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**An investigation into the alleged haunting of
Hampton Court Palace: Psychological variables and magnetic fields**

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Abstract

Hampton Court Palace is reputed to be one of the most haunted places in England, with both staff and visitors reporting unusual phenomena in many areas of the building. Our investigation aimed to discover the extent to which these reports were related to three variables often proposed to account for alleged hauntings, namely, belief in ghosts, suggestion and magnetic fields. Over 600 members of the public took part in the experiment. Participants completed Likert-type questionnaires measuring their belief in ghosts, the unusual phenomena they had experienced in the past and whether they thought these phenomena were due to ghosts. Participants who believed in ghosts reported significantly more unusual phenomena than disbelievers, and were significantly more likely to attribute the phenomena to ghosts. Participants then walked around an allegedly haunted area of the Palace and provided reports about unusual phenomena they experienced. Believers reported significantly more anomalous experiences than disbelievers, and were significantly more likely to indicate that these had been due to a ghost. Prior to visiting the locations, half of the participants were told that the area was associated with a recent increase in unusual phenomena, whilst the others were told the opposite. In line with previous work on the psychology of paranormal belief, the number of unusual experiences reported by participants showed a significant interaction between belief in ghosts and these suggestions. Results also provided partial support of a possible relationship between the locations in which participants reported their experiences and local magnetic fields. Competing interpretations of the data and possible future research are discussed.

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Introduction

Hampton Court Palace has been the home to some of Britain's most famous monarchs for over 500 years, and it is now one of the country's most popular historical attractions. The Palace has also gained a considerable reputation for 'ghostly' phenomena, and is frequently referred to as one of the most haunted places in England (see, e.g., Law, 1918; Underwood, 1971; Guiley, 1994). Perhaps the Palace's best known 'ghost' is that of Catherine Howard, the fifth wife of Henry VIII. Fifteen months after her marriage to the King in 1540, the queen was accused of adultery, arrested, found guilty and sentenced to death (Thurley, 1996). Legend suggests that upon hearing the news, Catherine Howard ran to the King to plead for her life, but was stopped by guards and dragged back along a section of the Palace now known as 'The Haunted Gallery' (Underwood, 1971, Guiley, 1994). By the turn of the century the Gallery had become associated with various unusual experiences, including sightings of a 'woman in white' and reports of inexplicable screams (Law, 1918). More recent visitors to the Gallery have reported other 'ghostly' phenomena, including a strong sense of presence, a feeling of dizziness and sudden changes in temperature (Franklin, 1998). Interestingly, The Haunted Gallery is not the only part of the Palace associated with such phenomena, with visitors and staff reporting similar experiences in several other areas of the building (Franklin, 1998). In early 2000 the Palace administrators invited RW to investigate why many people reported 'ghostly' activity within the building¹.

Belief in ghosts

Some past research has examined how people's belief or disbelief in the paranormal correlates with the way in which they perceive, interpret and report alleged paranormal phenomena (see, French, 1992, for a review). Some of this work has examined the relationship between belief in ghosts and reports of 'ghostly' phenomena. For example, Lange, Houran, Harte and Havens (1996) analysed a large sample of eyewitness reports of 'ghostly' encounters, and found that approximately thirty percent of witnesses expressed a prior belief in ghosts or other supernatural entity. Also, Lange and Houran (1998, 1999) administered questionnaires measuring belief in the paranormal and past levels of paranormal experiences to participants who had reported experiencing poltergeist phenomena. Path analysis indicated that participants' belief in the paranormal strongly affected their alleged paranormal experiences.

The initial part of the experiment built upon this work by examining the relationship between participants' prior belief in ghosts and the 'ghostly' phenomena they reported experiencing both in the past, and when walking through an allegedly haunted area of the Palace.

Participants first completed a questionnaire that measured their belief in the existence of ghosts, the frequency with which they had experienced eight types of unusual phenomena often associated with the existence of ghosts (e.g., unusual smells, sudden changes in temperature, a strong sense of presence etc.) and the degree to which they believed such experiences were caused by a ghost. On the basis of the previous work cited above, it was predicted that believers would report significantly more unusual experiences than disbelievers, and would be significantly more likely to attribute these experiences to ghosts.

Next, groups of participants walked around one of two allegedly haunted areas of Hampton Court Palace, and reported if they experienced any unusual phenomena. Participants reporting such

¹ The experiment also attempted to replicate previous studies that have claimed to obtain visual evidence of alleged 'ghostly' activity, and the results of this aspect of the study will be reported in a separate paper.

phenomena were asked to rate the degree to which they believed their experiences were caused by a ghost. Again, it was predicted that believers would report significantly more unusual experiences than disbelievers, and would be significantly more likely to interpret these experiences as being due to a ghost.

Suggestion

In their analysis of over 900 'ghostly' experiences, Lange et al. (1996) noted that approximately 60% of reports mentioned some form of prior suggestion that the location was haunted (e.g., rumours, advertising or prior knowledge of previous experiences reported in the location). Some researchers have argued that such suggestions may play a key role in causing people to misattribute mild psychosomatic and/or hallucinatory phenomena to paranormal activity (Houran & Lange, 1996; Houran & Williams, 1998).

To our knowledge, only one experiment has empirically tested this idea. Lange and Houran (1997a) had two groups of participants walk around a disused cinema and rate the degree to which it caused them to experience certain cognitive, physiological, emotional, psychic and spiritual phenomena. The experimenters suggested to half of the participants that the cinema had been the site of reports of paranormal activity, whilst the other half were told that the premises were currently under renovation and the research concerned people's reaction to the environment. Overall, participants in the 'paranormal' group reported significantly more physical, emotional, psychic, and mystical experiences than those in the 'renovation' group.

The present experiment was designed to further explore the 'suggestion' hypothesis. Prior to walking around one of two 'haunted' locations within the Palace, half of the participants were told that the location had recently been associated with an increased number of reports of unusual experiences (Positive Suggestion condition), whilst the other half were told that very few people had recently experienced anything unusual in the location (Negative Suggestion condition).

Participants were then asked to rate their expectations of experiencing any unusual phenomena during the experiment. It was predicted that participants in the Positive Suggestion condition would have significantly higher expectations than participants in the Negative Suggestion condition.

Participants then visited the 'haunted' location, reported any unusual phenomena they experienced and rated the degree to which they believed these experiences were caused by a ghost. It was predicted that participants in the Positive Suggestion condition would report significantly more phenomena than participants in the Negative Suggestion condition, and would assign significantly higher 'ghost' ratings to their experiences.

Previous work also suggests that people who believe in the paranormal may be more likely to be influenced by suggestion than disbelievers. For example, Irwin (1985) reported that people who tend to experience extrasensory perception and related phenomena tend to score highly on measures of hypnotic responsiveness. Also, Wiseman, Smith & Seager (1997) had participants attend a fake seance during which an actor suggested that a stationary table was levitating. Two weeks after the seance participants were asked to state whether they thought that the table actually levitated. Results revealed a significant interaction between prior belief in seance phenomena and suggestion, with more believers than disbelievers reporting movement of the table. Thus, it was also predicted that there would be a significant interaction between participants' prior belief in ghosts and the Suggestion conditions, for (i) participants' expectations of experiencing unusual phenomena, (ii) the number of unusual experiences they reported in the 'haunted' location and (iii) the degree to which they believed these experiences were due to a ghost.

Links with magnetic fields

Persinger (1985) argued that changes in geomagnetic fields (created, for example, by tectonic stresses in the Earth's crust) could stimulate the brain's temporal lobes and produce many of the subjective experiences associated with hauntings. In a preliminary test of this theory, Gearhart and Persinger (1986) examined large case collections of alleged hauntings, and reported finding significant relationships between the time of onset of unusual phenomena and sudden increases in global geomagnetic activity (for a critique of this and related work, see Wilkinson & Gauld [1993] and Rutowski [1984]). More recent support has come from several on-site investigations of alleged hauntings that have reported a high degree of local magnetic activity in locations associated with eyewitness reports of unusual phenomena (see, e.g., Roll & Nichols 2000). Finally, a third strand of evidence has involved laboratory studies in which stimulation of the temporal lobe with transcerebral magnetic fields has elicited subjective experiences that strongly parallel phenomena associated with hauntings (see e.g., Cook & Persinger, 1997; Persinger, Tiller, & Koren, 2000).

Some of the work arguing for a link between magnetic fields and unusual experiences has noted that the effect seems to be associated with high levels of geomagnetic activity (Halgreen, Walter, Cherlow, & Cranall, 1978; König, Fraser & Powell, 1981), whilst other researchers have related the effect more to gradients in static magnetic fields (see, e.g., Persinger, 1988; Nichols & Roll, 1999; Roll & Nichols, 1999). The present experiment was designed to test both of these hypotheses.

Participants reporting any unusual phenomena in the 'haunted' location within the Palace were asked to mark the locations of their experiences on a floorplan. These floorplans were then divided into several equally-sized areas. The mean strength and variance of the magnetic field within each of the areas was measured and subsequently correlated with the number of unusual phenomena reported by participants within that area. It was predicted that the sample mean of the resulting correlations would be significantly different from zero.

Researchers have also argued that people who display high levels of 'temporal lobe lability' may be more sensitive to the effects of geomagnetic activity than others (Makarec & Persinger, 1990; Persinger & Richards, 1994, 1995), and therefore more likely both to experience unusual phenomena and to believe in the paranormal (Neppe, 1983). On the basis of this work, it was predicted that the correlations between the measured magnetic fields and the unusual experiences reported by believers would be significantly higher than the corresponding correlations of disbelievers.

The above analysis could be biased by participants having previous knowledge of the areas within the Palace that are traditionally associated with reports of 'ghostly' phenomena. To assess the extent of possible bias, participants were asked to rate if they knew where previous witnesses had reported 'ghostly' phenomena within the two 'haunted' areas of the Palace used in the experiment.

Locations

The experiment took place at Hampton Court Palace (Surrey, England) between 27 May and 4 June 2000.

Participants listened to an initial talk about the study, and completed Questionnaire One (see below), in the Prince of Wales Closet - a quiet area of the Palace not usually open to the public. They were then taken to one of two locations within the Palace that had a considerable reputation for being haunted - The Haunted Gallery and The Georgian Rooms - and were asked to complete Questionnaire Two (see below).

The Haunted Gallery is located in the part of the Palace that would have originally contained Henry VIII's state apartments. It consists of an L-shaped corridor containing various early 16th century tapestries and paintings from the Royal Collection. The Georgian Rooms comprise of several rooms used by George II during the last visit of the full court to the Palace in 1737. The parts of this

location used during the study contained The Communication Gallery (a long gallery containing portraits of 'the most beautiful women at the court of Charles II') and The Wolsey Closet (a small paneled closet containing a highly ornate frieze and ceiling).

Questionnaires

Questionnaire One

There were two versions of this Questionnaire. Version A was administered to participants who were taken to The Haunted Gallery, whilst Version B was administered to those who were taken to The Georgian Rooms. The questionnaire consisted of five questions. The first three questions were identical for Versions A and B of the questionnaire.

Question One asked participants whether they believed in the existence of ghosts (definitely yes, probably yes, uncertain, probably no, definitely no). Question Two presented participants with a list of eight unusual experiences frequently associated with the presence of a ghost (an unusual change in temperature, sense of presence, sound or noise, sight, taste, smell, sense of dizziness, emotional feeling) and asked them to rate how often they experienced each of these phenomena (never, very infrequently, infrequently, frequently, very frequently). These eight items were based upon previous work examining the phenomena most frequently reported by people claiming to have experienced a ghost (see, e.g., Lange et al., 1996). Question Three asked participants to indicate whether they thought that the unusual phenomena that they had experienced in the past were due to a ghost (definitely yes, probably yes, uncertain, probably no, definitely no). Question Four noted that many people had reported having unusual experiences in either The Haunted Gallery (Version A) or The Georgian Room (Version B), and asked participants whether they had heard (e.g., from friends or the media) where in these locations these experiences had been reported (definitely yes, probably yes, uncertain, probably no, definitely no). Finally, Question Five asked participants if they expected to experience any unusual phenomena in The Haunted Gallery (Version A) or Georgian Rooms (Version B) during the experiment (definitely yes, probably yes, uncertain, probably no, definitely no).

Questionnaire Two

There were also two versions of this questionnaire. Version A was completed by participants who visited The Haunted Gallery whilst Version B was completed by participants who visited The Georgian Rooms. Version A contained a floorplan of The Haunted Gallery (Floorplan 1 in Appendix A) whilst version B contained a floorplan of The Georgian Rooms (Floorplan 2 in Appendix A). Both floorplans were kindly provided by the renovation department at Hampton Court Palace and were highly accurate. The questionnaire instructed participants to quietly walk around The Haunted Gallery (Version A) or The Georgian Rooms (Version B). If participants did not experience anything unusual then they were instructed to simply return the blank questionnaire. If participants did have an unusual experience then they were asked to place one or more crosses on the floorplan to indicate where their experience(s) occurred, write a brief description of their experience(s) and indicate whether they believed that their experience(s) were due to a ghost (definitely yes, probably yes, uncertain, probably no, definitely no).

Magnetic sensors

Local magnetic fields were measured using two Mag-03MS100 3-axis sensors feeding into a laptop computer via a Mag-03DAM Data Acquisition Module (Bartington Instruments, Witney, Oxford). This system had a measuring range of +/- 100uT with a resolution of 0.1nT, and recorded both static and dynamic components of the local field between 0 and 3kHz. Each sensor produced three streams of data, corresponding to the x, y and z axes of the local magnetic field, with a sampling rate of once per second. The three data streams were then combined to give the total field strength (using the formula $\sqrt{x^2 + y^2 + z^2}$), and the mean field strength and variance was calculated from the resulting values.

Procedure

Participants were self-selecting members of the public visiting Hampton Court Palace. On entering the Palace visitors were handed a booklet outlining various special week-long activities designed to celebrate the life and times of Catherine Howard. The experiment was described in this booklet as an opportunity to take part in an unusual research project concerned with the possible existence of ghosts. Members of the public interested in taking part in the experiment were invited to attend one of three daily sessions at 11.45, 14.15 and 15.15.

Each session involved a maximum of forty people and consisted of two parts. The first part took place in the Prince of Wales Closet. This room contained forty chairs that had been arranged into two groups of twenty. Prior to each talk, Version A of Questionnaires One and Two were placed onto twenty clipboards, and the clipboards placed onto one group of chairs. Version B of Questionnaires One and Two were placed onto another twenty clipboards and placed on the remaining group of chairs.

Once all participants were seated, RW explained the first four questions on Questionnaire One and allowed participants five minutes to complete these items. RW then briefly outlined the purpose and methodology of the experiment. In half of the talks he stated that The Haunted Gallery had been associated with a recent increase in reports of unusual experiences, but that few people had recently experienced anything unusual in The Georgian Rooms. This suggestion was reversed in the other half of the talks. Participants then rated their expectation of experiencing any unusual phenomena during the experiment by completing the final item on Questionnaire One.

Participants were then split into two groups and escorted by an assistant experimenter (CW, EG or CK) to either The Haunted Gallery or The Georgian Rooms. Once at the location participants were asked to quietly walk around the location and complete Questionnaire Two. Participants then returned this questionnaire to the assistant experimenter and were thanked for taking part in the study.

Mapping the magnetic fields

Prior to conducting the study, RW divided the floorplans of both The Haunted Gallery and The Georgian Rooms into 24 equally sized locations (see floorplans in Appendix A).

Due to understandable security and safety considerations, it was not possible to completely map the magnetic fields within all of the areas whilst the public were visiting the Palace. We did, however, obtain permission to carry out a partial mapping of 12 areas during the daytime and a complete mapping of all 48 areas during the evening.

The daytime measurements were made by PS between approximately 13.00 and 18.00 on 31 May in The Haunted Gallery, and between approximately 8.30 and 10.00 on 30 May in The Georgian Rooms. The mapping involved 6 areas in The Georgian Room (Areas 12, 13, 17, 18, 19, 21 on Floorplan 1 in Appendix A) and 6 areas in The Haunted Gallery (Areas 1, 3, 11, 12, 13, 14 on Floorplan 2 in Appendix A). These areas were agreed upon by RW and the Palace administration on the basis of two criteria. First, to maximise the chances of detecting any anomalies in the magnetic fields, many of the areas chosen were those associated with a large number of past reports of 'ghostly' activity. Second, to help minimise visitor disruption, the areas were not located in especially busy or narrow parts of the Palace. Third, to minimise the amount of time the equipment was in place, the areas were chosen such that they could be mapped in adjacent pairs. The sensors were placed onto stands that held them approximately 20cm above the floor and aligned with magnetic north. Magnetic data was recorded for thirty minutes in each area.

The evening mapping took place in The Haunted Gallery between approximately 18.00 and 23.00 on the 30th May, and in The Georgian Rooms between approximately 19.00 and 23.00. on the 2 June. The measurements in The Haunted Gallery were made by PS, whilst those in The Georgian Rooms were made by RW and EG. The 24 areas were, for the most part, mapped in pairs. Magnetic data was recorded for ten minutes in each area. PS was blind to the number of unusual experiences reported in each of the areas whilst setting-up and operating the magnetic field sensors.

Participants

678 participants attended one of the eighteen sessions (247 males and 430 females [1 missing data point]: mean age: 35.8 years, age range: 5 - 82 [11 missing data points]). Of these, 131 were excluded as they did not complete all of the items on Questionnaire One. A further 85 were excluded for not completing all of the items on Questionnaire Two. 462 participants remained (163 males, 299 females; mean age: 35.0, age range: 7 - 82). As the 18 groups of participants were assigned to one of the two conditions, there were a total of 36 groups of participants.

Results

Questionnaire One

The five questions were coded in the following way:

Responses to the question regarding the existence of ghosts were coded on a five point scale from 1 (definitely yes) to 5 (definitely no).

Unusual experiences: Each of the eight items concerned with the frequency with which participants had experienced unusual phenomena were coded from 1 (never) to 5 (very frequently).

Ghost Rating: Participants' beliefs concerning the degree to which their past unusual experiences were caused by a ghost were coded from 1 (definitely yes) to 5 (definitely no).

Prior knowledge: The degree to which the participants had heard which areas within each location had been associated with past reports of unusual experiences were coded from 1 (definitely yes) to 5 (definitely no).

Expectation: Participants' expectations of experiencing some unusual phenomena during the experiment were coded from 1 (definitely yes) to 5 (definitely no).

Participant classification

Each participant was classified as either a 'believer' or 'disbeliever' on the basis of a median split to the question concerning the existence of ghosts in Questionnaire One. A median split resulted in 237 participants being classified as believers (mean score=1.61, s.d.=.49) and 225 participants as disbelievers (mean score=3.89, s.d.=.66). The disbeliever group included 136 participants who had a belief score of 3. This classification was carried out by RW prior to any analyses comparing believers and disbelievers.

As there were no significant differences between responses from participants visiting The Haunted Gallery or The Georgian Rooms, responses to items within Questionnaire One were combined across the two locations.

Table 1 contain the means, standard deviations, t-values (unpaired) and p-values (2 tailed) for believers and disbelievers on the first four items within Questionnaire One. Believers reported experiencing seven of the unusual phenomena (emotional feelings, sense of presence, sounds, changes in temperature, smells, sights and tastes) significantly more frequently than disbelievers. They did not, however, report experiencing an unusual sense of dizziness significantly more frequently than disbelievers. Believers were also significantly more likely to interpret their experiences as being due to a ghost, and reported having a greater amount of prior knowledge about the areas associated with past unusual experiences than disbelievers.

	Believers (N=237)	Disbelievers (N=225)	t-value (unpaired)	p-value (2 tailed)
Unusual emotional feeling	2.90 (1.19)	2.47 (1.07)	4.09	.0001
Sense of presence	2.87 (1.05)	1.92 (.87)	10.52	.0001
Unusual sound	2.68 (1.20)	2.2 (.97)	4.72	.0001
Unusual temperature	2.46 (1.15)	2.04 (1.03)	4.16	.0001
Unusual dizzy feeling	2.22 (1.16)	2.08 (.96)	1.45	.1484
Unusual smell	2.02 (1.12)	1.65 (.95)	3.83	.0001
Unusual sight	1.87 (.95)	1.44 (.76)	5.33	.0001
Unusual taste	1.59 (.88)	1.35 (.71)	3.22	.0014
Ghost Rating	2.62 (1.02)	3.93 (.76)	-15.66	.0001
Prior knowledge	4.02 (1.30)	4.38 (1.10)	-3.16	.0017

Table 1: Mean score, standard deviations (in parentheses), t-values (unpaired) and p-values (2 tailed) for differences in believers and disbelievers on the first four items within Questionnaire One.

Table 2 contains the means, and standard deviations, for the expectation scores of believers and disbelievers in the Positive and Negative Suggestion conditions. A 2 x 2 factorial ANOVA revealed a significant main effect of belief ($F(1, 458)=49.91, p=.0001$), a non-significant main effect of suggestion ($F(1, 458)=2.67, p=.10$) and a non-significant interaction between belief and suggestion ($F(1, 458)=.01, p=.91$).

	Believers (N=237)	Disbelievers (N=225)	Overall mean
Positive Suggestion	3.50 (.87)	4.04 (.74)	3.78 (.85)
Negative Suggestion	3.38 (.85)	3.91 (.75)	3.62 (.85)
Overall mean	3.44 (.80)	3.98 (.75)	

Table 2: Means and standard deviations (in parentheses) for the expectation scores of believers and disbelievers in the Positive and Negative Suggestion conditions.

Questionnaire Two

Overall data

The 462 participants reported a total of 431 unusual experiences. 189 (43.8%) of these experiences were reported in The Haunted Gallery and 242 (56.2%) in The Georgian Rooms. 215 (46.5%) of participants reported at least one experience, and the mean number of experiences for participants reporting one or more experiences was 2.0 (s.d.=1.45).

Approximately two thirds of these experiences involved an unusual change in temperature. The remaining one third involved a mixture of phenomena including, for example, a feeling of dizziness, headaches, sickness, shortness of breath, some form of 'force', a foul odor, a sense of presence and intense emotional feelings.

The mean of the ghost rating was 3.39 (s.d.=.92), and the number and percentage of experiences receiving that each of the five ghost ratings are shown in Table 3.

Ghost Rating	Number of experiences	Percent
Definitely ghost	26	6.0
Probably ghost	55	12.8
Uncertain	170	39.4
Probably not ghost	155	36.0
Definitely not ghost	25	5.8

Table 3: Number and percentage of experiences receiving each of the five ghost ratings in Questionnaire Two.

Combining data

Each of the 36 groups completed Questionnaire Two after quietly walking around either The Haunted Gallery or The Georgian Rooms. Individual responses to the questionnaire cannot therefore be considered statistically independent as they may have influenced, and been influenced by, other members of the group. As a result, participants' responses to the questionnaire were combined within each of the thirty-six groups (see Rosenthal & Rosnow, 1991).

Coding data

The degree to which the participants believed that the experience was caused by a ghost was coded from 1 (definitely yes) to 5 (definitely no).

For each group the following dependent variables were then calculated:

Experiences: The total number of experiences reported divided by the number of participants reporting one or more experiences.

Ghost Rating: The total ghost rating divided by the number of participants reporting one or more experiences.

Group classification

Each group was classified as either 'believers' or 'disbelievers' on the basis of their responses to the question concerning the existence of ghosts in Questionnaire One. Responses to this question were coded on a five point scale from 1 (definitely yes) to 5 (definitely no). A median split resulted in 17 groups being classified as believers (mean score=2.21, s.d.=.19) and 19 groups as disbelievers (mean score=2.82, s.d.=.28). The disbeliever group included 2 groups who had a belief score of 2.5. This classification was carried out by RW prior to any analyses comparing believers and disbelievers.

As there were no significant differences between responses from participants visiting The Haunted Gallery or The Georgian Rooms, responses to items on Questionnaire Two were combined across the two locations.

Table 4 contains the means, and standard deviations, for the experiences reported by believers and disbelievers in the Positive and Negative Suggestion conditions. A 2 x 2 factorial ANOVA revealed a significant main effect of belief ($F(1, 32)=5.83, p=.02$), a non-significant main effect of suggestion ($F(1, 32)=1.37, p=.25$) and a significant interaction between belief and suggestion ($F(1, 32)= 4.33, p=.05$).

	Believer Group (N=17)	Disbeliever Group (N=19)	Overall mean
Positive Suggestion	2.59 (.34)	1.76 (.58)	2.04 (.64)
Negative Suggestion	1.99 (.54)	1.93 (.51)	1.97 (.51)
Overall mean	2.22 (.55)	1.83 (.55)	

Table 4: Means and standard deviations (in parentheses) for the mean number of unusual experiences reported by believer and disbeliever groups in the Positive and Negative Suggestion conditions.

Table 5 contains the means, and standard deviations, for the ghost ratings for believers and disbelievers in the Positive and Negative Suggestion conditions. A 2 x 2 factorial ANOVA revealed a significant main effect of belief ($F(1, 31)=4.26, p=.05$), a non-significant main effect of suggestion ($F(1, 31)=1.23, p=.27$) and a non-significant interaction between belief and suggestion ($F(1, 31)= .09, p=.76$).

	Believer Group (N=17)	Disbeliever Group (N=19)	Overall mean
Positive Suggestion	3.33 (.35)	3.61 (.45)	3.51 (.43)
Negative Suggestion	3.11 (.52)	3.48 (.36)	3.26 (.48)
Overall mean	3.20 (.46)	3.56 (.41)	

Table 5: Means and standard deviations (in parentheses) for the ghost rating reported by believer and disbeliever groups in the Positive and Negative Suggestion conditions.

Magnetic fields

Magnetic data was recorded in 12 areas during the daytime and in 48 areas in the evening. However, as naturally occurring magnetic fields show considerable diurnal variation, it was possible that the evening measurements would not reflect daytime activity. To examine this possibility, the mean field strength and variance obtained during the daytime were correlated with the values obtained in the same 12 areas during the evening mapping. Neither correlation was significant (Mean field strength: Spearman Rho= .38, p[2 tailed]=.20; Variance: Spearman Rho= .18, p[2 tailed]= .55), and thus it was decided to only use magnetic data obtained during the daytime mapping.

Mean field strength varied between approximately 42 uT and 50uT in The Georgian Rooms, and between 32uT and 51uT in The Haunted Gallery. Given that the Earth's magnetic field varies around approximately 50uT, these values are not unusually high or low.

The two floorplans shown in Appendix A were photocopied onto acetate and used to classify the location of each unusual experience. EG and CK classified the location of each experience, and both were blind to the results of the magnetic field measurements that had been made within each area.

Spearman Rank Correlation Coefficients were calculated between the number of experiences reported by each group of participants within each of the 12 areas, and mean field strength and variance. Groups reporting no experiences in the 12 areas used during the daytime mapping were dropped from these analyses. One sample t-tests were then used to examine whether the sample mean of these correlations differed significantly from zero. The results of these analyses are shown in Table 6. The Table also contains post hoc analyses of the data separated by location. Results suggest a significant positive relationship between the location of reported experiences and magnetic variance. Post hoc analyses suggested a significant relationship between mean field strength and location in The Haunted Gallery, and between the variance and location in The Georgian Rooms. However, these latter analyses should be treated with caution as they were carried out post hoc and based upon data from only 6 areas in each location.

Type of magnetic field measurement correlated with location of unusual experiences	df	Sample mean	t-value (1 sample)	p-value (2 tailed)
Overall				
Mean field strength	32	.06	.82	.42
Variance	32	.17	2.15	.04
The Haunted Gallery				
Mean field strength	15	.27	2.89	.01
Variance	15	.08	.63	.54
The Georgian Rooms				
Mean field strength	16	-.13	-1.21	.24

Variance	16	.25	2.65	.02
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Table 6: The df, sample mean, t-value and p-values (2 tailed) of one sample t-tests examining whether the correlations between locations of unusual experiences, and magnetic field measurements, differed significantly from zero.

As shown in Table 7, unpaired t-tests revealed no significant differences in the correlations between believers and disbelievers.

	Believers	Disbelievers	df	t-value	p-value(2-t)
Mean field strength	-.03 (.46)	.16 (.44)	31	-1.24	.22
Variance	.07 (.42)	.26 (.47)	31	-1.18	.24

Table 7: Means, standard deviations (in parentheses), df, t-value (unpaired) and p-values (2 tailed) for correlations between the locations of unusual experiences and magnetic field measurements, for believers and disbelievers.

Discussion

Past research into alleged hauntings has examined whether the reported phenomena were related to belief in ghosts, suggestion and both local and global magnetic environments. Our study aimed to discover whether these approaches could account for some of unusual phenomena reported at Hampton Court Palace.

Belief in ghosts

The experiment examined the relationship between participants' belief in ghosts, the frequency with which they reported experiencing unusual phenomena in the past and the degree to which they believed these experiences were due to a ghost. Consistent with previous psychological studies on paranormal belief, believers reported having experienced seven of the eight unusual phenomena significantly more often than disbelievers. They were also significantly more likely to attribute their experiences to ghosts. The only phenomenon not reported more frequently by believers was an unusual sense of dizziness.

These results provide further support for the notion that people who believe in ghosts report perceiving more 'ghostly' phenomena than others. This finding is open to two main interpretations. It is possible that the 'ghostly' experiences preceded and, to some extent, caused participants to believe in ghosts. Alternatively, participants who held a prior belief in ghosts may be more prone to report unusual experiences, and/or to interpret such experiences as being due to a ghost, than others. A second part of the project assessed this latter interpretation. Groups of participants were asked to walk around an area of Hampton Court Palace that was allegedly haunted, and report if they experienced any unusual phenomena. Participants reporting such phenomena were asked to rate the degree to which they believed their experiences were due to a ghost. As predicted, believers reported significantly more unusual experiences, and rated their experiences as significantly more likely to be caused by a ghost, than disbelievers. The size of these effects was non-trivial, as reflected in the fact that the experiment achieved significance despite having only 36 groups of participants and therefore relatively low statistical power. Again, this finding can be interpreted in many ways. For example, it is possible that believers' expectations led them to experience significantly more psychosomatic phenomena than others (Lange & Houran, 1997a). Indeed, many of these experiences resemble the same types of psychosomatic phenomena that Lange and Houran (1997a) induced by suggestion. Furthermore, these 'symptoms' are also found in many cases of contagious (mass) psychogenic illness, which Lange and Houran (1998, 1999) propose might be synonymous

with poltergeist outbreaks. An alternative interpretation centres around the notion that believers may be more sensitive to particular environmental factors than disbelievers (Thalbourne, 1998), and because of their belief system, misattribute such effects as being due to a ghost.

The next two parts of the experiment were designed to assess both of these hypotheses.

Suggestion

Half of the participants were placed in the Positive Suggestion condition (i.e., told that the 'haunted' area they were about to visit was associated with a recent increase in reports of unusual phenomena), whilst the other half were placed in the Negative Suggestion condition (i.e., told that the 'haunted' area they were about to visit was not associated with recent reports of unusual phenomena). This manipulation had no significant effect on participants' expectations of experiencing unusual phenomena during the experiment, the number of unusual experiences they reported or the degree to which they were attributed to a ghost. Clearly, these results could be interpreted as evidence against the suggestion hypothesis. Alternatively, various factors may have compromised the validity of the suggestion manipulation. For example, as noted in the Introduction, The Haunted Gallery has a considerable reputation for 'ghostly' phenomena, and participants may simply not have believed the suggestion that the Gallery was not associated with recent reports of unusual experiences. Also, the suggestion itself was quite subtle, and only made once during part of a fifteen minute talk about the experiment. Future work could investigate these issues by making any suggestion more explicit, and using 'haunted' locations that do not have such a strong reputation for being haunted.

It was also predicted that there would be a significant interaction between participants' belief in ghosts and the suggestion manipulation. These predictions were not confirmed for participants' expectation of experiencing unusual phenomena during the experiment or the degree to which they believed their experiences were caused by a ghost. However, the results did support the predicted interaction for the number of unusual experiences reported by participants walking around an allegedly haunted area of the Palace, with significantly more believers reporting experiences in the Positive Suggestion condition than disbelievers. Again, this result is open to several interpretations. First, given that it is the only prediction involving suggestion to reach significance, it may simply represent a chance finding. Alternatively, it may reflect support for the notion that believers are more influenced by the effects of suggestion than disbelievers (Irwin, 1985). This interpretation would coincide with Lange et al.'s (1996) finding that those with a prior belief in the paranormal tend to be primed to notice ghostly phenomena. Future research should attempt to tease apart these competing hypotheses by replicating the experiment with greater statistical power and, as noted above, employing a more explicit manipulation of suggestion.

Magnetic environment

Some researchers have argued that certain 'ghostly' phenomena are correlated with geomagnetic activity. Some of this work has suggested that the effect seems to be associated with high levels of geomagnetic activity, whilst other researchers have related the effect more to gradients in field strength. The results of our study provided partial support for both hypotheses. Results suggested a significant overall relationship between the location of experiences and variance of local magnetic fields. Post hoc analyses suggested a significant positive relationship between mean field strength and location in The Haunted Gallery, and a significant positive relationship between variance and location in The Georgian Rooms. These findings could be interpreted in several ways.

First, the significant findings may be the result of the magnetic measurements co-varying with another factor (e.g., visual features of the areas or participants' prior knowledge about the area) which, in turn, influenced the locations in which participants reported experiences. This interpretation is plausible, as the significant correlations were only found in one of the two locations, and thus based upon data from only 6 areas. Alternatively, the significant correlations may represent

a causal effect. If so, the results support the notions that both magnetic field strength and variance are positively associated with the reporting of unusual experiences. These interpretations can only be teased apart by attempting to replicate the analyses at other 'haunted' locations. Such work should both minimise the potential for co-variables such as participants' prior knowledge about the location, and should measure magnetic fields concurrent with participants visiting the location. The data did not support the hypotheses that the correlations for believers would be significantly greater than those of disbelievers, and thus provides no support for the notion that belief in ghosts is related to sensitivity for geomagnetic activity, mediated by temporal lobe lability. However, this analysis needs to be viewed in the context of the methodological issues discussed above. Future work should perhaps attempt to replicate the analyses using improved methodological procedures, and could also include self-report questionnaires designed to measure temporal lobe lability (see, e.g., Neppe, 1983).

Interestingly, the distribution of areas in which participants reported their unusual experiences was clearly non-random, with some areas being associated with far more reports than others. Repeated measures ANOVAs suggested highly significant differences in the numbers of reports associated with the areas in both The Haunted Gallery ($F[23, 391]= 2.60, p[2\text{ tailed}]<.0001$) and The Georgian Rooms ($F[23, 391]= 4.79, p[2\text{ tailed}]<.0001$). This finding could be interpreted in many ways. For example, it is possible that participants may have been influenced by their prior knowledge concerning the places in which previous witnesses had reported their experiences. Alternatively, the participants may have been responding to some form of environmental signal. Future work could examine other signals that might cause 'ghostly' phenomena, including, for example, presence of certain chemicals, subtle draughts, odors, electromagnetic fields and light levels. It is also possible that the effect may be caused by participants associating certain visual features of the room, (e.g., corners, staircases or doorways that conform to popular conceptions of haunted locations) with the presence of a ghost, and these expectations then becoming self-fulfilling prophecies by producing psychosomatic phenomena when the participants visited these areas. These are the type of context effects that Lange et al. (1996) referred to as 'embedded cues'. Houran (2000) also found that many of these context effects were present in many cases in his collection of 'entity encounter experiences'. Future work should examine which, if any, environmental factors and visual features may produce context effects.

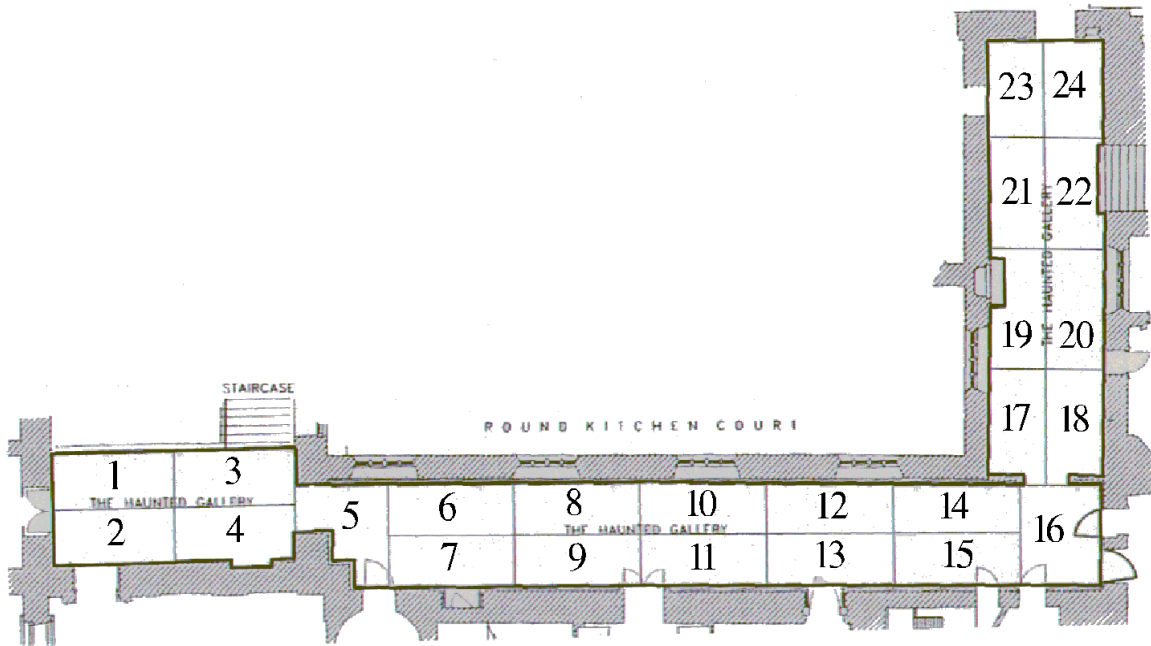
As noted at the start of this paper, Hampton Court Palace has a considerable reputation for being haunted. The results of this experiment suggest that this reputation is understandable, given that such a high percentage of participants reported experiencing unusual phenomena when walking through two allegedly haunted areas of the Palace. The experiment provided no support for the notion that the experiences could be explained by suggestion alone, and only modest evidence that magnet fields caused the experiences. However, clearly believers tended to report significantly more experiences than disbelievers, and those reports tended to cluster or focus in certain areas. We agree with Houran and Brugger (2000) that future studies need to examine the extent to which these findings generalise to other buildings that do, and do not, have a similar reputation for being haunted. This work also needs to investigate other mechanisms that may cause believers to report more experiences than disbelievers, and why people report phenomena in some areas, but not in others. Until such work provides clear-cut conclusions, the explanation of the 'ghostly' activity at Hampton Court Palace, and other allegedly haunted buildings, is likely to remain something of a mystery.

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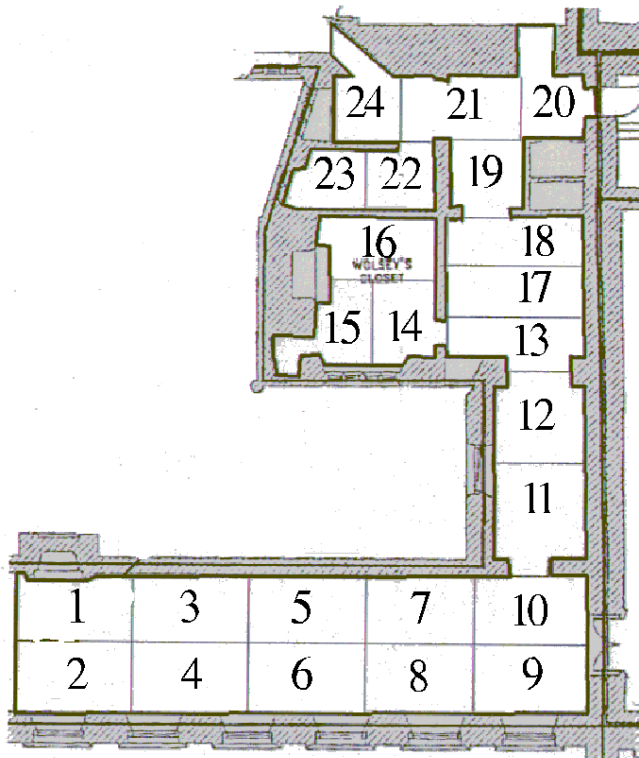
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Appendix A
Floorplans of The Haunted Gallery and The Georgian Rooms



Floorplan 1: The Haunted Gallery



Floorplan 2: The Georgian Rooms

