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Predictors of Hearing Electronic Voice Phenomena in Random Noise: Schizotypy, Fantasy Proneness, and Paranormal Beliefs[1]

Kenneth Drinkwater, Andrew Denovan, Neil Dagnall, and Andrew Parker

Manchester Metropolitan University

Abstract. This study used a modified White Christmas task to examine reports of electronic voice phenomena (EVP) within random noise. Following familiarization with the concept of EVP, 107 participants listened to an audio track combining white and pink noise. Instructions directed participants to press a keyboard button to indicate if they heard EVP. At the end of the track, participants provided an overall confidence rating of EVP perception. Thirty-nine participants (36%) reported the presence of EVP. Comparisons between EVP experiencers vs. non-experiencers on cognitive-perceptual (schizotypy, hallucinations, and fantasy proneness) and paranormal belief measures (general and haunting) revealed no significant differences. A path analysis indicated that belief in haunting mediated the relations between paranormal belief and hallucination proneness with EVP outcomes (number and confidence). However, fantasy proneness and schizotypy did not have significant relations with EVP. Results were consistent with previous findings, where participants imagine hearing the famous White Christmas song. Within this study, a non-trivial minority of participants experienced EVP as a form of belief congruent hallucination. These findings support the notion that anomalous beliefs provide a framework for structuring unusual cognitions and perceptions.
Keywords: Auditory hallucinations, belief in the paranormal, Electronic Voice Phenomena, fantasy proneness, White Christmas task.

Electronic voice phenomena (EVP) refer to the presence of anomalous speech-like sounds in recordings containing background or static noise (MacRae, 2004). Some believers in the paranormal posit that EVP represents a process by which the "normally" unheard voices of the dead or discarnate entities become audible via electronic media (MacRae, 2004). Interest in EVP historically derives from spiritualist attempts to communicate with the deceased (Alvarado, 2003). EVP has entered general awareness as evidenced by it featuring prominently in mainstream ghost hunting television programs (e.g., Ghost Hunters), where investigators typically claim that EVP provides objective evidence of paranormal activity.

Recognizing a distinction between continuously present and transient voices, Leary and Butler (2015) identified two types of EVP. Type 1 (transform) delineates intermittent EVP, whereas type 2 (live-voice or radio voice) describes persistent EVP. With Type 1, although people are present at the time of

1 Address correspondence to: Dr. Kenneth Drinkwater, Department of Psychology, Manchester Metropolitan University, Brooks Building, 53 Bonsall Street, Manchester, M15 6GX, UK, K.Drinkwater@mmu.ac.uk

recording, perception of EVP occurs only during playback. In contrast, type 2 EVP is enduring and audible via electronic equipment (e.g., spirit box).

Researchers attribute the origin of contemporary EVP work to Raymond Bayless and Attila von Sealay (or Szalay) (Bayless, 1959). Later, Raudive amassed a significant number of voice recordings produced by seemingly paranormal (unexplained) sources (Raudive, 1971). Critics, however, argue that this formative work lacked methodological rigor (Leary & Butler, 2015). Explicitly, using Raudive's method, Smith (1974) was unable to eliminate mundane explanations such as word recognition arising from imagination, or sounds caused by foreign language stations (Keil, 1980). Further attempts to replicate Raudive's findings have also proved unsuccessful (Barušs, 2001).

Despite this, advocates of EVP point to myriad instances in which contemporary electronic communication devices (e.g., mobile telephones, televisions, and computers) have captured alleged voices, texts, and images. Observation of this phenomenon has led to the development of the term instrumental transcommunication (ITC). ITC signifies communication with deceased persons through instruments or technical devices (Laszlo, 2008). Paralleling EVP research, the study of ITC suffers from methodological issues (Boccuzzi & Beischel, 2011). Particularly, independent observers within controlled settings are not able to replicate findings, and researchers often fail to provide detailed experimental protocols. Accordingly, skeptics explain EVP using conventional explanations, such as apophenia (perceiving patterns in random information), erratic equipment functioning, and hoaxes (Leary & Butler, 2015).

Paranormal Belief and The Tendency to see Meaningful Patterns within Noise

Believers in the paranormal are prone to interpret causal relations within random stimuli (Dagnall et al., 2016, 2016a; Nees & Phillips, 2015). Correspondingly, Blackmore and Moore (1994) reported that higher levels of belief were associated with the willingness to make positive identifications of pictures with a high degree of background visual noise. This propensity manifests at both a cognitive and perceptual level.

Cognitively, believers in the paranormal are susceptible to statistical biases, particularly, misrepresentation of chance (Dagnall et al., 2016). Hence, believers are more likely to infer relations between unconnected events. Perceptually, believers in paranormal phenomena are more liable to interpretative bias, such as pareidolia (Riekki et al., 2013). Pareidolia is a specific form of apophenia denoting the perception of meaningful sounds or images in arbitrary stimuli.

Illustratively, Riekki et al. (2013) using a signal detection task found that believers in the paranormal (vs. non-believers) possessed a more liberal response bias. Specifically, believers identified ambiguous stimuli as 'face-like', but did not differ in degree of detection sensitivity. Similarly, Van Elk (2013) reported that believers (vs. skeptics) demonstrated a bias toward illusory perceptions of human motion. Collectively, these studies indicate that belief in the paranormal is associated with the tendency to infer agency in ambiguous stimuli (Nees & Phillips, 2015). Explicitly, that expectation and previous knowledge (top-down processing) facilitate incorrect interpretation of indiscriminate audio and visual noise (Nees & Phillips, 2015). Skeptics contend that this research is consistent with the notion that EVP is a form of auditory pareidolia ("Rorschach Audio") arising from the tendency to interpret random data as voices (Banks, 2012).

In this context, paranormal belief may provide a framework with which to interpret ambiguous stimuli. Particularly, beliefs influence cognitive-perceptual processes in such a way to produce interpretations consistent with the existence of paranormal phenomena (Houran & Lange, 1996). This includes searching for anomalies, labeling events as paranormal and deducing that irregularities provide evidence for supernatural forces (Houran & Lange, 1996). For example Terhune and Smith (2006), using a mirror-gazing task (psychomanteum), demonstrated that individuals given suggestions for anomalous experiences reported a greater number of visual and vocal hallucinations. Relatedly, Beck and Rector (2003) observed that patients with strong paranormal beliefs interpreted hallucinatory voices in a belief congruent manner.

Consistent with this view, researchers have noted that belief in the paranormal is associated with a range of cognitive-perceptual measures related to unusual perceptions, magical ideations, and distorted perception of causality (Cella et al., 2012). These include factors associated with productive experiences and perceptions (i.e., schizotypy, Dagnall et al., 2016; fantasy proneness, Smith, Johnson, & Hathaway, 2009; delusion-hallucination proneness, Lawrence & Peters, 2004).

The White Christmas Paradigm

Numerous studies report hallucination proneness within non-clinical populations, although incidence varies as a function of question phrasing and definition used. Allowing for disparities, Beck and Rector (2003) observed that between 4-24% of the population experience auditory hallucinations. Furthermore, within large samples approximately 10% of respondents report hallucinations (Bentall & Slade, 1985a).

Correspondingly, Bentall and Slade (1985b) found that 15% of participants reported hearing a voice when no voice was present, and 17% stated that they often heard their thoughts as if spoken aloud. These findings were consistent with research using suggestion, notably the White Christmas task. This involves asking participants to close their eyes and listen to a stimulus that is actually not present (e.g., the White Christmas song) (Barber & Calverley, 1964). Under these conditions, a significant proportion of non-clinical participants report perceiving a non-existent stimulus (Bowers, 1967; Spanos & Barber, 1968; Spanos & Stam, 1979).

More recently, Merckelbach and van de Ven (2001) used an adapted White Christmas task[2] with a group of 44 undergraduate students. Participants listened to white noise and pressed a button when they believed they heard the Bing Crosby version of White Christmas. Within the sample, fourteen participants (32%) responded at least once. Analysis revealed that participants who reported hearing White Christmas scored higher on fantasy proneness and the Launay–Slade Hallucination Scale (LSHS) (Bentall & Slade, 1985a). Further analyses revealed that fantasy proneness was the best predictor of experiences.

Van de Ven and Merckelbach (2003) extended the earlier findings with an undergraduate sample, in which 35% of participants indicated that they had heard the White Christmas song. Those reporting hallucination(s) had significantly higher fantasy proneness scores. However, scores on hallucination proneness and schizotypy did not differ significantly.

2 There are several versions of the White Christmas paradigm. Within the Merckelbach and van de Ven (2001) study participants were told that the song might be embedded in white noise below the auditory threshold.

Our study used the White Christmas task to examine the degree to which participants report the presence of EVP within random noise. In line with previous research it was anticipated that around a third of the sample would hear meaningful sounds (EVP) (Merckelbach & van de Ven, 2001; van de Ven & Merckelbach, 2003). Additionally, this study investigated whether EVP experiencers (vs. non-experiencers) differed on cognitive-perceptual personality factors and belief in the paranormal (Nees & Phillips, 2015). In order to compare outcomes with those observed in previous studies the cognitive-perceptual personality factors comprised constructs employed by Merckelbach and van de Ven (2001) and van de Ven and Merckelbach (2003), particularly, propensity to hallucination, fantasy proneness, and schizotypy.

Preceding research has consistently reported that experiencers of the White Christmas song score higher on fantasy proneness (Merckelbach & van de Ven, 2001; van de Ven & Merckelbach, 2003), whereas differences in propensity to hallucination (Merckelbach & van de Ven, 2001) have not always been reproduced (van de Ven & Merckelbach, 2003). Moreover, van de Ven and Merckelbach (2003) failed to find differences on schizotypy.

Given inconsistent outcomes and the fact that the EVP and White Christmas tasks differ, this study examined whether experiencers (vs. non-experiencers) demonstrated differences across cognitive-perceptual measures. Accordingly, outcomes will add incrementally to those of earlier work and help to identify the conditions under which hallucinatory vs. imaginational experiences are most likely to occur. Hence, the researchers predicted cautiously higher scores for experiencers (vs. non-experiencers).

Finally, measures of paranormal belief were included (general and haunt-related). Inclusion of these factors allowed the researchers to assess the degree to which paranormal beliefs influenced EVP perception. Specifically, it facilitated testing of the assumption that unequivocal beliefs (i.e., the existence of ghosts) provide a framework for structuring unusual cognitions and perceptions (Dagnall et al., 2016). Compatible with this notion, and consistent with Williams and Irwin's (1991) supposition that belief in the paranormal facilitates organization and interpretation of atypical phenomena, the authors predicted that belief in haunting would best predict EVP perception and mediate relations between cognitive-perceptual factors, general paranormal belief, and EVP. Examining mediation in this context provided an explicit assessment of whether paranormal belief structured interpretation of ambiguous auditory stimuli.

Method

Participants

One hundred and seven participants took part in this study. The sample comprised 33 (30%) males (M = 31.36, SD = 12.40) and 74 (70%) females (M = 27.08, SD = 12.39); 71 participants were students (60 undergraduates and 11 postgraduates) and 36 non-students. Recruitment was via *the* Manchester Metropolitan University (MMU) Psychology Participant Pool and opportunity sampling (other university students and staff). Prior to participation, questions established that participants were at least 18 years of age, possessed normal hearing levels, and had not undertaken involvement with other electronic voice phenomenon (EVP) studies.

A female postgraduate research student, aged 38 years was the sole experimenter in the study. She possessed moderate belief in psi as a paranormal phenomenon, which represents 4 on a 1-5 scale (5 being strong belief). The research student advertised the study within the host university via flyers posted on notice boards, student/staff email, the Psychology Department Participation Pool, and social media. Recruitment information invited potential participants to take part in a two-phase study. The first required completion of self-report measures on beliefs/attitudes towards paranormal phenomenon and cognitive-perceptual personality measures. The second involved listening to short sound clips of background noise on a computer and reporting detection of voices.

The ethics process in the Psychology Department designated the project as routine and approved the study accordingly. Hence, formal submission to a second-tier ethics panel was not required. Prior to agreeing to contribute, potential participants read the study brief, this informed them of the study requirements, and stated that the research protocol adhered to The British Psychological Society Code of Human Research Ethics guidelines. Participants provided informed consent before participation.

Materials

Background visual and audio. To ensure that participants were familiar with EVP prior to the listening task, they watched video and listened to audio examples. Visual segments comprised three instances, lasting approximately two minutes, taken from the television show Ghost Adventures, which is readily available on the internet. Audio instances included excerpts from The Ghost Orchid: An Exploration of EVP, CD recordings from Raudive (1971) and Cass (1959), and the website of researcher Randall Keller (https://thevoicesblog.wordpress.com/) (Kellar, 2012). Text supporting messages appeared on the computer monitor as the audio played. In total, the audio was approximately three minutes in duration.

Stimulus audio track. A three minute stereo audio track combining white and pink noise was created using Audacity (version 2.1.0.). White noise (random signals possessing equal intensity at different frequencies) is predictable and consistent, whereas pink noise (random noise with equal energy per octave) is an algorithm of sound that corresponds more closely to human hearing curves. The mixture of white and pink noise produced a subtly varying, meaningless sound. Audio task presentation occurred via a desktop computer. PsychoPy software (version 1.82.01) controlled and regulated material throughout the auditory task. To eliminate external noise and ensure that volume levels were appropriate participants wore high specification headphones. Participants indicated when they heard EVP by pressing a keyboard space bar. At the end of the audio track, via a visual analogue scale (VSA) (0-100%), participants provided an overall confidence rating of EVP perception.

Cognitive-perceptual measures

Schizotypy. The Schizotypal Personality Questionnaire Brief (SPQ-B) (Raine & Benishay, 1995) is a shorter version of the 74-item Schizotypal Personality Questionnaire (SPQ) modeled on the DSM-III-R criteria for Schizotypal Personality Disorder (SPD) (Raine, 1991). SPQ scales assess schizotypal personality disorder, or dimensional schizotypy in non-clinical samples (Jahshan & Sergi, 2007). The SPQ-B contains 22 questions comprising three sub-scales: cognitive-perceptual, interpersonal, and disorganization. Items appear in the form of statements. For example, “People sometimes comment on my

unusual mannerisms and habits." Participants answer each item with a "yes" or "no" response. Totaling yes responses produces scores ranging from 0-22; upper scores signify higher levels of schizotypy. The SPQ-B possesses established psychometric properties (i.e., internal consistency, test–retest reliability, and criterion validity) (Raine & Benishay, 1995).

Hallucination Proneness. The Launay-Slade Hallucination Scale Revised (LSHS-R) (Bentall & Slade, 1985a) assesses the inclination to hallucinate in normal individuals. The measure assumes that hallucination experience exists on a continuum of psychological functioning. The LSHS-R contains 12 items, which index visual and auditory hallucinations. For instance, "On occasions I have seen a person's face in front of me when no one was in fact there" and "In my daydreams I can hear the sound of a tune almost as clearly as if I were actually listening to it." Items appear as statements and respondents indicate the degree to which they endorse each item on a 5-point scale, from certainly does not apply = 0 to certainly applies = 4. Total scores range from 0 to 48; higher scores indicate a greater predisposition to hallucination-like experiences. The LSHS-R possesses satisfactory psychometric properties (Jones et al., 2009; Dagnall et al., 2015).

Fantasy Proneness. The Creative Experiences Questionnaire (CEQ) (Merckelbach, Horselenberg, & Muris, 2001) comprises 25 dichotomous items indexing fantasy proneness that originated from case descriptions of fantasy proneness (Wilson & Barber, 1983). Items appear as statements (e.g., "In general, I spend at least half of the day fantasizing or daydreaming"), and participants respond to each statement with "yes" or "no." Hence, total scale scores range from 0-25 with higher scores representing greater propensity to fantasy proneness. The CEQ demonstrates good test-retest and internal reliability (Merckelbach et al., 2001).

Belief in the Paranormal. The Australian Sheep-Goat Scale (ASGS) (Thalbourne & Delin, 1993) measures belief in and alleged experience of, extrasensory perception, psychokinesis, and life after death. The ASGS contains 18 items, for example, "I believe in the existence of ESP" and "I believe I have marked psychokinetic ability." Participants respond to each item on a three-point scale (false = 0, uncertain = 1, and true = 2). Raw scores range from 0-36, with higher scores indicating greater levels of belief in the paranormal. The ASGS designates believers as *sheep* and non-believers as *goats*. Drinkwater et al., (2018) in a recent review of the ASGS reported the scale possesses high reliability, $\alpha = 0.90$.

Haunting and Communication with the Dead Scale. The 8-item Haunting and Communication with the Dead Scale (Dagnall, Parker, Munley, & Drinkwater, 2010) assesses participants' belief in the existence of ghosts, haunted locations, and the possibility of contacting the dead. Statements include "Some places are haunted by the souls of people now dead." Participants indicate agreement with each item on a 7-point Likert scale ranging from 1 = strongly disagree to 7 = strongly agree. Scores range from 8 to 56 with higher scores indicating greater belief in ghosts and haunt-related phenomena. The scale has previously demonstrated excellent internal reliability (Dagnall et al., 2010).

Scale Properties

In the present study, the paranormal measures (ASGS and Haunting Scale) demonstrated excellent internal reliability, Cronbach's alpha (α) = 0.91 and 0.94 respectively. The SPQ-B ($\alpha = 0.80$) and the

LSHS-R (α = 0.84) possessed good internal reliability. The CEQ (α = 0.77) also demonstrated adequate reliability (see table 1 for descriptive statistics).

Procedure

To ensure that participants could hear sounds using the headphones, the researcher asked participants to listen to and respond to a series of tones (sound calibration). During this standardization phase, participants could adjust the sound to an appropriate level, where they could clearly detect the tones. EVP familiarization followed and involved watching, via a desktop computer, film of paranormal investigators detecting alleged EVP and then listening to auditory examples.

Before commencement of the test phase, the researcher administered instructions that asked participants to relax, close their eyes, and focus on the recording. Next, the researcher told participants to press the space bar whenever they perceived meaningful audible sound. Once participants confirmed that they understood the instructions, they placed the headphones over their ears and the researcher started the audio track. On completion of the track, participants indicated on a visual analogue scale (0-100) how confident they were that they had heard EVP.

After a break of five minutes, the researcher asked participants to fill in the self-report measures. Participants accessed the scales via a Qualtrics link on the desktop computer. Instructions directed participants to work through the measures at their own pace, complete all questions, and respond honestly. Additional ethical detail reaffirmed confidentiality and that participants could withdraw at any point during the study.

The measures comprised sections on demographic information (i. e., age, preferred gender, and course/occupation), belief in the paranormal, and cognitive-perceptual measures (schizotypy, hallucinations, and fantasy proneness). For the self-report measures, counter-balancing across participants prevented order effects. At the end of the testing session, the researcher debriefed participants and thanked them for engaging with the research.

Results

Analysis

Preceding analysis, screening for outliers and non-normality occurred. Following inspection of descriptive statistics, tests of difference for EVP detection and zero-order correlations, and path analysis (Amos 25) tested hypothesized relationships among the study variables using Maximum Likelihood (ML) estimation. Analyses specifically tested whether belief in haunting mediated relationships between cognitive-perceptual factors, general paranormal belief, and EVP.

In the model, exogenous variables were the cognitive-perceptual factors (schizotypy, propensity to hallucination, and fantasy proneness) and paranormal belief. The proposed mediator was belief in haunting, with EVP rating (confidence) and EVP number representing endogenous variables.

The χ^2-distributed goodness-of-fit statistic assessed omnibus model (global) fit, with non-significant results indicative of good fit. Additionally, judgment of fit considered the comparative fit index (CFI), root-mean-square error of approximation (RMSEA), and the standardized root-mean-square residual (SRMR), with cut-offs more than 0.95 for CFI and less than 0.08 for RMSEA and SRMR (Browne & Cudeck, 1993). Assessment of fit for RMSEA also examined 90% confidence intervals (CI).

Following scrutiny of the omnibus model, hypothesis testing (local fit) involved appraising the standardized path coefficients with an established $p < 0.05$. The analytic procedure of bootstrapping tested indirect effects (mediation) by resampling the data 1000 times to create bias-corrected 95% confidence intervals. Akaike Information Criterion (AIC) compared models, with lower values indicating better fit.

EVP Incidence

Of the 107 participants who took part in the auditory task, 39 (36%) pressed the button to indicate they heard EVP in the soundtrack. The remaining participants, 68 (64%) did not report EVP. Number of space bar presses indicated frequency of EVP detection and EVP rating specified level of response confidence. Within the EVP group, the mean number of EVP responses (*M*) was 3.31 with a standard deviation (*SD)* of 2.76. The mean confidence rating was *M* = 30.31, *SD* = 18.49.

Table 1.
Descriptive statistics

	Mean	*SD*	**Minimum**	**Maximum**	**Skew**	**Kurt**
Cognitive-Perceptual						
SPQ-B	8.24	4.61	0.00	17.00	0.14	-0.79
LSHS-R	16.02	8.73	0.00	37.00	0.25	-0.64
CEQ	8.38	4.34	0.00	18.00	0.21	-0.63
Paranormal						
ASGS	12.03	8.27	8.10	32.00	0.40	-0.81
Haunting	31.93	13.94	8.00	56.00	-0.16	-1.04

Note. SPQ-B, Schizotypal Personality Questionnaire Brief; LSHS-R, Launay-Slade Hallucination Scale Revised; CEQ, Creative Experiences Questionnaire; ASGS, Australian Sheep Goat Scale; Haunting, Haunting and Communication with the Dead Scale.

Tests of difference

Table 1 displays descriptive statistics. A series of independent *t*-tests examined differences between EVP experiencers (vs. non-experiencers) on cognitive-perceptual (SPQ-B, LSHS-R and CEQ) and paranormal belief measures (ASGS and Haunting). These revealed no significant differences after Bonferroni correction for multiple comparisons of $p = 0.010$ (see table 2).

Table 2.
Tests of difference for EVP detection

	EVP							
	Yes		**No**					
	M	*SD*	*M*	*SD*				
Measures	(*n* = 39)		(*n* = 68)		*t*	*df*	*d*	*p*
Cognitive-Perceptual								
SPQ-B	7.62	4.92	8.60	4.42	-1.07	105	0.21	0.29
LSHS-R	17.33	9.94	15.26	7.93	1.18	105	0.23	0.24
CEQ	8.05	4.28	8.57	4.39	-0.59	105	0.12	0.55
Paranormal								
ASGS	13.18	8.73	11.37	7.99	1.09	105	0.22	0.28
Haunting	35.74	14.54	29.75	13.16	2.18	105	0.43	0.03

Note. SPQ-B, Schizotypal Personality Questionnaire Brief; LSHS-R, Launay-Slade Hallucination Scale Revised; CEQ, Creative Experiences Questionnaire; ASGS, Australian Sheep Goat Scale; Haunting, Haunting and Communication with the Dead Scale.

EVP detection and scales

Pearson's Product correlation examined relationships between EVP measures (number and rating) and scales (Haunting, ASGS and LSHS-R) (see table 3).

Table 3.
Inter-measure correlations

	1	**2**	**3**	**4**	**5**	**6**	**7**
1. EVP Number							
2. EVP Rating	0.71**						
3. SPQ-B	0.01	0.00					
4. LSHS-R	0.22*	0.16	0.56**				
5. CEQ	0.07	0.02	0.48**	0.48**			
6. ASGS	0.12	0.23*	0.28**	0.42**	0.28*		
7. Haunting	0.27*	0.35**	0.20*	0.44**	0.18	0.71**	

Note. SPQ-B, Schizotypal Personality Questionnaire Brief; LSHS-R, Launay-Slade Hallucination Scale Revised; CEQ, Creative Experiences Questionnaire; ASGS, Australian Sheep Goat Scale; Haunting, Haunting and Communication with the Dead Scale; *$p < 0.05$, **$p < 0.001$

A large positive correlation existed between EVP number and EVP Rating. EVP number was weakly positively associated with belief in haunting and LSHS-R. Significant positive correlations were evident between EVP Rating and level of paranormal belief (ASGS) and belief in haunting.

The cognitive-perceptual measures (SPQ-B, LSHS-R, and CEQ) all correlated positively with one another. Finally, the paranormal belief measures were strongly positively associated, and correlated positively with SPQ-B and LSHS-R. CEQ was associated with only ASGS; there was no significant correlation between CEQ and haunting.

Model test

Prior to path analysis, assessment of normality (multivariate and univariate skewness and kurtosis) determined whether ML estimation was apposite. Based on Bollen (1989), a Mardia's coefficient less than $p(p + 2)$ (p is the quantity of observed variables) indicates multivariate normality. Mardia's coefficient was 8.69, which was considerably lower than 63, revealing acceptable normality. Furthermore, all univariate skewness statistics were less than 3.0 and univariate kurtosis values were below 7.0 inferring univariate normality (Finney & DiStefano, 2006).

The initial mediation model demonstrated poor overall fit, χ^2 (1, N = 107) = 66.49, $p < .001$, CFI = .74, RMSEA = 0.79 (90% CI of 0.63 to 0.95), SRMR = 0.11. Correlating the error term between EVP Number and EVP Rating, and eliminating the non-significant paths from schizotypy and fantasy proneness to haunting produced very good fit across indices, χ^2 (2, N = 107) = 2.99, p = 0.224, CFI = 0.99, RMSEA = 0.07 (90% CI of 0.01 to 0.09), SRMR = 0.02.

Inspection of the paths (Figure 1) revealed hallucination proneness and paranormal belief significantly predicted greater belief in haunting (β = 0.17, p = 0.021 and β = 0.64, $p < 0.001$ respectively). Belief in haunting predicted higher EVP Number and EVP Rating (β = 0.35, p = 0.008 and β = 0.31, p = 0.021 respectively). Neither schizotypy, fantasy proneness, paranormal belief, nor hallucination proneness predicted EVP outcomes. However, a test of mediation revealed significant indirect effects of paranormal belief (95% CI of 0.04 to 0.44, p = 0.021) and hallucination proneness (95% CI of 0.01 to 0.15, p = 0.032) on EVP Rating through belief in haunting. Similarly, there existed significant indirect effects of paranormal belief (95% CI of 0.04 to 0.41, p = 0.025) and hallucination proneness (95% CI of 0.01 to 0.16, p = 0.039) on EVP Number through belief in haunting. Variables explained 13% of the variance in EVP Rating and 11% of the variance in EVP Number.

As the study was cross-sectional, an alternative model examined reverse relations by inversing the paths between exogenous (cognitive-perceptual factors and paranormal belief) and endogenous variables (EVP outcomes). This model demonstrated weaker data-model fit, χ^2 (3, N = 107) = 7.48, p = 0.058, CFI = 0.98, RMSEA = 0.12 (90% CI of 0.01 to 0.23), SRMR = 0.05. Importantly, this existed after following analysis recommendations and correlating error terms among cognitive-perceptual factors. The explanatory variables accounted for 4% of fantasy proneness variance, 21% of hallucination proneness

variance, 4% of schizotypy variance, and 52% of paranormal belief variance. The constrained model had a lower AIC (68.99) than the reversed model (71.48), indicating superior fit.

Overall, the results revealed that belief in haunting mediated the relations between paranormal belief and hallucination proneness with EVP outcomes (number and rating). Fantasy proneness and schizotypy did not demonstrate any meaningful relation with EVP.

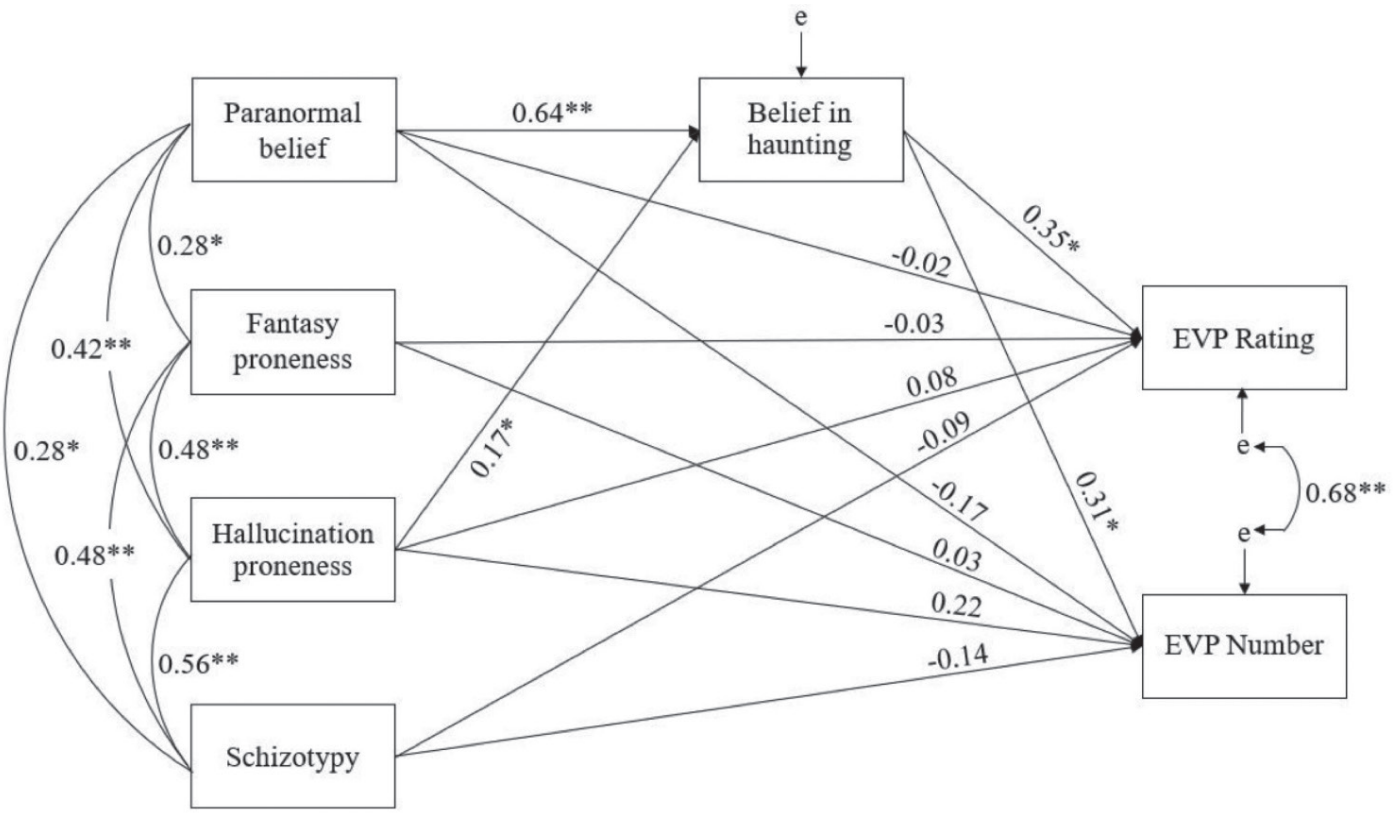

Figure 1. Path model depicting putative relationships between cognitive-perceptual factors, paranormal belief, belief in haunting and EVP outcomes. *Note.* Standardized regression coefficients and correlations between variables are shown; 'e' indicates error; * $p < .05$, ** $p < .001$

Discussion

Within this study, a non-trivial minority of participants (36%) indicated that they heard meaningful sounds (EVP) within random noise. This false detection rate accorded with previous research examining hallucinatory experiences in non-clinical samples. Specifically, reporting rate was comparable with Merckelbach and van de Ven (2001) and van de Ven and Merckelbach (2003) who, using the White Christmas task, observed that approximately one third of participants (32% and 35% respectively) imagined hearing the classic song when it was not present. The figure aligns also with Terhune and Smith's (2006) mirror-gazing study, in which between 20% (controls) and 40% (suggestion condition) of participants reported vocal hallucinations. More generally, the tendency to perceive non-present stimuli concurred with studies reporting moderate levels of hallucination proneness within non-clinical populations (between 4% and 24%) (cf. Beck & Rector, 2003; Bentall & Slade, 1985a).

In addition to this, the current study observed a weak correlation (r = 0.35) between EVP recognition and confidence. This indicated that the more responses participants made, the greater their level of confidence. However, consistent with van de Ven and Merckelbach (2003), overall levels of confidence within participants who believed that they had heard EVP were low (M = 30.31, SD =18.49).

Previous work has established that auditory hallucinations are more likely to occur when participants encounter unstructured sensory stimuli (e.g., white noise), or experience partial sensory deprivation (McCreery & Claridge, 1996). In this context, because the present study asked participants to determine whether EVP was present within meaningless sound (a fusion of white and pink noise) and derived from the White Christmas paradigm, it was appropriate to conclude cautiously that the EVP task elicited hallucinatory experiences. Noting that it is difficult to establish the authenticity of hallucinations, subsequent studies, could interview participants, in order to explore the nature and content of their experiences. This would help to establish whether they arise from genuine hallucinations or originate from other factors, such as misinterpreted imagined stimuli or response bias.

Belief in haunting mediated the effects of general paranormal belief and proneness to hallucinations. Specifically, pathways through belief in haunting increased the relations between belief in the paranormal and hallucination proneness and EVP (reporting and confidence). Indeed, the direct effect of paranormal belief on EVP measures was non-significant. This view aligns with Williams and Irwin's (1991) supposition that belief in the paranormal facilitates organization and interpretation of atypical phenomena.

In the case of hauntings, this manifests as an interpretive bias where believers perceive ambiguous stimuli in a manner congruent with pre-existing beliefs about the reality of spirits. This notion concurs with Dagnall et al., (2015), who found that the extent to which participants believed a building had a history of being haunted mediated the relationship between paranormal belief and expectation of haunt-related phenomena. Additionally, Wiseman, Watt, Stevens, Greening, and O'Keeffe (2003), in their study of Hampton Court Palace and South Bridge Vaults, noted that participants reported significantly more unusual experiences in areas that had a reputation for being haunted. These findings accorded with earlier studies that observed that expectations and suggestion could facilitate haunt-like experiences (e.g., Lange & Houran, 1997; Wiseman et al., 2003).

Overall, our view is consistent with the model proposed by Houran, Wiseman and Thalbourne (2002), who postulated that hauntings may derive from psychological experiences arising from a combination of psychophysiological mechanisms (i.e., high scores on productive cognitive-perceptual factors, such as transliminality), and the misconstruing of physical/environmental changes in accordance with motivational and cognitive biases. This conceptual framework extends beyond haunting-related phenomena to other scientifically unsubstantiated beliefs. For instance, Dagnall et al. (2016) found that greater levels of belief in the paranormal and schizotypy were associated with the tendency to perceive unrelated events as connected and meaningful (causally related). This may explain why participants scoring higher on proneness to hallucinations and belief in the paranormal (especially haunting) report hearing meaningful sounds (EVP) within random auditory noise.

Within the present study, the only cognitive-perceptual factor associated with EVP detection was hallucination proneness. This contrasts with findings from the White Christmas test. Specifically, Merckelbach and van de Ven (2001) reported that participants who heard White Christmas also scored higher on fantasy proneness. Furthermore, van de Ven and Merckelbach (2003) observed that those reporting hallucinations had significantly higher fantasy proneness scores. These findings suggest that the contribution of cognitive-perceptual factors may vary as a function of task and context. Accordingly, further research is required to determine the conditions under which propensity to hallucination and fantasy proneness best predict false detection of non-presented auditory stimuli.

This conclusion corresponds with van de Ven and Merckelbach's (2003) inference that there is no straightforward connection between hallucinatory reports produced via the White Christmas paradigm and schizophrenia-like symptoms reported by normal participants. In this paper, the presence of background static noise may provide a basis for productive experiences related to the LSHS-R rather than facilitating eagerness to endorse unusual items when presented with suggestion. Congruent with this notion, when schizophrenic patients and normal controls encounter unstructured sensory stimuli, such as white noise, hallucinatory reports increase (van de Ven & Merckelbach, 2003).

Indeed, there is evidence that participants high in fantasy proneness do not typically have genuine, life-like hallucinations. Rather, they classify internal experiences as hallucinations using less stringent criteria (Lynn & Rhue, 1986). In the context of the White Christmas paradigm, this would manifest as the tendency to report inappropriately imagined stimuli as hallucination. Clearly, further work in this area is required.

Limitations

The conclusions reached within this paper require cautious interpretation and significant outcomes require replication. Moreover, there are limitations to note. Particularly, this study was cross-sectional, data collection occurred at only one time point and therefore it is not possible to infer causal relations because path analysis provides only correlational/predictive evidence. In order to produce complex causal models, subsequent research should test relations over time, conduct comparisons across modality, and employ sophisticated statistical techniques. This could involve assessing whether participants who detect auditory phenomena (EVP) are more likely to report meaningful noises (i.e., footsteps) and perceive visual anomalies (e.g., orbs).

It is worth noting that it is possible to draw predictive inferences when specification of tested models is a priori and researchers use structural equation modeling (SEM) (Hubbard & Mannell, 2001). In these circumstances, good fit provides evidence for model veracity. Explicitly, SEM enables directional inferences about relations (Bollen, 1989; Denovan et al., 2017). To promote use of SEM, future research needs to recruit larger samples of participants. As a rule of thumb, Kline (2015) recommends a minimum sample of 200.

An issue with the White Christmas paradigm, also pertinent to the EVP adaptation used within the present study, is that it is unclear whether reporting reflects response bias or a reality-testing deficit. Accordingly, future research should attempt to discern whether participants are reacting in unusual ways

to stimuli, or whether they are actually experiencing unusual things (van de Ven & Merckelbach, 2003). This is a problem with self-report measures generally. Reality testing deficits by nature are spontaneous and may not be available to conscious awareness. Hence, individuals may not have insight into their judgment processes or the authenticity of their experiences.

Finally, this paper adopted a unidimensional approach to hallucination proneness. This may only provide limited insight into the hallucinatory mechanisms underpinning EVP. Consequently, future research could adopt a multidisciplinary approach (Fonseca-Pedrero et al., 2010; Waters et al., 2006), which identifies three factors within the LSHS-R (vivid mental events, hallucinations with a religious theme, and auditory and visual hallucinatory experiences). Hence, subsequent work could investigate whether susceptibility to EVP detection varies as a function of the hallucination dimension. The researchers were not able to perform sophisticated latent modeling within the current paper due to relatively small sample size (*N* = 107).

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Prédicteurs des Phénomènes d'Audition de Voix Électroniques dans du Bruit Aléatoire: La Schizotypie, l'Inclination à la Fantaisie, et les Croyances Paranormales

Résumé. Cette étude utilisait une version modifiée de la tâche « Noël blanc » pour examiner les récits de phénomènes d'audition de voix électronique (EVP) à partir d'un bruit aléatoire. Après une familiarisation avec le concept d'EVP, 107 participants ont écouté une piste audio combinant bruit blanc et bruit rose. Les instructions indiquaient aux participants pour presser un bouton sur un clavier afin d'indiquer qu'ils ont entendu un EVP. À la fin de la piste, les participants ont fourni un score de confiance pour leur perception d'EVP. Trente-neuf participants (36 %) ont relaté la présence d'EVP. La comparaison entre les expérienceurs d'EVP et les non-expériences sur des mesures cognitives-perceptuelles (schizotypie, hallucinations et inclination à la fantaisie) et de croyances paranormales (générale et relatives à la hantise) n'a relevé aucune différence significative. Une analyse pas à pas a indiqué que la croyance dans la hantise médiatisait les relations entre les croyances paranormales et l'inclination aux hallucinations avec les résultats aux EVP (nombre et confiance). Toutefois, l'inclination à la fantaisie et la schizotypie n'avaient pas de relations significatives avec l'EVP. Ces résultats étaient conformes aux précédentes découvertes, avec des participants qui ont imaginé entendre la fameuse chanson « Noël blanc ». Au sein de cette étude, une minorité non-triviale de participants ont vécu des EVP sous la forme d'une hallucination congruente avec la croyance. Ces résultats supportent l'idée que les croyances anomales fournissent un cadre de structuration des cognitions et perceptions inhabituelles.

Zur Überprüfung von Präkognition und veränderten Bewusstseinszuständen mit ausgewählten Teilnehmern im Ganzfeld

Zusammenfassung. Diese Studie ist die erste, die zu einer prospektiven Metaanalyse von zuvor registrierten Ganzfeld-Studien zur Außersinnlichen Wahrnehmung (ASW) beiträgt. Wir versuchten, ein-

en erwarteten Psi-Effekt zu maximieren, indem wir Teilnehmer aufgrund ihrer selbstberichteten Kreativität, früherer Psi-Erfahrungen oder -Überzeugungen oder der Ausübung einer mentalen Disziplin auswählten. Aus Gründen der Einfachheit und Sicherheit verwendeten wir auch ein automatisiertes Präkognitionsdesign, um zusätzlich zur Erweiterung der geringen Datenbasis präkognitiver Ganzfeldstudien beizutragen. Ziel- und Kontrollbilder waren kurze Videoclips, die zufällig aus einem Pool von 200 Bildern mit Zurücklegen ausgewählt worden waren. Neben der Vorhersage eines signifikanten Gesamteffektes der Ganzfeld-Präkognitionsaufgabe sollte die Studie auch die Annahme testen, dass die Ganzfeld-Methode einen psi-förderlichen veränderten Bewusstseinszustand hervorruft, indem zwei Maße des veränderten Bewusstseinszustands (Altered State of Consciousness, ASC) mit dem Ergebnis der Präkognitionsaufgabe korreliert wurden. Wir sagten vorher, dass die Ähnlichkeit der Übereinstimmungen mit den Zielbildern mit dem Grad der Ausprägung des ASC während der Sitzung verknüpft war. Drei Experimentatoren führten jeweils 20 Einzelversuche durch. Es wurden zweiundzwanzig direkte Treffer erzielt (37% Trefferquote), was den geplanten Test der Ganzfeld-Präkognitionsaufgabe signifikant unterstützt (exakter Binomialtest $p = .03$, 1-*t*). Entgegen der Vorhersage wurde kein Zusammenhang zwischen dem ASC und der Psi-Aufgabe gefunden. Abschließend diskutieren wir die Gründe, die für eine Fortsetzung der Ganzfeld-ASW-Forschung sprechen.

Predictores de Audición de Fenómenos de Voz Electrónica en Ruido Aleatorio: Esquizotipia, Propensión a la Fantasía, y Creencias Paranormales

Resumen. Este estudio utilizó una prueba modificada de la canción White Christmas para examinar respuestas de fenómenos electrónicos de voz (EVP) en ruido aleatorio. Tras familiarizarse con el concepto de EVP, 107 participantes escucharon una pista de audio que combina ruido blanco y rosa. Las instrucciones dirigieron a los participantes a presionar un botón del teclado para indicar si habían oído EVP. Al final de la grabación, los participantes dieron una calificación de confianza general de la percepción de EVP. Treinta y nueve participantes (36%) confirmaron la presencia de EVP. Las comparaciones entre quienes experimentaron o no EVP en medidas de percepción cognitiva (esquizotipia, alucinaciones, y propensión a la fantasía) y creencias paranormales (general y de casas encantadas) no revelaron diferencias significativas. Un análisis de pautas (path analysis) indicó que la creencia en casas encantadas medió las relaciones entre la creencia paranormal y la propensión a las alucinaciones con las experiencias de EVP (número y confianza). Sin embargo, la propensión a la fantasía y la esquizotipia no tuvieron relaciones significativas con EVP. Los resultados son consistentes con resultados anteriores, donde los participantes imaginaron escuchar la famosa canción White Christmas. En este estudio, una minoría no trivial de participantes experimentó EVP como un tipo de alucinación congruente con las creencias. Estos hallazgos respaldan la noción de que las creencias anómalas dan un marco para estructurar cogniciones y percepciones inusuales.