; .150–.225 mV = 8.5–25.0 mG; .225–.300 mV = 25.0–100.0+ mG

Results indicated that EMF magnitude and variability were significantly greater for all of the EMF Tri-Field meters inside the haunted location in comparison to single readings taken outside. In terms of mean differences, readings inside the location ranged from 50% to 100% greater compared to outside the location (see Table 2). In all cases, variability inside those locations with activity spots was greater than the variability obtained from the outside baseline EMF/GMF meters. Statistical significance for both mean differences and variability was well beyond p < .001, as indicated by the strength of t scores and Levene ratios. Effect sizes provided by Cohen's δ in all cases exceeded 1.0 thus indicating large differences between means.

GMF mean scores also differed significantly ($p < .01$) with one exception: at locations with activity compared to the single outside baseline meters across sessions. However, Cohen's δ tests for GMF show that, while statistically significant, these mean differences were very small in terms of effect size (δ = .0 to .11, see Table 3). Although mean differences were small, similar to EMF findings, variability for GMF was significantly greater across all of the sample sets within all sessions in comparison to the baseline data. In this case, variability was similar to EMF, where the significance of GMF variability was less than .001 in all cases.

Correlation of Meter Readings Across Sessions: Test of EMF and GMF as Separate Measurements, and Common Sources of EMF/GMF Generation

Product moment correlations were conducted for each session between all of the meters as part of a manipulation check to ensure that EMF and GMF meters were measuring different hertz ranges, as well as an exploratory investigation of covarying meters as a potential indicator of a common source of EMF/GMF field production. These results are provided in Table 4.

Table 2

Baseline Tests: Magnitude and Variability Comparison of Tri-Field (EMF) Meters for Each Session

Meter No.	Base Mean	Comp. Mean	Mean *t*	Mean *p*	Cohen *δ*	Base *SD*	Comp *SD*	Var. *F*	Var. *p*
				SESSION 1 (*n* = 176,586)					
1	0.109	0.165	-2113.83	.001	7.32	.006	.009	2.62	.001
3	0.109	0.268	-7188.11	.001	24.38	.006	.007	1.57	.001
5	0.109	0.172	-2150.21	.001	7.11	.006	.011	3.53	.001
7	0.109	0.068	1754.10	.001	5.79	.006	.008	1.90	.001
				SESSION 2 (*n* = 165,778)					
1	0.107	0.167	-2306.23	.001	7.84	.006	.009	2.00	.001
3	0.107	0.269	-6912.62	.001	24.84	.006	.007	1.40	.001
5	0.107	0.170	-2013.02	.001	7.11	.006	.011	3.30	.001
7	0.107	0.068	1548.46	.001	5.15	.006	.008	1.75	.001
				SESSION 3 (*n* = 361,936)					
1	0.114	0.195	-2485.41	.001	5.81	.008	.018	5.03	.001
3	0.114	0.303	-4512.60	.001	10.56	.008	.024	9.10	.001
5	0.114	0.182	-2391.22	.001	5.65	.008	.015	3.56	.001
7	0.114	.073	1991.00	.001	4.52	.008	.010	1.49	.001
				SESSION 4 (*n* = 54,019)					
1	0.121	0.221	-1981.90	.001	11.70	.005	.011	3.91	.001
3	0.121	0.342	-4676.90	.001	27.95	.005	.010	3.25	.001
5	0.121	0.195	-1080.50	.001	6.61	.005	.015	7.95	.001
7	0.121	0.077	857.89	.001	5.14	.005	.011	4.01	.001

Note: Numbers are in volt input. Approximate mapping of millivolts to milligauss for Tri-Field: .000–.075 mV = .000–.037 mG; .075–.150 mV = .037– .085 mG;.150–.225 mV = .085–.250 mG; .225–.300 mV = .250–1.0 + mG

As Table 4 indicates, the vast majority of relationships between meters were statistically significant, due to sample size. However, for practical interpretation, correlations greater than .30 were underlined, indicating where two meters shared approximately 10% or greater covariation. Correlations indicate that Tri-Field meters did not substantially correlate with Natural EM meter readings. In the majority of cases, the *r* between these meters was less than .10, and in some few instances inversely related, but below our arbitrary .30 threshold. In other words, these correlations provided evidence that both types of meters were registering different frequencies of the electromagnetic field. The lack of correlation between EMF and GMF meters suggests that frequencies of EMF were not produced in the higher end of the Natural EM meter, nor in the lower end of the Tri-Field meter. In theory, such a scenario would produce covariation between both types of meters if coming from a common source.

However, as more of an exploratory analysis, correlations were also examined to determine whether common sources of EMF within the "haunted" location produced similar increases or decreases in EMF/GMF readings. These relationships are graphed according to meter placement in Figure 1. A re-examination of the correlation tables within each session indicates that EMF and GMF readings do

Table 3
Baseline Tests: Magnitude and Variability Comparison of Geomagnetic (GMF) Meters for Each Session

Meter No.	Base Mean	Comp. Mean	Mean *t*	Mean *p*	Cohen *δ*	Base *SD*	Comp *SD*	Var. *F*	Var. *p*
SESSION 1 (*n* = 176,586)									
1	.012	.013	-7.16	.001	0.01	.002	.104	2565.80	.001
3	.012	.012	-10.29	.001	0	.002	.010	25.42	.001
5	.012	.012	-22.39	.001	0	.002	.010	21.53	.001
7	.012	.012	8.08	.001	0	.002	.005	5.51	.001
SESSION 2 (*n* = 165,778)									
1	.012	.014	-7.85	.001	0.02	.002	.106	2674.39	.001
3	.012	.012	-14.55	.001	0	.002	.010	25.46	.001
5	.012	.012	-22.48	.001	0	.002	.010	22.41	.001
7	.012	.012	3.78	.001	0	.002	.005	5.67	.001
SESSION 3 (*n* = 361,936)									
1	.011	.014	-10.28	.001	0.03	.002	.141	4081.98	.001
3	.011	.012	-15.89	.001	0.11	.002	.012	30.96	.001
5	.011	.012	-22.40	.001	0.11	.002	.012	29.79	.001
7	.011	.011	1.22	.22	0	.002	.006	7.52	.001
SESSION 4 (*n* = 54,019)									
1	.011	.014	-4.13	.001	0.02	.002	.165	4776.00	.001
3	.011	.012	-14.24	.001	0.08	.002	.017	52.00	.001
5	.011	.012	-6.58	.001	0.10	.002	.014	33.90	.001
7	.011	.011	3.24	.001	0	.002	.006	7.12	.001

Note: Numbers are volts input. Approximate mapping of millivolts to milligauss for Geomagnetic Meters: .000-.075 mV = .000–3.7 mG; .075-.150 mV = 3.7 to 8.5 mG; .150-.225 mV = 8.5-25.0 mG; .225-.300 mV = 25.0-100.0+ mG

strongly correlate (or inversely relate) with their own meter type within sessions, despite the fact that pairs of meters were placed more than 15 feet apart in separate rooms. In some instances, these relationships are more perplexing as the meters are more than 30 to 40 feet apart. Although the precise meaning can be debated, as Figure 1 shows, Meters 5 and 6 were always inversely related to other meters in other locations in the house. In some cases, other meters would correlate substantially with each other, depending on the time, and then become unrelated or inversely related, depending on the session. These relationships, particularly when they were inverse, suggest the presence of multiple sources of EMF variation in a house with no known artificial means to create them.

Table 4

Correlations of EMF and GMF Readings Between Meters for Each Session

Session 1 (n = 176,586)

Meter	1	2	3	4	5	6	7	8	9
1T									
2G	**.14**								
3T	**-.20**	**-.14**							
4G	**.02**	**-.04**	.00						
5T	**.08**	**.11**	**-.41**	**.02**					
6G	**-.02**	**.01**	**.02**	**-.62**	**-.01**				
7T	**-.11**	**-.22**	**.40**	**-.01**	**-.50**	**.03**			
8G	**.03**	**-.12**	**-.01**	**.37**	**.02**	**-.64**	.00		
9TB	**.31**	**.01**	**.01**	**.02**	**.25**	**-.01**	**-.01**	**.05**	
10GB	**-.03**	**.02**	**.02**	**-.08**	**-.02**	**.19**	**.04**	**-.31**	**.05**

Session 3 (n = 361,936)

Meter	1	2	3	4	5	6	7	8	9
1T									
2G	**.11**								
3T	**.73**	**-.06**							
4G	.00	**-.05**	**-.02**						
5T	**.43**	**.16**	**.28**	**.01**					
6G	**-.04**	**.02**	**-.01**	**-.61**	**-.02**				
7T	**.09**	**-.27**	**.34**	**-.02**	**-.41**	**.02**			
8G	.00	**-.11**	**-.04**	**.35**	**.01**	**-.61**	**-.02**		
9TB	**.68**	**.03**	**.64**	.00	**.44**	**-.02**	**.12**	.00	
10GB	**-.06**	**.01**	**-.03**	**-.10**	**-.06**	**.19**	**.03**	**-.33**	**-.03**

Session 2 (n = 165,778)

Meter	1	2	3	4	5	6	7	8	9
1T									
2G	**.16**								
3T	**-.25**	**-.14**							
4G	**.02**	**-.03**	.00						
5T	**.11**	**.12**	**-.44**	**.02**					
6G	**-.04**	**.02**	**.02**	**-.62**	**-.01**				
7T	**-.19**	**-.22**	**.39**	**-.01**	**-.48**	**.03**			
8G	**.04**	**-.12**	**-.02**	**.39**	**.02**	**-.64**	.00		
9TB	**.22**	**.01**	**-.02**	**.01**	**.33**	**-.01**	**.03**	**.05**	
10GB	**-.03**	**.03**	**.01**	**-.12**	**-.03**	**.20**	**.04**	**-.31**	**.05**

Session 4 (n = 54,019)

Meter	1	2	3	4	5	6	7	8	9
1T									
2G	**.21**								
3T	**-.07**	**-.19**							
4G	**.04**	**-.03**	.01						
5T	**.08**	**.20**	**-.43**	**.02**					
6G	**-.08**	.00	**.03**	**-.44**	**-.02**				
7T	**-.14**	**-.29**	**.32**	**.00**	**-.60**	**.03**			
8G	**.07**	**-.10**	**-.05**	**.23**	**.04**	**-.60**	-.01		
9TB	**.22**	**.06**	**.05**	.01	**.10**	-.01	**-.09**	**.05**	
10GB	**-.05**	**.01**	**.05**	**-.07**	**-.06**	**.12**	**.07**	**-.32**	**.03**

Note: Bold = $p < .05$, Underline = $r > .30$

Phenomena-Based Analysis: EMF/GMF and Its Potential Association to Objective Anomalous Phenomena

In terms of phenomena, the site performed exceedingly well. Although many subjective feelings, noises, and sensations were present during the investigation, this location produced numerous phenomena that were difficult to explain by normal means. Some of these events were captured by our equipment, some were not. For example, both coins and candy appeared on the floors of the room without any apparent means of doing so. In addition, a milk crate both disappeared and reappeared in the basement of the house. In both instances, cameras could not determine how these events occurred.

Likewise, two cases of apparent apparitions occurred in which a series of shadows of 7- to 8-foot-tall people were captured on video while the house was empty. We conducted further investigation with available light sources but were unable to re-create these shadows from any aspect of the room or house. Childlike voices not belonging to any investigator were also captured on audio, despite the fact that there

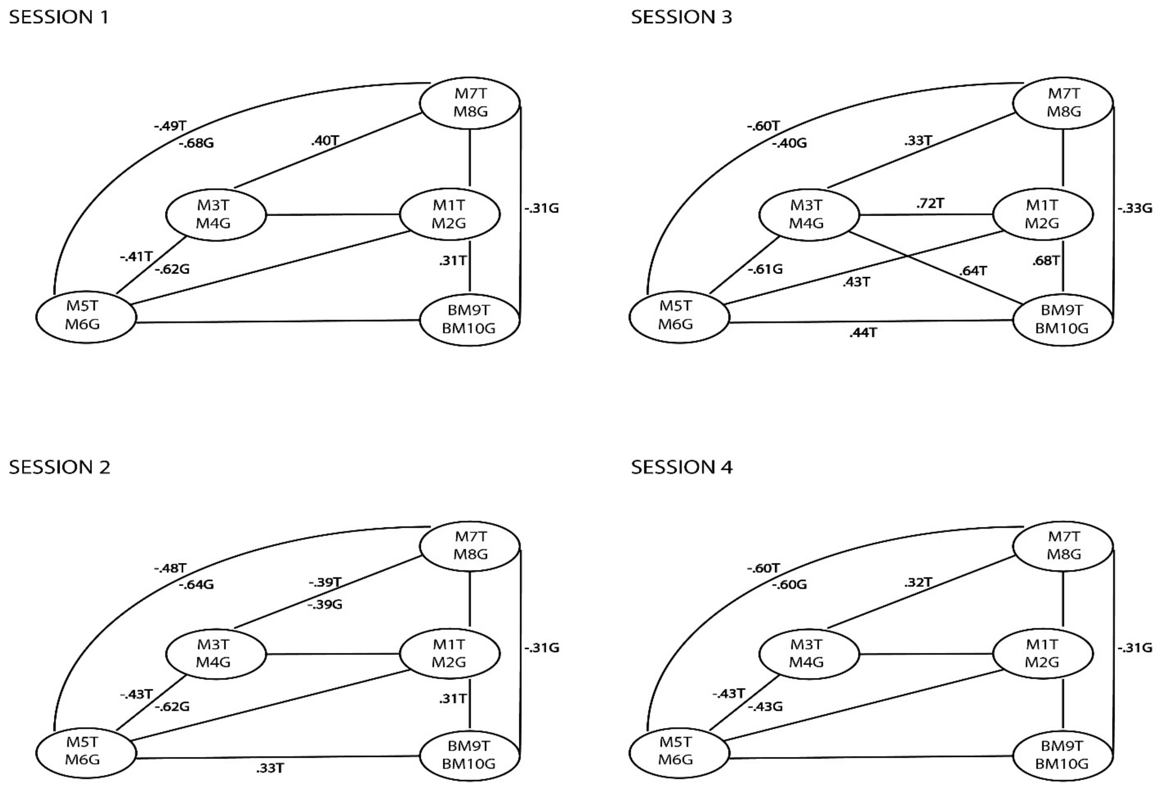

Figure 1. Correlation Coefficients Greater Than .3 By Physical Location for EMF (T) and GMF (G) Meters in Each Session

were no children present and residential houses were not nearby. Thus, this house appeared to have genuine anomalous activity occurring within it.

Examination of Events With and Without EMF/GMF Spikes in Comparison to Captured Potential Phenomena

In order to test the hypothesis that EMF/GMF increases and decreases were associated with phenomena, a series of chi-square tests were conducted within each series of counts for each classification category of phenomena collected. Results are provided in Table 5. The expected count for events that occurring a spike was determined by the overall ratio of spike seconds (e.g., the number of seconds during which three or more 3 SD spikes occurred) in comparison to total seconds over the investigation. The assumption of the test is that if phenomena events are random then the number of events that occur during spikes should not exceed the overall ratio of spike seconds compared to nonspike seconds during the course of the investigation. In order to account for the fact that some events lasted more than 1 second, the expected ratios were multiplied by 4, providing an expected ratio representing the random expected occurrence of these spikes over 4 seconds. Please note that all events recorded across the classes of phenomena were shorter than 4 seconds. However, using a 4-second anomalous event time in comparison to the overall seconds of spikes creates a more conservative test with regard to the expected counts of the chi square. Thus, the chi-square analysis conducted was artificially deflated to present a more conservative estimate. As Table 5 demonstrates, across all categories of phenomena, including ruled out and explainable events, chi squares were highly significant for analysis examining EMF and GMF, EMF only, and GMF only (p = .0006 to 10^{-6}).

Table 5

Chi-Square Tests of Evidentiality Categories by Presence or Absence of Serial Spikes

	Events with Spikes		Events Without Spikes			
Category (Tri & Geo)	O	E	O	E	χ^2	*p*
Class 0	32	8.20	9	32.80	86.34	10^{-6}
Class 1	57	18.8	37	75.20	97.02	10^{-6}
Class 2	10	3.60	8	14.40	14.22	.000162
Class 3	8	1.80	1	7.20	26.69	10^{-6}
Percentage Expecteda		20		80		
Category (Tri Only)	O	E	O	E	χ^2	*P*
Class 0	14	1.60	6	18.40	104.45	10^{-6}
Class 1	29	3.84	19	44.16	179.18	10^{-6}
Class 2	3	0.56	4	6.44	11.55	.000675
Class 3	6	0.56	1	6.44	57.44	10^{-6}
Percentage Expectedb		8		92		
Category (Geo Only)	O	E	O	E	χ^2	p
Class 0	18	2.52	3	18.48	108.06	10^{-6}
Class 1	28	5.40	17	39.60	107.48	10^{-6}
Class 2	7	1.32	4	9.68	27.77	10^{-6}
Class 3	2	0.24	0	1.76	14.66	.000128
Percentage Expectedc		12		88		

Note: [a]Expected = 1,592(spike seconds)/31,597(total investigation seconds) = 5% rounded times 4 (20%). [b]Expected = 534(spike seconds)/31,597(total investigation seconds) = 2% rounded times 4 (8%). [c]Expected = 1,058(spike seconds)/31,597(total investigation seconds) = 3% rounded times 4 (12%)

Examination of Positive, Negative, and Mixed EMF/GMF Spikes and Captured Potential Phenomena

In order to examine whether increases, decreases, or mixed increases and decreases (variability) differentially predicted events, additional chi squares were conducted within each class of phenomena. Results are shown in Table 6. Expected counts were calculated by the percentage of serial increases, decreases, and mixed-second events collected within the total sample. Again, the assumption of the test is that if a particular type of spike is more predictive of phenomena, then it will exceed the expected percentage of its spike type from the entire sample when compared with phenomena. As Table 6 indicates, the proportion of increases, decreases, and variability do not significantly differ from the overall sample. As such, serial spikes associated with phenomena do not appear to relate specifically to a particular type (e.g., positive, negative, or mixed) of EMF/GMF spike.

Table 6
Chi-Square Tests of Evidentiality Categories by Types of Spikes

	Positive Spikes		Negative Spikes		Mixed Spikes			
Category (T&G)	O	E	O	E	O	E	χ^2	*p*
Class 0	12	9.61	14	16.74	5	4.65	1.07	.58
Class 1	19	17.67	30	30.78	8	8.55	0.15	.92
Class 2	5	2.79	2	4.68	2	1.35	3.75	.15
Class 3	2	2.48	5	4.32	1	1.20	0.23	.88
Percentage Expected[a]		31		54		15		
Category (Tri-Field Only)	O	E	O	E	O	E	χ^2	*p*
Class 0	4	3.85	9	9.08	1	1.04	0.01	.99
Class 1	9	7.97	18	18.82	2	2.15	0.18	.91
Class 2	1	0.55	1	1.298	0	0.15	0.58	.74
Class 3	1	1.65	4	3.89	1	0.44	0.95	.62
Percentage Expected[a]		27.5		64.9		7.4		
Category (Geo Only)	O	E	O	E	O	E	χ^2	*p*
Class 0	8	6.20	5	7.58	4	3.20	1.60	.48
Class 1	10	10.22	12	12.48	6	5.26	0.13	.93
Class 2	4	2.55	1	3.12	2	1.36	2.56	.27
Class 3	1	0.73	1	0.89	0	0.38	0.49	.78
Percentage Expected[a]		36.5		44.6		18.8		

Note: [a] Expected percentages derived from total number of positive, negative, and mixed spikes over duration of investigation.

Examination of Number of Spikes in Association with Captured Potential Phenomena

Finally, in order to determine if the overall number of serial spikes (e.g., variability) differentially predicted phenomena, chi squares were again employed within each phenomena category. Results are shown in Table 7. As per the previous analyses, expected counts were determined by the total sample percentage of the number of serial spikes (within 1 second) that occurred within the total dataset. As Table 7 indicates, across all categories of phenomena, the number of spikes that occurred on the given second of the event and, therefore, the duration of the spike, was not a significant predictor of events across categories with the exception of Class 2 events ($p = .007$). Examination of Table 7 suggests this significant finding comes from a greater number of 5 or more serial spikes in 1 second occurring at a greater frequency than expected.

Discussion

The goal of the current study was to examine the hypothesis that EMF/GMF changes as a function of anomalous phenomena that occur in purportedly haunted locations. We deemed our hypotheses exploratory, because previous research (e.g., Braithwaite, 2004, 2006; Braithwaite & Townsend, 2005; Wiseman et al., 2002; 2003) has examined degree and magnitude of EMF or GMF in a supposed haunted location but has not examined objective captured evidence of potentially anomalous events in relation to these fields. The overall findings of the current research appear to support previous research that showed that

Table 7

Chi-Square Tests of Evidentiality Categories by Numbers of Serial Spikes

	3 Spikes		4 Spikes		5 Spikes		6+ Spikes			
Category	O	E	O	E	O	E	O	E	χ^2	*p*
Class 0	21	22.40	7	4.80	3	1.80	1	2.70	2.93	.40
Class 1	41	39.90	11	8.55	1	3.36	4	4.95	2.58	.46
Class 2	5	6.30	1	1.35	3	0.55	0	0.78	11.99	.007
Class 3	5	5.60	1	1.20	1	0.46	1	0.69	0.84	.83
Percentage Expected[a]		70		15		5.8		8.7		

Note: Expected percentages derived from total number of serial spikes collected over duration of investigation.

EMF/GMF fields are abnormal, or at least different, in these "haunted" locations. Also, we provided the first field evidence (to our knowledge) that EMF and GMF do seem to predict potentially anomalous phenomena. We address individual hypotheses below.

General EMF/GMF Magnitude and Behavior

Our examination of EMF/GMF demonstrated that field strength in terms of magnitude and variability was significantly greater at locations with activity compared to the single pair of outside baseline meters. These findings lend partial support to previous research, although Braithwaite et al. (2004) and Wiseman et al. (2002, 2003) noted more differences in the geomagnetic fields, and found less variability and magnitude differences with standard "mains" frequency EMF.

What is interesting is that both magnitude and variability of EMF "mains" frequency fields demonstrated the most variability and magnitude despite a lack of EMF generating sources in the location. GMF fields could be expected to vary simply as a function of environmental conditions of the earth, solar rays, and other effects, but EMF is most often affected by artificially created means. One explanation is that the frequency of the fields during the investigation lay somewhere in between EMF and GMF frequencies, thus increasing the magnitude readings of 60-Hz calibrated EMF meters. However, correlations between EMF and GMF were essentially nonexistent, which rules this possibility out. As such, we have no explanation as to why these EMF fields were greater and why they varied as they did.

EMF meters were attached to extremely sensitive coils, whereas GMF meters were not. One reason why GMF may not have shown the magnitude differences that EMF did is that the GMF meters were not sensitive enough to pick up that smaller variations in magnitude that the EMF meters could detect. In either event, GMF still produced significantly greater degrees of variability. However, despite smaller differences from baseline measurements, GMF appears to predict anomalous events as well as EMF does.

From a broader perspective, the above findings do generally support some of Persinger's earlier hypotheses (e.g., St. Pierre & Persinger, 2006). Even though specific frequencies of fields could not be determined, there are definite differences in EMF and GMF fields above and beyond baseline measures. As such, the EMF/GMF readings within a potentially haunted house suggest that these sites are a likely place where a person's perception could be affected.

The current research examined multiple areas within the site in comparison to baseline readings. When the correlations are examined by session, a very intriguing finding seems evident. Correlations across sessions demonstrated that readings in different rooms either correlated or inversely correlated depending on location and time. The results of these correlations lead to some tentative conclusions about the source and behavior of EMF/GMF in "haunted" locations. First, we accept the likelihood that one field or vector of EMF/GMF affecting two sets of meters that are physically distant from each other would increase or decrease the readings at the same time and in the same way. If this assumption is theoretically correct, then the current findings demonstrate through correlation that multiple sources of EMF were present inside the house affecting different meters at different times. Given the quick decay of magnitude that occurs as distance of a meter increases from a source of an EMF/GMF field, multiple and numerous fields within the house would account for varying positive and negative relationships between meters. Degrees of correlation would indicate the extent to which a particular field was affecting a meter in a different location.

One potential explanation is that these changes in correlation over time may represent the reflection of fields from metallic content inside the house. However, this explanation does not entirely fit with the data. A closer inspection of Figure 1 and Table 4 demonstrates that different meter areas would strongly correlate with other meter areas, but only at certain assessment times. At other times during assessment, these areas were unrelated. Using metal reflection to explain these changes in association becomes difficult for a simple reason: The metal in the house is presumably fixed and immobile. As such, if the fields in the house are not mobile, then the reflection angles of the metal would not change, and thus, relationships between meter areas would remain constant in terms of the pattern of correlations between meter areas across all four sessions.

Thus, if this site is typical, an examination of the correlations across sessions suggests that EMF/GMF in these locations do not represent one large encompassing field that is occurring at the location. Rather, multiple sources of EMF of varying strength seem apparent. We would suggest that the correlations across time suggest multiple fields that are changing in size and areas of effect as well as covering and effecting different areas of the house as time progresses. This interpretation is at least partially congruent with Braithwaite et al.'s (2004) finding of fields that changed in variability and magnitude over time. However, as electricity sources were deemed nonexistent in the house, we have no explanation as to why, or how these fields could have been conventionally generated.

Coded Analysis of EMF/GMF Spikes and Associated Phenomena

In terms of our principal hypothesis regarding the association of EMF and GMF with phenomena, our results lend initial support to the idea that EMF and GMF are associated with captured nonhallucinatory phenomena that occur within purportedly haunted locations. The ratio of events occurring during spikes was highly significant compared to what we would expect from random association of spikes to phenomena.

These findings are theoretically important in terms of understanding and explaining haunting phenomena, with a few caveats that will be mentioned below. Primarily, the demonstrated relationship between audio- and video-captured phenomena and EMF/GMF provides the first evidence that "paranormal phenomena" cannot be fully accounted for by Persinger's (e.g., Gearhart & Persinger, 1986; St. Pierre & Persinger, 2006) hypothesis of GMF-stimulated hallucination. This, by no means, discredits GMF hallucinations, but it does provide evidence that would rule out an entirely neurological explanation of haunting phenomena. Although the explanation of what these events represent is something we leave to others, the data in their simplest interpretation suggest that difficult-to-explain phenomena do occur within some purportedly haunted locales, they are associated with EMF and GMF, and that internal sensation and perception are not sufficient to explain their occurrence.

However, these spike-to-event ratios were highly significant even with Class 1 and ruled-out Class 0 phenomena, which presents a quandary. Our goal for performing the analyses on Class 0 (ruled-out events) and Class 1 (likely non-anomalous events such as bumps, thumps, and noises) was to provide transparency to the event classification process. Although Class 0 and Class 1 phenomena show high percentages of spikes during their occurrence, our classification system and method could not influence when spikes occurred over the data set. Thus, some sort of association exists between these "likely non-anomalous" phenomena and EMF. Several potential explanations exist. First, particularly with Class 0 phenomena, many of the events were noises due to either airplanes overhead or cars passing by. Both of the objects in question are metal, and both have strong electrical power supplies which in turn create EMF fields. It may be the case that, as the meters are highly sensitive, the EM fields of these cars and planes were being picked up. In a somewhat similar vein, Class 1 phenomena most frequently consisted of loud bangs, bumps, and knocks that frequently occurred in the house, as well as voices that were more likely to be investigators than EVP, or lights or dust that appeared to have odd trajectories. While interesting, by EMPE criteria this type of phenomena was too easily explainable, and therefore relegated to Class 1. Although better safe than sorry, some of these events may not, in fact, have been due to environmental means, and thus the number of events categorized as Class 1 phenomena may have been inflated due to Type II error.

Regardless of the significance of the ratios of Class 0 and Class 1 phenomena, they exist for comparison purposes. The remaining classes of phenomena, particularly Class 3, represent very closely examined and analyzed events that most people would interpret as "paranormal." We are at a loss to explain all of the Class 3 phenomena, and the percentage ratios of events occurring on spikes are highest with this class. Events in this category included actual human-shaped shadows that we could not explain after considerable effort, audio voices of children who were not present, sounds of footsteps and keys jingling with investigators absent, and several instances of a male voice with a southern accent repeating what appears to be "dee-dup." Ratios of spikes for Class 3 events, which were much less common in the dataset, ranged from 85–100%. However, despite other sources of EMF that may add error to the model and false positives to the lower classifications, the prediction rate of spikes to the events that were likely to be anomalous, while not perfect, is strong enough to warrant the claim that spikes do seem to be associated with closely examined anomalous events.

Increases, Decreases, and Variability in EMF/GMF and Length of Spike and Captured Phenomena

Secondary analysis of EMF/GMF spikes overall was not significant. Results showed that both three-*SD* increases or decreases, as well as increases and decreases within a 1-second interval (i.e. variability), did not appear to differentially predict phenomena occurring in any of our phenomena categories. Likewise, the number of serial spikes that occurred within 1 second (e.g., the length of the perturbation) also did not seem to differentially predict phenomena events. However, our non-significant findings actually provide very telling information about EMF/GMF that, until now, has not been examined. Essentially, nonsignificant results in these tests demonstrate that both increases and, more importantly, decreases from average field strength are associated with phenomena. These data suggest that any type of perturbation—whether the field increases, decreases, or varies positively and negatively—is a potential sign of anomalous events.

Our lack of relationship between both the type of EMF/GMF spikes and the duration of spikes with anomalous events is also useful for understanding how EMF/GMF behave in the context of anomalous phenomena. The current research seems to suggest that very brief magnitude small spikes and longer sustained spikes are equal potential predictors of anomalous activity. Practically speaking, this has relevance to the hobbyists of ghost hunting as well as to parapsychological field research. Meters used for either ghost hunting or formal research must be both sensitive to small perturbations and able to sample EMF quickly enough to detect spikes and decreases within a fraction of a second in order to test EMF as a predictor in the field. Although speculative, the current research suggests that most of the inexpensive EMF meters do not have the processing speed or sensitivity to capture EMF spikes that might predict quality phenomena. It also suggests that the practice of ignoring small variations in EMF may mean missing or not capturing a potentially anomalous event.

Weakness, Perspective, and Future Research

The methods used in the current study have some weaknesses, some of which are due to the nature of EMF/GMF, and others which can be improved or are philosophically and scientifically thorny. The most obvious issue with the current research is a desperate need for replication. Although probability in many ways protects the investigator from Type I error, the current research can make no claims that the field and phenomena behavior here is consistent either with the site itself or other locations. As such, our current goal is to return to conduct additional investigations, implement software to better review evidence, and make a comparison of other sites that have reliably demonstrated objective anomalous phenomena.

As to the association of EMF/GMF spikes in relation to phenomena, while every conceivable precaution was taken with regard to the accurate estimation of the EMF/GMF equipment we used, the equipment is by no means perfect. We hope to expand on our equipment in order to examine frequency or add additional meters to areas in hopes of triangulating fields. Yet, the nature of these findings cannot be discounted by a perceived deficiency in the equipment. If the reader can accept that the meters and data-logging equipment employed register changes in EMF/GMF magnitude, and were applied, implemented, and recorded in a consistent manner, then any error in the equipment cannot explain why registered spikes (produced from data logging) would correspond to external events recorded in the environment. Even if some internal error of the equipment was occurring, such as electrical feedback, it still would not explain why particular feedback was occurring at a time that corresponded to the recording of external phenomena.

Related to the above, general magnitude and variability readings regarding EMF/GMF may have been different if coils had been available for all meters. Whereas three-standard-deviation spikes were plentiful with GMF meters, overall magnitude readings and the number of spikes may have differed if coils had been employed with GMF. Because these spikes were plentiful with GMF meters, we do not believe that the EMF/GMF phenomena relationship demonstrated here was significantly confounded by a lack of coils for these meters, but we do intend to examine this possibility in future research.

Finally, and in a more theoretical context, we wish to state that the phenomena that have been captured are not intended to be considered "proof" of ghosts or haunting. Scientifically and philosophically, we prefer to make a clear statement that the captured phenomena were consistently evaluated only on their ability to be easily explained. We leave the interpretation and personal meaning of such phenomena as child-like female voices or shadow apparitions to the individual reader. Unfortunately, people will go great lengths towards disavowing or accepting this type of research according to their belief systems, which in many cases go above and beyond reasonable conclusions whether they are skeptics or believers. As such, we feel the only reliable position to take is within the stated methods of evaluation that we employed to determine the likelihood that these relationships exist.

Although the current research methods can always be improved, the findings are strong enough to demonstrate that a relationship exists between phenomena that are difficult to explain by environmental means and changes in EMF and GMF readings, even when factoring in considerable degrees of error. A definitive explanation for the occurrence of the phenomena, either by very unlikely but normal causes or by supernatural means, is not something we can provide.

Conclusion

The overall research, despite some unavoidable weaknesses, provides initial evidence that video- and audio-captured phenomena are associated with perturbations in the EMF/GMF fields of a "haunted" location. Through careful classification of these events, and the independently measured variation in EMF/GMF that is associated with them, we cannot help but conclude that a hallucination-based explanation for haunting phenomena alone does not account for these findings or phenomena. However, we openly claim that this study represents initial findings, and we are in the process of replicating this research at the same location, as well as at other locations. We welcome theoretical contributions and other researchers' interest in these phenomena, as well as independent replication of these findings.

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Abstracts in Other Languages

Spanish

UNA PRUEBA CRÍTICA DE LA TEORÍA PARANORMAL DE FENÓMENOS EMF-GMF: INVESTIGACIÓN DE UNA CASA ENCANTADA SIN CAMPOS GENERADORES DE ELECTRICIDAD

RESUMEN. Las investigaciones previas sobre los campos electromagnéticos y geomagnéticos (EMF y GMF) y su relación con los fenómenos paranormales se han realizado bajo los supuestos teóricos de alucinaciones debida a los campos GMF. El presente estudio evalúa la posibilidad de que fenómenos paranormales no alucinatorias también estén asociados con campos EMF/GMF. Examinamos las perturbaciones de EMF y GMF en el contexto de fenómenos potenciales recolectados con equipos de registro de datos en una casa encantada sin electricidad. Los resultados globales indican que los campos EMF y GMF fueron significativamente mayores en magnitud y variabilidad dentro de la casa en comparación con las mediciones iniciales realizadas fuera de dicha ubicación. Las diferencias en la magnitud de GMF fueron pequeñas en comparación con EMF. Las correlaciones mostraron que los campos EMF/GMF cambiaron en rango y ubicación a lo largo de la investigación. Los resultados relacionados con los fenómenos individuales revisados indican que los fenómenos están fuerte y significativamente asociados con los picos EMF GMF en serie, que los aumentos y disminuciones en los campos EMF/GMF no predicen diferencialmente los fenómenos, y que el aumento en el número (es decir, duración) de picos en serie no predicen diferencialmente los fenómenos.

French

UN TEST CRITIQUE DE LA THÉORIE DES PHÉNOMÈNES PARANORMAUX PAR CHAMPS ÉLECTRO-MAGNÉTIQUES (EMF) : PREUVES EN PROVENANCE D'UN SITE HANTÉ SANS CHAMPS GÉNÉRANT DE L'ÉLECTRICITÉ

RESUME : Les précédentes recherches sur les champs électromagnétiques et géomagnétiques (EMF et GMF) et leurs relations aux phénomènes paranormaux ont été réalisées en partant du postulat théorique que les champs GMF produisaient des hallucinations. La présente étude teste la possibilité que les phénomènes paranormaux non-hallucinatoires soient également associés avec les champs EMF/GMF. Les perturbations EMF et GMF furent examinées dans le contexte des phénomènes potentiels collectés avec un équipement collecteur de données sur un site hanté sans électricité. Les résultats globaux indiquent que les champs EMF et GMF étaient significativement plus grands tant en magnitude qu'en variabilité au sein du lieu par rapport à des mesures de base prises en dehors du lieu. Les différences dans la magnitude GMF étaient petites comparativement à celles dans l'EMF. A travers une corrélation, on a pu montré que les champs EMF/GMF changeaient en ampleur et en localisation durant tout le temps de la recherche. Les résultats impliquent des phénomènes pris individuellement impliquent que les phénomènes sont fortement et significativement associés avec des pics en série d'EMF et GMF, que tant les augmentations et les diminutions dans les champs EMF/GMF ne sont pas différentiellement prédictifs des phénomènes, et que cette augmentation dans le nombre (cf. la durée) des pics en série ne prédit pas différentiellement les phénomènes.

German

EIN KRITISCHER TEST DER THEORIE ÜBER EMF UND PARANORMALE PHÄNOMENE: HINWEISE VON EINEM SPUKORT OHNE ELEKTRIZITÄTSERZEUGENDE FELDER

ZUSAMMENFASSUNG: Frühere Forschungen über mögliche Zusammenhänge zwischen elektromagnetischen und geomagnetischen Feldern (EMF und GMF) mit paranormalen Phänomenen wurden unter der theoretischen Annahme durchgeführt, dass GMF-Felder Halluzinationen induzieren. Die vorliegende Studie überprüft die Möglichkeit, dass nicht-halluzinatorische paranormale Phänomene auch mit EMF/GMF-lFeldern zusammenhängen. Änderungen des EMF und GMF wurden im Kontext möglicher Phänomene mit Geräten zur Datenerfassung an einem Spukort ohne Elektrizität aufgezeichnet. Die Gesamtresultate weisen darauf hin, dass die EMF- und GMF-Felder sowohl in Grössenordnung wie Schwankung innerhalb der Örtlichkeit signifikant grösser sind—verglichen mit Baselinemessungen ausserhalb der Örtlichkeit. Unterschiede in der Grössenordnung zwischen GMF und EMF waren gering. Durch Korrelation konnte nachgewiesen werden, dass sich die EMF/GMF-Felder im Verlauf der Untersuchung in ihrer Reichweite wie Lokalisierung änderten. Die Nachprüfung an ausgewählten Phänomenen ergab, dass die Phänomene deutlich und signifikant mit Gruppen von EMF- und GMF-Spikes zusammenhängen, dass sowohl der Anstieg als auch der Abfall der EMF/GMF-Felder nicht zur Vorhersage bestimmter Phänomene beiträgt und dass Anstiege in der Anzahl, d. h. in der Dauer von Spikesserien die Ausprägung bestimmter Phänomene nicht vorhersagt.