Electromagnetic Field (EMF) Profile & Baselines at a Non-Haunted Control Location

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Abstract

There has been little to no environmental and experience data collected at randomly selected non-haunted control sites despite the call for researchers and field investigators to do so over twenty years ago. Electromagnetic Fields (EMFs) and their association and correlation with haunted locations and haunt-type phenomena have been studied by both academics and hobbyist ghost hunters/ paranormal investigators. The field has progressed over the years with mixed results and some within site controls. However, there is still a lack of data collected at non-haunted control locations and many questions remain on how to collect and analyze baselines data. The current study was conducted to collect multi-hour multiple-run baseline EMF data to explore EMF profiles and to better understand how EMF readings can vary temporally across the X, Y and Z axis of a 3-axis EMF meter at a non-haunted control site. The data showed the non-haunted control site had complex time varying magnetic fields during long-term data collection periods at various days and times Limitations of the study are noted and future research is described.

Introduction

Houran and Brugger (2000) noted that data collected during investigations of haunting and poltergeist cases is limited due to the absence of data from independent control sites. They recommended, "…that field investigators study events that occur at randomly selected control sites whose salient characteristics match those of the target sites, as well as for each investigation of a target site try to set up a control investigation of a similar house whenever possible." Despite this call to action, there has been little to no data collected at randomly selected control sites outside of the target research sites (Dagnall et al., 2020).

Field research investigating the potential link between magnetic fields and locations where people have reported haunt-type phenomena has been ongoing. (Braithwaite, 2004; Braithwaite et al., 2004; Braithwaite & Townsend, 2005; Laythe & Houran, 2019; Laythe & Owen, 2013; Maher, 2000; Terhune et al., 2007; Wiseman et al., 2002; Wiseman et al., 2003). These prior studies have mainly explored magnetic fields in target areas to within site baselines and controls. Two studies also compared target sites control locations outside of the study location.

Roll and Persinger (2001) found the magnetic field strength varied spatially throughout a reportedly haunted location. Magnetic field strength, variance and pulsing was found to be different in a bedroom at Muncaster Castle when comparing the head of the bed, where people reported numerous anomalous experiences, to the center of the bedroom (Braithwaite, 2004; Braithwaite et al., 2004). Data collected at Hampton Court Palace showed differences in EMF in target versus control areas (Wiseman et al., 2002; Wiseman, 2003). These intra-site comparisons provided useful data and this work was furthered by two studies that compared target sites with control locations either just outside of the study site or at locations that had similar characteristics as the target sites. With reported haunt-type phenomena.

Laythe and Owen (2013) placed EMF meters inside and seven feet outside of the target site and found significant differences in EMF magnitude and variability. Houran et al. (2002) conducted a study to analyze contextual variables and the incidence of photographic anomalies at a haunt site and control site. Part of the study was to explore the differences in the mean and variance of the EMF between inter-site target and control locations and intra-site active and inactive areas of the target site. No difference was found in the inter-site EMF, but there was a difference in the EMF mean and variance between the intra-site active and inactive areas.

Research into the potential role of magnetic fields at ghost and haunt locations has not been restricted to academics conducting formal research studies. Hobbyist ghost hunters and paranormal investigators have also explored the potential correlations between magnetic fields and ghost and haunt phenomena.

Various equipment is used by Amateur Research and Investigation Groups (ARIGs) during ghost hunts (Baker & Bader, 2014; Booker, 2009; Hill, 2017; Hill, 2010; Houran, 2017; Potts, 2004). Electromagnetic Field (EMF) meters are discussed in ghost hunting guides and used extensively by ARIGs (Hill, 2017; Parsons, 2015; Radford, 2017; Taylor 2007). However, EMF meters have mainly been used inappropriately during ghost hunts and paranormal investigations, especially regarding the collection of control (i.e. have not collected data in non-haunted locations) and baseline data (Biddle, 2017; Radford, 2017).

It is standard practice for ghost hunters (ARIGs) to arrive at a suspected haunted location and begin collecting measurements for baseline readings, which most often consists of a single electromagnetic field (EMF) meter. This activity usually consists of moving from room to room with the meter held in an outstretched hand, taking note of any high and low readings. This activity is performed either during setup of the ghost hunter's equipment or immediately after setup is complete, and usually takes approximately ten to twenty minutes to complete. Whatever readings are obtained during this short time become the standard in which future readings are compared, and how anomalies are determined. ARIGs are under the impression that this common practice provides accurate readings to establish a reliable baseline for later comparison. It simply does not. The meters are operated incorrectly and the short time in which the meter is passed through an area is grossly insufficient to establish valid comparisons.

Slight differences in orientation of the meter can cause drastic changes in the measurement displayed by the meter. For example, while rotating a Mel-Meter on a single axis next to microwave oven (plugged in, but not active), measurements ranged erratically between 0.3 mG to 70 mG. Additionally, Laythe and Houran (2019) showed significant changes in both single-axis and sum of all three axis measurements during anomalous perturbation of a target object. Therefore, multi- and single-axis sensing, and data-logging is preferred for an accurate understanding of EMF activity in the environment examining.

There is a plethora of events that can affect your readings; from automatic lights turning off/on, cooling & heating systems cycling On/Off, automated machines, pumps, radio interference, refrigeration units cycling power, and so on. All these variables, and more, need to be considered and accounted for in the data collection and analysis.

The most common meters used by ARIGs include the Safe Range EMF (commonly known as the "K2"), the Lutron EMF-822A, the Mel-Meter, and the Cell Sensor (also known as 'The Ghost Meter"). These are all are single-axis meters, meaning they only read the strength of an electromagnetic field on one axis at a time. Over the previous decade, general observations indicate these meters are most often held firmly in one position and are not rotated on any axis, much less all three. Since these meters are 'single-axis' meters, they require the user to rotate the meter on all three axes – X, Y, and Z – and calculating the average with the following equation SUM = $\sqrt{X^2+Y^2+Z^2}$, usually within a +/-5% accuracy.

Improper use of equipment and lack of proper baseline and control data leads to difficulties in drawing any conclusions about the data collected in haunted locations. How does one know that a specific reading is anomalous? Why would it be considered anomalous in a supposed haunted location? Are these types of readings and data present in non-haunted locations? How would that influence the interpretation of the data if they were?

The current study was conducted to collect multi-hour multiple-run baseline EMF data to explore EMF profiles and to better understand how EMF readings can vary temporally across the X, Y and Z axis of a 3-axis EMF meter at a non-haunted control site.

Methods

Electromagnetic Field data was collected using a 3-axis Taishi EMF Meter model TES-1393 with the following specifications: sample time of 0.5 seconds; band width 30-2000 Hz; range 20/200/2000 mG; resolution 0.01/0.1/1 mG; accuracy +/- (3%+3d) at 50/60 Hz, +/- (5%+3d) at 40-200 Hz, -3dB at 30-2000 Hz. The meter was positioned with the X-axis in the W-E position, Y-axis in the UP-DOWN position and Z-axis in the N-S position. Data was collected at a rate of one sample per second with the supplied software with a Dell Inspiron Mini 10 running Windows XP Home Edition.

EMF data was graphed, and descriptive statistics were calculated using Microsoft Office 365 Excel. Sum EMF was calculated using the formula $SUM_{EMF}= \sqrt{(X^2 + Y^2 + Z^2)}$. An Analysis of Variance (ANOVA) was conducted to determine if the difference between the means of SUM_{EMFs} for the different days and AM/PM runs were statistically significant (alpha = 0.01). The effect size was calculated with Eta-squared, $\eta2=SS_{Effect}/SS_{Total}$.

Data was collected in a non-haunted location in Round Lake, Illinois on January 2nd, 2020 from approximately 6am to 10am and 8pm to 12am and January 3rd, 2020 from approximately 6am to 10am and 8pm to 10:30pm. The house is in a subdivision and is approximately 20 years old. It is a two-story home with an unfinished basement, central air, natural gas heat and Wi-Fi. The owners also have multiple cell phones, tablet computers and TVs connected to cellular networks and/or the Wi-Fi network.

EMF frequency was determined using a 3-axis Fluxgate Magnetometer Model 539 with APS software with the following specifications: range -650 mG to +650 mG; accuracy +/-1% full scale. The meter was positioned with the X-axis in the W-E position, Y-axis in the N-S position, and Z-axis in the UP-DOWN position It was set to collect approximately 250 samples per second. Data was analyzed by FFT analysis using SigView software

Results

Figure 1 shows the only frequency was 60 Hz, which was expected since this is the mains power frequency in the United States.

Figure 1. FFT Frequency analysis of EMF data. 60Hz peak frequency.

Table 1 shows the summary statistics for the four data collection periods. All data runs showed leptokurtic distributions with various levels of positive skewness.

ANOVA analysis showed the difference between group means was statistically significant (Table 2) with an effect size of 0.066, considered a medium effect size (Cohen, 1988; Miles & Shevlin, 2001).

	Jan 2 2020 am	Jan 2 2020 pm	Jan 3 2020 am	Jan 3 2020 pm
Start	6:05:49	19:57:55	6:01:32	19:57:13
Stop	10:17:21	0:09:59	10:13:50	22:29:04
Count	15,093	15,125	15,139	9,112
Mean	2.23	2.47	2.20	2.74
Standard Error	0.01	0.01	0.01	0.01
Median	2.13	2.27	2.05	2.68
Mode	2.81	1.83	1.74	2.14
Standard Deviation	0.66	0.85	0.73	0.69
Sample Variance	0.44	0.73	0.54	0.47
Kurtosis	58.78	8.35	15.01	59.87
Skewness	4.05	1.81	2.15	4.79
Range	18.12	11.72	13.23	13.20
Minimum	0.93	0.99	0.94	1.38
Maximum	19.05	12.71	14.17	14.58

Table 1. Summary statistics for SUM_{EMF}.

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	2117.573	3	705.8576	1282.673	0	3.781981
Within Groups	29972.21	54465	0.550302			
Total	32089.78	54468				

Table 2. ANOVA alpha=0.01, P-value<0.01.

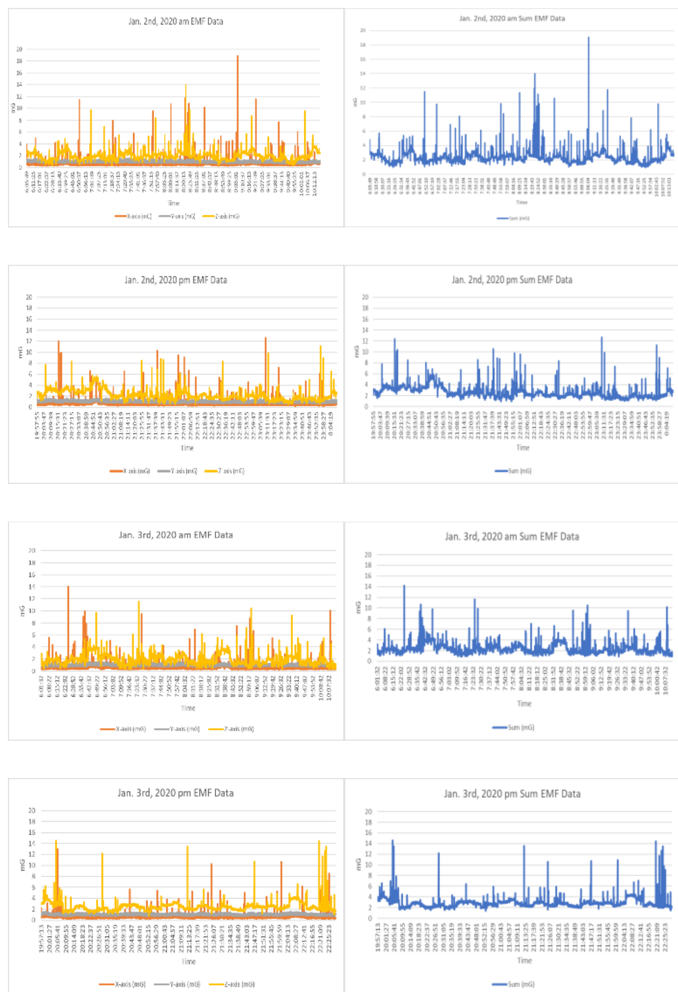

Figure 2. X, Y, Z-axis, and SUM EMF data plotted vs. time.

There was considerable variation in the EMF levels in the X and Z axes, which would have been oriented in the W-E and N-S positions, respectively (Figure 2). There were relatively low readings in the Y-axis readings (UP-DOWN) during all data runs. Figure 3 shows an enlarged view of an eight second data collection period on Jan. 2nd, 2020 as an example. Post experiment testing confirmed that the Y-axis on the EMF meter was working properly.

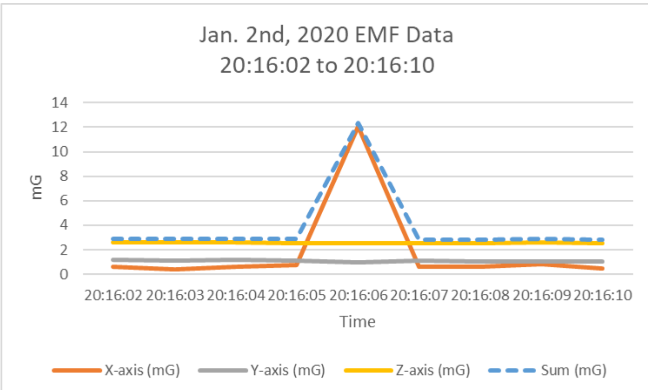

Figure 3.

Figure 4 shows the difference in what the reading would have been using a single-axis vs. a three-axis sensor meter when placed in the X, Y and X-axis orientation.

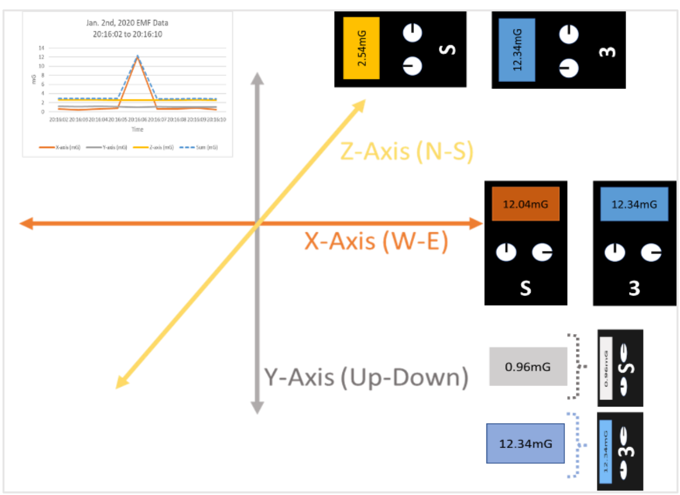

Figure 4. Single axis (S) vs. three axis (3) EMF meter readings on individual axis for an EMF "spike" on Jan. 2nd, 2020 at 20:08:16.

It should be noted that although the data location was not known to be haunted there were no reported anomalous experiences reported during the time data was collected.

Discussion

This study showed the non-haunted control site had complex time varying magnetic fields during long-term data collection periods at various days and times while the EMF meter was in a fixed position. The differences between the data collection periods were significantly different. The results were not surprising due to the number of electronic devices and appliances located in the home. The EMF profile was like that found in other studies of residential settings when data was collected over long periods of time (Gauger, 1985; Mader et al., 1990; NIEHS & NIH, 2002; Silva, 1988).

The temporal variation of the EMF data was also similar to that found for EMFs recorded over long periods of time in other reported haunted locations (Persinger & Koren, 2001).

Differences in the overall mean and variance have been found between areas where anomalous activity has been reported and within site control areas at reportedly haunted locations (Nichols & Roll, 1998; Wiseman et al., 2002; Wiseman et al., 2003). While the overall difference was noted, post-hoc individual t-tests and F-tests showed that each data collection period's mean and variance were significantly different from all others for this non-haunted location. Therefore, comparing the overall mean and variance of haunt and control site data may be problematic since control site data collection was shown to be significantly different just based on different data collection time periods. Small differences can become statistically different with large sample sizes, and this could have been what happened in this study as the N ranged from 9,112 to 15,139.

Interpretation of potential correlations between magnetic fields and anomalous experiences at reportedly haunted locations and the identification of an individual EMF reading as being anomalous, even if within site and external site controls are used, would seem to be further complicated if control sites (both non-haunted and within site haunted) show temporal variations and differences in overall mean and variance. How then can it be determined what is anomalous vs. baselines and controls? Will any stretch of time be sufficient for baselines and controls? A method not normally applied to EMF and haunt phenomena has proven useful in solving this problem.

The distributional approach to EMF analysis was recently developed and applied to haunt research involving EMF and physical variables and objective and subjective phenomena. Binomial probability analysis methodology was effectively applied to analyzing magnetic field data in locations where contamination could not be controlled (Laythe et al., 2017; Laythe & Houran, 2019; Laythe & Owen, 2013).

This method mathematically deals with contaminating sources of magnetic fields by absorbing the contamination in the raw data distribution, which then expands or contracts the overall standard deviation, and therefore adjusts the probability of success. Success is defined as data points that are +/- 2 or 3 standard deviations from the mean. Each data point becomes a binomial trial, and the resulting chi square analysis tests the association between random magnetic fields and the anomalous phenomena in question. While control sites are still used with this methodology, it provides a solution to some of the problems identified in this discussion and eliminates the need for the traditional type of baseline measurements. This analysis, and any other, is dependent on the quality of equipment used and the data collected.

The majority of ARIGs use single-axis handheld meters while walking throughout a location to collect both baseline readings and search for anomalous EMFs. This is woefully inadequate as the data in this study has shown that EMFs collected over long periods of time show considerable temporal variation just in one fixed location on different axes. Single axis moving meters will provide both false positives and negatives. Therefore, lon-term data collection with three axis data logging meters is preferred to collect accurate and meaningful data.

There were a few major limitations of the current study. First, data was collected in only one location and only in one area of this single location. Second, a formal method of collecting anomalous experiences should be used, such as the Survey of Strange Events," even in non-haunted control locations (Houran et al., 2019). Third, it would have been useful to collect data when the main power to the house was turned off to see what the EMF baseline profile looked like. Fourth, it would have been beneficial to find houses similar in structure, design, electronic equipment, with one being reportedly haunted and the other non-haunted and collect data at the same time periods. These limitations can be corrected with future research.

References

Baker, J. O. & Bader, C. D. (2014). A social anthropology of ghosts in twenty-first- century America. *Sociological Review, 61,* 569-593.

Booker, M. K. (2009). *Red, white and spooked: the supernatural in American culture."* Westport, CT: Praeger.

Bell, G. B., Marino, A. A., & Chesson, A. L. (1992). Alterations in brain electrical activity caused by magnetic fields: Detecting the detection process. Electroencephalography. *Clinical Neurophysiology, 83,* 389-397.

Bell, G. B., Marino, A. A., & Chesson, A. L. (1994). Frequency-specific responses in the human brain caused by electromagnetic-fields. *Journal of Neuro Sciences, 123,* 26-32.

Biddle, K. (2017, October 11). Electromagnetic fields & EMF detectors. Retrieved from https://anomaliesresearchsociety.wordpress.com/2017/10/11/electromagnetic-fields-emf-detectors-script/

Braithwaite, J. J. (2004). Magnetic variances associated with "haunt-type" experiences: A comparison using time-synchronized baseline measurements. *European Journal of Parapsychology, 19,* 3–28.

Braithwaite, J. J. (2006). Using digital magnetometry to quantify anomalous magnetic fields associated with spontaneous strange experiences: The magnetic detection system (MADS). *Journal of Parapsychology, 69,* 151–171.

Braithwaite, J. J. (2008). Putting magnetism in its place: A critical examination of the weak intensity magnetic field account for anomalous haunt-type experiences. *Journal of the Society of Psychical Research,* 72, 34–50.

Braithwaite, J. J., Perez-Aquino, k., & Townsend, M. (2004). In search of magnetic anomalies associated with haunt-type experiences: Pulses and patterns in dual time-synchronized measurements. *Journal of Parapsychology*, *68*, 255–288.

Braithwaite, J. J. & Townsend, M. (2005). Sleeping with the entity – A quantitative magnetic investigation of an English castle's reputedly "haunted" bedroom. *European Journal of Parapsychology, 20, 65-78.*

Cohen, J (1988) Statistical power analysis for the behavioral sciences (2nd ed.). Hillsdale, NJ: Erlbaum.

Dagnall, N., Drinkwater, K. G., O'Keeffe, Ventola, A., Laythe, B., Jawer, M. A., Massullo, B., Caputo, G. B., & Houran, J. (2020). Things that go bump in the literature: An environmental appraisal of "haunted houses." *Frontiers in Psychology, 11, 1-15.*

Fowler, J., Cohen, L. & Jarvis, P. (2009). *Practical Statistics for Field Biology, Second Edition.* West Sussex, England: John Wiley & Sons Ltd.

French, C. C., Haque, U., Bunton-Stasyshyn, R., & Davis, R. (2009). The "Haunt" Project: An Attempt to Build a "Haunted" Room by Manipulating Complex Electromagnetic Fields and Infrasound. *Cortex*, 45(5), 619-629.

Gauger, J.R., (1985). IEEE Transactions on Power Apparatus and Systems, PA-104, Sept, 1985.Silva, M.et al. (1988). IEEE/PES 1988 Winter Meeting, 88-WM-101-8.

Hill, S. A. (2010). *Being Scientifical: Popularity, purpose and promotion of amateur research and investigation groups in the U.S.* Mater's Thesis: University of Buffalo, State University of New York.

Hill, S. A, (2017). *Scientifical Americans: The culture of amateur paranormal researchers.* Jefferson, NC McFarland.

Houran, J. (2000). Toward a psychology of 'entity encounter experiences'. *Journal of the Society for Psychical Research*, 64(680), 141-158.

Houran, J. (2017). "Sheet happens!" Advancing ghost studies in the analytics age. *Australian Journal of Parapsychology, 18(1)*, 187-206.

Houran, J. & Brugger, P. (2000). The need for independent control sites: A methodological suggestion with special reference to haunting and poltergeist field research. *European Journal of Parapsychology*, 15, 30-45.

Houran, J., Lange, R., Laythe, B., Dagnall, N. Drinkwater, K, & O'Keeffe, C. (2019). Quantifying the phenomenology of ghostly episodes: Part II – A rasch model of spontaneous accounts. *Journal of Parapsychology*, *83*, 168-192.

Lange, R. & Houran, J. (1997). Context induced paranormal experiences: support for Houran and Lang's model of haunting phenomena. *Perceptual and Motor Skills,* 84, 1455-1458.

Lange, R. & Houran, J. (2001). Ambiguous stimuli brought to life: the psychological dynamics of hauntings and poltergeists. In J. Houran & R. Lange (Eds.), *Hauntings and poltergeists: Multidisciplinary perspectives* (pp. 280-306). Jefferson, North Carolina: McFarland & Company, Inc.

Layther, B. R. & Houran, J. (2019). Concomitant object movements and EMF-spikes at a purported haunt. *Journal of the Society for Psychical Research*, 83, 212-229.

Laythe, B. R. & Owen, K. (2013). A critical test of the EMF-paranormal phenomena theory: Evidence from a haunted site without electricity generating fields. *Journal of Parapsychology*, 77(2), 212-236.

Laythe, B. R., Laythe, E. C. & Woodward, L. (2017). A test of an occult-themed séance: Examining anomalous events, psychosomatic symptoms, transliminality, and electromagnetic fields. *Journal of Scientific Exploration*, 31(4), 572-624.

Mader, D. L., Barrow, D. A., Donnelly, R. R., Scheer, R. R. & Sherar, M. D. (1990). A simple model for calculating residential 60-Hz magnetic fields. *Bioelectromagnetics*, 11, 283-296.

Maher, M. C. & Hansen, G. P. (1997). Quantitative investigation of a legally disputed "haunted house." *The Parapsychological Association 40th Annual Convention, Proceedings of Presented Papers*, 337-346.

Maher, M. C. & Hansen, G. P. (1992). Quantitative investigation of a reported haunted using several detection techniques. *Journal of the American Society for Psychical Research*, 86, 347- 374.

Maher, M. C. (2000). Quantitative investigation of the General Wayne Inn. *Journal of Parapsychology, 64*, 365–390.

Miles, J and Shevlin, M (2001). Applying Regression and Correlation: A Guide for Students and Researchers. Sage:London.

Motulsky, H. (1995). *Intuitive Biostatistics.* New York, NY: Oxford University Press Ltd.

National Institute of Environmental Health Sciences & National Institutes of Health (2002). *EMF – Electric and magnetic fields associated with the use of electric power*. https://health.hawaii.gov/irhb/files/2013/12/NIEHS-EMF-Rapid-Booklet-2002.pdf

Nichols, A., & Roll, W. G. (1998). The Jacksonville water poltergeist: Electromagnetic and neuropsychological aspects [Abstract]. *Journal of Parapsychology, 62*, 110–111.

Parsons, S. T. (2015). *Ghostology: the art of the ghost hunter.* Hove, UK: White Crow Books.

Persinger, M. A. (1988). Increased geomagnetic activity and the occurrence of bereavement hallucinations: Evidence for melatonin-mediated microseizuring in the temporal lobe? *Neuroscience Letters*, 88, 271-274.

Persinger, M. A, Ludwig, H. W., & Ossenkopp, K. P. (1973). Psychophysiological effects of extremely low frequency electromagnetic fields: A review. *Perceptual and Motor Skills*, 36, 1131-1159.

Persinger, M. A, & Koren, S. A (2001). Predicting the characteristics of haunt phenomena from geomagnetic factors and brain sensitivity: Evidence from field and experimental studies. In J. Houran & R. Lange (Eds.), *Hauntings and poltergeists: Multidisciplinary perspectives* (pp. 179-194.). Jefferson, North Carolina: McFarland & Company, Inc.

Persinger, M. A., Koren, S. A., & O'Connor, R. P. (2001). Geophysical variables and behavior: CIV. Power frequency magnetic field transients (5 microTesla) and reports of haunt experiences within an electronically dense house. *Perceptual and Motor Skills*, 92, 673-673.

Persinger, M. A. & Schaut, G. B. (1988). Geomagnetic factors in subjective telepathic, precognitive, and postmortem experiences. *Journal of the American Society for Psychical Research*, 82, 217-235.

Potts, J. (2004). Ghost hunting in the twenty-first century. In J. Houran (Ed.), *From shaman to scientist: Essays on humanity's search for spirit's* (pp.211-232). Lanham, MD: Scarecrow Press.

Radford, B. (2017). Can electromagnetic fields create ghosts? *Skeptical Inquirer*. 41(3).

Radford, B. (2017). *Investigating ghosts: the scientific search for spirits.* Corrales, NM: Rhombus.

Roll, W. G., & Persinger, M. A. (2001). Poltergeist and nonlocality: Energetic aspects of RSPK [Abstract]. *Journal of Parapsychology, 62*, 118–119.

Silva, M.et al. (1988). IEEE/PES 1988 Winter Meeting, 88-WM-101-8.

Taylor, T. (2007). *Ghost hunter's guidebook: the essential guide to investigating ghosts and hauntings.* Decatur, IL: Whitechapel Press.

Terhune, D. B., Ventola, A., & Houran, J. (2007). An analysis of contextual variables and the incidence of photographic anomalies at an alleged haunt and a control site. *Journal of Scientific Exploration*, 21, 99-120.

Wiseman, R., Watt, C., Stevens, P., Greening, E., & O'Keeffe, C. (2003). An investigation into alleged 'hauntings'. *British Journal of Psychology*, 94,195-211.

Wiseman, R., Watt, c., Greening, E., Stevens, P., & O'Keeffe, C. (2002). An investigation into the alleged haunting of Hampton Court Palace. Psychological variables and magnetic fields. *Journal of Parapsychology*, 66,387-408.