
RESEARCH ARTICLE

Assessing the Relationships Between Paranormal Beliefs, Higher-Order Cognitive Processes, Delusions, and Hallucinations in a Non-Clinical Population

Sofia Katsigianni ¹

Previous studies suggest that paranormal beliefs, cognitive processes, and psychotic-like experiences are correlated. To further explore this connection, research was conducted to examine whether paranormal beliefs were correlated with, or predicted by executive functioning, metacognition, delusions, and hallucinations. A convenience sample of 180 people completed five measures- evaluating paranormal beliefs, executive functioning deficits, metacognition awareness, delusions, and hallucinations. Prior to performing correlation and multiple regression analyses, the reliability of each measure was assessed. Findings revealed the significant positive correlations of paranormal beliefs with deficits in executive functioning, delusions, and hallucinations, whilst no significant correlation was found with metacognition. Regression analysis showed that delusions and hallucinations were significant predictors of paranormal beliefs. Concerning the relevant literature, these outcomes are debated.

Keywords: paranormal beliefs, executive functioning, metacognition, delusions, hallucinations

Even though scientists are highly skeptical towards *paranormal phenomena* (e.g., clairvoyance, psychokinesis) or even firmly deny the nature of these events and interpret them as established statistical or psychological principles (Schienle et al., 1996; Snyder, 1997), a large number of people worldwide accept and disseminate them. For example, almost half of the American population embraces paranormal/irrational beliefs, such as extrasensory perception, also known as the sixth sense (Gallup & Newport, 1991). Furthermore, in many European countries, astrological forecasts are at the heart of an individual's daily life (Nemeroff & Rozin, 2000).

The term *paranormal* is used to define events that if genuine, contradict the fundamental limiting principles of science (Tobacyk, 1995); nevertheless, there is a dispute of what paranormal beliefs involve,

as several of the widely used measures contain distinct and various subscales (Tobacyk, 2004). For instance, "witchcraft" is involved as a paranormal component in the Revised Paranormal Belief Scale, whilst it is not considered in the Australian Sheep-Goat Scale, in which "sheep" refer to believers and "goats" to disbelievers in the paranormal (Thalbourne, 2010). In the present research, beliefs in the paranormal relate to the acknowledgement of functions outside of the conventional empirical knowledge, including religion, witchcraft, psychokinesis, and extrasensory perception amongst other phenomena (Tobacyk & Milford, 1983; Tobacyk, 2004). Beliefs that have been the subject of several scientific studies over the last three decades, aiming to explore in what way distinct cognitive processes, such as critical thinking and problem-solving may be related to them (Farias et al., 2017; Irwin et al., 2012).

Paranormal Beliefs and Higher-Order Cognitive Processes

The ability to rationally assess situations, solve problems, and successfully control behaviours are

¹ Manchester Metropolitan University, Faculty of Health and Education, Department of Psychology, All Saints Building, Manchester, M15 6BH
Corresponding author: Sofia Katsigianni
(sofiakats94@gmail.com)

some of the core elements of the advanced level of a cognitive process, known as executive functioning, which plays a significant role in organising and assimilating paranormal and normal beliefs (Wain & Spinella, 2007). Although paranormal beliefs are assumed to be prevalent in Western society (Rice, 2003), variations among such beliefs and specific thinking styles are also noted (Aarnio & Lindman, 2005). More specifically, according to Epstein and Pacini's (1999) cognitive-experiential self-theory, individuals operate with two distinct information processing systems that have specific operating rules. The first is the experiential/intuitive system, which is concrete, holistic associative, and mainly focused on experiences. The other is an analytical/rational system which is on the other hand distinguished for the conscious processes that lead to deliberative, explicit knowledge. Both systems are controlled by executive functioning and responsible for the inhibition of automatic responses when necessary, thus resulting in a rational approach to a stimulus (Diamond, 2012).

In this context, experiential/intuitive reasoning rather than logical/critical thinking plays a greater part in developing paranormal beliefs. It appears that the formation of such beliefs is the result of a more personal type of experiences; therefore, these experiences may have been perceived as validated, implying the existence of a positive correlation between personal experiences and intuitive thinking (Drinkwater, 2017). Similarly, Stanovich and West (2000) suggested that intuitive thinking and impulsivity contribute to an increased number of paranormal beliefs as no empirical justification is required. Accordingly, the inhibition of non-rational information processing does not take place. This evidence also adds that as cognitive processing systems depend upon the inhibitory control of executive functioning, people who embrace paranormal beliefs may exhibit reduced executive skills since they are not able to override internal predispositions and instead act and think impulsively (Diamond, 2012).

Further, based on previous studies, if those who score high on paranormal beliefs measures cannot control their thinking, they may also demonstrate difficulty in reasoning and problem-solving (Dagnall et al., 2007; French & Wilson, 2007). This assumption lies in the fact that reasoning and problem-solving are part of the rational system, through which people make inferences from knowledge rather than emotions (Khemlani & Johnson-Laird, 2017). However, it appears that many paranormal belief theories support the more traditional and mundane interpretations, particularly misinterpretation and

misconception of chance (Lange & Houran, 1998). Other reasoning studies indicate that the lower the ability to perform critical thinking tasks, the higher the degree of belief in paranormality (Otis & Alcock, 1982). Otis and Alcock (1982) compared believers and disbelievers and illustrated that believers are generally poorer when undertaking critical evaluation tasks. Although previous studies provide some guidance for the present study, the area includes a range of cognitive processes that require an investigation in order to clarify whether executive functioning, particularly deficits in this domain, are associated with beliefs in the paranormal.

In contrast to many of the executive function's processes discussed, the role of metacognition, which is often referred to as thinking about thinking, in paranormal beliefs is poorly researched (Irwin et al., 2012). More specifically, the focus of the existing literature is on delusion-associated metacognitive beliefs as illustrated by Irwin et al. (2012), who found them to display a positive link with paranormal beliefs. This research, however, assessed individual differences in a number of metacognitive beliefs thought to be significant in the metacognitive model of psychological disorders rather than in healthy metacognitive thinking. Also, the correlation found was not uniform as only women with increased cognitive self-consciousness and negative beliefs tended to experience delusions, which were also implicated in the formation of beliefs in the paranormal. Therefore, given there were notable gender differences in previous studies, the sex-gender variable should be controlled. On the other hand, empirical evidence has demonstrated that executive functioning and metacognition are related under the cognitive self-regulation concept (Carlson et al., 2015; Devine & Hughes, 2014), implying that the former is necessary or facilitates metacognition. For example, individuals who used deliberative, rational thinking to solve reasoning problems had better insight (i.e., metacognitive awareness) than intuitive problem-solvers (Mata & Almeida, 2014). If this is the case, then people with high metacognitive awareness as those with low intuitive thinking may be more likely to reject paranormal beliefs.

Paranormal Beliefs and Psychotic-Like Experiences

Earlier studies suggested that subtle, subclinical delusions and hallucinations, known as psychotic-like experiences are evident within the normal population (Cella et al., 2012; Jones & Fernyhough, 2007). Since Thalbourne's (1985) ground-breaking research, it has frequently been revealed that the proneness to these schizophrenic-like behaviours is linked to paranormal

beliefs (Peltzer, 2003). Indeed, Lawrence and Peters (2004) identified that strong believers in the paranormal demonstrated greater delusional ideation than weaker believers. Similar findings were found by Cella et al. (2012), who was interested in how psychotic-like paranormal beliefs occurred. Their findings are notable as they found that the intensity and frequency of psychotic-like experiences was greater in paranormal believers, while susceptibility to delusion and hallucination were vital predictors of paranormal beliefs. One explanation for the above association was given by Peters et al. (2014), who concluded that delusions often arise and are maintained through certain reasoning biases. Some of these biases, particularly catastrophizing—a way to speculate about contingent negative aspects of one's life in terms of the worst possible outcome—and emotion-based reasoning have also been observed in paranormal beliefs (Irwin et al., 2012). Indeed, individuals with delusional ideation were found to display a reasoning bias through which they gathered little or no information before deciding, a characteristic, which is commonly known as *jumping to conclusions* (Averbeck et al., 2011).

The tendency of paranormal believers to jump to conclusions was explored by Irwin, Drinkwater, & Dagnall (2014), using two versions of the “Beads” Task (1) a behavioural measure of jumping to conclusions proneness and (2) self-report measures. Their findings supported the relationship between paranormal beliefs and the proclivity to jump to conclusions, with the best predictors of paranormal beliefs being self-report measures. These outcomes support the hypothesis advanced by Irwin, Dagnall, & Drinkwater (2012) that paranormal beliefs are formed as a result of specific cognitive processes which have been independently identified as underpinning the formation of delusions. Lastly, and more tangentially concerning the development of delusions, McKay, Langdon, and Coltheart (2006) emphasised the intervention of a cognitive-motivational element, known as the need for cognitive closure. That is to say, a habitual tendency to “seize” a decision and then “freeze” instead of continuing to consider a variety of options until the most appropriate decision is reached. Therefore, this habitual inclination has been found in paranormal believers and particularly in those who hold paranormal beliefs around religion (Irwin et al., 2012), meaning positive associations between delusions and beliefs in the paranormal may be anticipated.

In a similar way, sufferers from hallucinations (i.e., sensory distortions of perception) exhibit reasoning biases which might contribute to the formation of paranormal beliefs (Dein, 2012). These biases include

the belief in control over random events and poor probability reasoning. For instance, Brugger and Taylor (2003) reviewed several studies concluding that paranormal believers utilise the aforementioned biases since they perceive random stimuli as meaningful patterns; consequently, forming a false perception for these events. While previous studies indicate the importance of delusions and hallucinations in the genesis of paranormal beliefs, the hallucination factor requires additional investigation in the non-clinical population.

The purpose of this research is to determine whether paranormal beliefs correlate with executive functioning deficits, metacognition, delusions, and hallucinations. Although associations between many of these variables have been somehow examined formerly, the studies discussed indicate the need for further exploration (Irwin et al., 2012). This research will provide an explanation of the questions that have been arisen from each factor to deeper understanding and contribute to the empirical base. Additionally, as literature has illustrated the significance of specific processing systems in the formation of paranormal beliefs and experience. In line with this, the hypotheses for this study are as follow:

Hypothesis 1: Deficits in executive functioning will have significant positive correlations with paranormal beliefs.

Hypothesis 2: Higher metacognitive awareness will have significant negative correlations with paranormal beliefs.

Hypothesis 3: Delusions will have significant positive correlations with and be significant predictors of paranormal beliefs.

Hypothesis 4: Hallucinations will have significant positive correlations with and be significant predictors of paranormal beliefs.

Methods

Design

A quantitative, non-experimental correlation design was carried out. Predictors of executive functioning, metacognition, delusions, and hallucinations have been tested to determine whether they were correlated with the criterion of general paranormal beliefs. A multiple regression analysis was carried out next to understand whether paranormal beliefs can be predicted based on executive functioning, metacognition, delusions, and hallucinations. Self-reporting measures were selected based on their ability to provide rich datasets and their established practicality (Paulhus & Vazire, 2007).

Respondents

The total number of respondents who completed the questionnaire was 180. Ages varied between 18 to 60 years ($M = 29.51$, $SD = 11.38$); 71.1% (128) of the participants were females, and 28.9% (52) were males. Female ages ranged from 18–60 years ($M = 25.52$, $SD = 8.23$), while the ages of the males ranged from 18–58 years ($M = 27.04$, $SD = 10.44$).

The sample consisted of students from the Manchester Metropolitan University as well as volunteers from the broader community; 18% were undergraduate students and 82% were professionals. Of the total number of students, 85% were females and 15% were males, while of the nonstudents 73% were females and 27% were males.

Regarding respondents' recruitment, a wide range of sources were involved. Participants were recruited to the study via emails, via written advertisements distributed around public areas, and via face-to-face invitations. Their involvement in the study was voluntary, and could be cancelled at any time during and after the study. The only restriction was that respondents were eligible to take part only if they were aged at least 18 years.

Materials

This research employed five self-reporting measures, as they are advantageous for testing anomalistic beliefs (Dagnall et al., 2010): The Revised Paranormal Belief Scale (R-PBS; Lange et al., 2000; Tobacyk & Milford, 1983; Tobacyk, 1988), the Barkley Deficits in Executive Functioning Scale-Short Form (BDEFS-SF; Barkley, 2011), the Metacognitive Awareness Inventory (MAI; Schraw & Dennison, 1994), the 21-Item Delusions Inventory (PDI-21; Peters et al., 2004), and the Launey-Slade Hallucination Scale-Revised (LSHS-R; Bentall & Slade, 1985; Launay & Slade, 1981). All measures were provided in their original version to those who were native English speakers and translated into Greek to those who were native Greek speakers and were struggling with the English language. For the second case, a forward translation process was followed by an independent translator after an extensive literature review to ensure the validity and reliability of the existing questionnaires (Guillemin et al., 1993).

Paranormal beliefs. The Revised Paranormal Belief Scale is Tobacyk and Milford's (1983) modified version of the Paranormal Belief Scale (R-PBS; Lange et al., 2000; Tobacyk & Milford, 1983; Tobacyk, 1988), comprises of 26 questions and measures self-report beliefs in seven dimensions: traditional religious belief, witchcraft, psi, spiritualism, superstition, extraordinary life forms, and precognition. Items were measured on

a 7-point Likert scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*) and were presented as positive statements (e.g., "I believe in God"), except for item 23 ("Mind reading is *not* possible") which was reverse-coded. Moreover, the overall scores ranged from 0 to 182, with higher summed scores indicating an increased belief in the paranormal. Although the number and nature of the aforementioned facets have been debated (Lawrence et al., 1997), the scale was psychometrically and conceivably adequate, with high internal reliability ($\alpha = .92$; Tobacyk, 2004).

Executive functioning. The BDEFS-SF is an executive functioning self-rating scale of 20 items, which is based on Barkley's (2011) 89-item Barkley Deficits in Executive Functioning Scale-Long Form (BDEFS-LF) and evaluates the dimensions of executive functioning in adults. The short-form scale contains five constructs of executive functioning; each of them includes four of the highest loading items that have been identified after the factor analyses of the BDEFS-LF: time-management, self-organisation/problem solving, self-restraint, self-motivation, and self-regulation of emotions. This scale uses a 4-point Likert scale structure, which indicates the degree of occurrence ("1 = *never or rarely*; 2 = *sometimes*; 3 = *often*; 4 = *very often*"). A summary score was derived from the total of the subscales, with greater scores to be interpreted as deficits in executive functioning. Generally, previous studies using clinical samples of adults and adolescents with Attention Deficit Hyperactivity Disorder (ADHD) demonstrated the strong validity and reliability of this scale (Barkley, 2014).

Metacognition. The MAI measurement comprises a total of 52 statements, and it was first used to measure students' metacognitive awareness (Schraw & Dennison, 1994). Within the inventory, there are two components of metacognition which are divided into clusters. The knowledge of cognition component includes 17 questions and measures declarative, procedural, and conditional knowledge for a possible total of 17 points. The regulation of cognition component contains 35 questions and measures planning, information management strategies, comprehension monitoring, debugging strategies, and evaluation, for a possible total of 35 points. The items were measured on a dichotomous *true/false* scale (e.g., "I know how well I did once I finish a test"), with the higher scores corresponding to greater knowledge and regulation of cognition. A total score of metacognitive awareness was also derived by summing all responses.

Delusions. Peter's et al. (2004) PDI-21 was designed to evaluate delusional symptoms within the general population. It consists of 21 items that are presented with the format of dichotomous response "yes/no" (e.g., "Do you ever feel as if people are reading your mind?"). The sum of positive responses formulated the total score, with the maximum score being 21 points. The higher the total score, the greater the symptoms of delusions or the proneness to paranoia was. Previous studies have indicated that PDI-21 is a tool of adequate measuring quality in terms of reliability, internal consistency, and validity (Peters et al., 2004).

Hallucinations. The 12-item LSHS-R is a widely used indicator of predisposition to hallucinations in a non-clinical population which is composed of four factors: vivid dreams, clinical auditory hallucinations, vivid or intrusive thoughts, and subclinical auditory hallucinations (e.g., "I often hear a voice speaking my thought aloud"). The vivid dreams and thoughts apply to mental experiences which are identified as one's own, while the common feature of the other two factors is the hallucinatory experience which is linked to another source. The items were measured on a 4-point Likert scale ranging from "1 *certainly does not apply to you* to 4 *certainly does apply to you*". Total scores ranged from 0 to 48, with the higher summed scores revealing greater hallucinatory predisposition. The good validity and reliability of this measure were demonstrated by Mohammadzadeh's (2017) research, who concluded that it could be used as a valid measure in psychosis-related studies.

Procedure

At the beginning of the self-reporting measures, respondents were informed by a set of instructions that the research was concerned with investigating paranormal beliefs and cognitive processes. They were also informed that the questionnaire had no time limit to complete. Prior to engaging in the research, prospective participants read the background information which clarified the purpose

of the study as well as the ethical procedures that were followed. Participants who agreed to take part received a consent form and a set of five questionnaires, either in a printed or online form. Regarding the online version on the Qualtrics platform (Qualtrics, Provo, UT), all items were compulsory, and respondents could not proceed to the next part without fully completing the items on the page. Written instructions requested participants to read and answer all questions carefully and complete the items openly and honestly. The sequence of the questionnaires rotated throughout sections; that is for the response bias to be controlled, counterbalancing of items order within questionnaire manipulated.

Ethical Considerations

Ethical considerations were considered with regards to participant's safety. Their anonymity was protected through a unique identifier they provided, whilst their autonomy was respected. The latter gave the right to respondents to withdraw at any time after their participation. Successfully recorded data was stored securely on a University network drive and their access was exclusively controlled by the researcher, ensuring the confidentiality of participants' responses. After the completion of the analysis, all data was destroyed.

Results

Data Screening for Correlation and Regression

Prior to the process of data analysis, the raw data were tested for detecting any errors or missing items. The Standardised Residual was also assessed after the analysis to identify the outliers within the data set. The threshold value to determine whether a data point was an outlier was ≥ -3.29 or ≤ 3.29 .

Reliability Analysis

The internal reliability of the five measures was

Table 1. Summary statistics and correlations for paranormal beliefs, executive-functioning deficits, metacognitive awareness, delusions, and hallucinations

Scales	1	2	3	4	5	M	SD	α
1. R-PBS						57.40	27.41	.92
2. BDEFS-SF	.14*					36.09	10.01	.90
3. MAI	.02	.47*				64.89	7.94	.87
4. PDI	.41*	.30*	.02			91.25	34.13	.79
5. LSHS-R	.35*	.37*	.06	.59*		21.31	6.68	.86

Note. $N = 180$. Revised Paranormal Belief Scale (R-PBS), Barkley Deficits in Executive Functioning Scale-Short Form (BDEFS-SF), Metacognitive Awareness Inventory (MAI), Delusions Inventory (PDI), and Launey-Slade Hallucination Scale-Revised (LSHS-R). * $p < .007$. Probabilities are one-tailed.

Table 2. Summary statistics and correlations between the subscales of paranormal beliefs (R-PBS) and executive functioning deficits (BDEFS-SF)

BDEFS-SF	R-PBS							M	SD	α
	Religion	Witchcraft	Psi	Spiritualism	Superstition	ELF	Precognition			
T-M	-.07	.01	-.11	.13*	.27*	.11	.17*	8.69	2.98	.80
P-S	-.01	.03	-.05	.09	.31*	.06	.18*	6.53	2.50	.80
S-R	-.01	-.03	.06	.17*	.12	.16*	.12	6.70	2.22	.70
S-M	-.04	-.01	-.10	.03	.28*	.13*	.14*	6.12	2.40	.79

Note. N = 180. Revised Paranormal Belief Scale (R-PBS), Barkley Deficits in Executive Functioning Scale-Short Form (BDEFS-SF), Time-Management (T-M), Problem-Solving (P-S), Self-Restraint (S-R), Self-Motivation (S-M), Emotion Regulation (ER), and Extraordinary Life Forms (ELF).

* $p < .007$. Probabilities are one-tailed.

evaluated utilising Cronbach's alpha (α). In the R-PBS measure, item 23 was reversed for scoring as proposed by the author, and the new Cronbach's alpha was ($\alpha = .92$), which indicates excellent internal reliability. In the same context, BDEFS-SF ($\alpha = .90$) displayed excellent internal reliability. MAI ($\alpha = .87$) and LSHS-R ($\alpha = .86$) demonstrated good internal reliability, while the internal reliability of the PDI measure ($\alpha = .79$) was adequate. Table 1 outlines the summary statistics for the overall measures.

Internal consistency of the subscales was also computed. R-PBS subscales of traditional religious beliefs ($\alpha = .86$), witchcraft ($\alpha = .88$), superstition ($\alpha = .83$), and precognition ($\alpha = .82$) had good internal reliability, while psi ($\alpha = .75$) and spiritualism ($\alpha = .78$), displayed adequate internal reliability. However, extraordinary life forms ($\alpha = .49$) showed unacceptable internal reliability due to the small number of items. The internal reliability of the BDEFS-SF, MAI and LSHS-R subscales is shown in Tables 2, 3 and 4, respectively.

Descriptive Statistics and Paranormal Beliefs, Executive-Functioning, Metacognition, Delusions, and Hallucinations Correlations
For this research r (Pearson's correlation coefficient) was used as an effect size indicator, with .80 representing a large effect size, .50 a medium effect size, and .20 a small effect size (Cohen, 1988). Seven Pearson correlation tests between the scales and subscales of R-PBS, BDEFS-SF, MAI, PDI, and LSHS-R were carried out and tested against a Bonferroni-adjusted alpha level of .007. Significant positive correlations were found between measures of executive functioning deficits, $r(178) = .14, p = .006$; delusions, $r(178) = .41, p < .001$; and hallucinations, $r(178) = .35, p < .001$, while no significant correlations were found for R-PBS and MAI. Executive functioning deficits possessed significant positive correlations with metacognition awareness, $r(178) = .47, p < .001$; delusions, $r(178) = .30, p < .001$; and hallucinations, $r(178) = .37, p < .001$. Furthermore, metacognition demonstrated no significant correlations with

Table 3. Summary statistics and correlations between the subscales of paranormal beliefs (R-PBS) and metacognitive awareness (MAI)

MAI	R-PBS							Pre-cognition	M	SD	α
	Religion	Witchcraft	Psi	Spiritualism	Superstition	ELF					
Declarative	.06	.01	-.14*	.00	.10	-.06	-.01	9.65	1.46	.48	
Procedural	.02	.07	.03	.12	.16*	.10	.11	5.11	1.14	.56	
Conditional	.06	-.02	-.01	-.01	.17*	-.01	.03	6.08	1.10	.43	
Planning	-.09	-.01	-.05	.06	.14*	.06	.12	9.10	1.82	.67	
Management	-.04	-.01	-.11	-.13*	.10	-.08	-.02	12.27	1.84	.56	
Comprehension	.08	-.01	-.12	-.10	.09	-.15*	-.08	9.04	1.63	.55	
Debugging	-.06	.10	.00	.07	.26*	.10	.19*	5.61	1.00	.55	
Evaluation	-.00	.04	-.09	-.02	.17*	-.03	.02	8.10	1.59	.54	

Note. N = 180. Revised Paranormal Belief Scale (R-PBS), Metacognitive Awareness Inventory (MAI), Declarative knowledge (Declarative), Procedural knowledge (Procedural), Conditional knowledge (Conditional), Debugging strategies (Debugging), and Extraordinary Life Forms (ELF).

* $p < .007$. Probabilities are one-tailed.

Table 4. Summary statistics and correlations between the subscales of paranormal beliefs (R-PBS) and hallucinatory experiences (LSHS-R)

LSHS-R	R-PBS							Pre-cognition	M	SD	α
	Religion	Witchcraft	Psi	Spiritualism	Superstition	ELF					
Vivid d.	-.05	.20*	.10	.35*	.27*	.34*	.31*	9.44	3.55	.79	
CAH	.13*	.31*	.29*	.37*	.21*	.21*	.31*	6.65	2.38	.70	
Vivid t.	.10	.22*	.06	.31*	.22*	.34*	.28*	8.68	2.77	.70	
S-CAH	.03	.27*	.24*	.30*	.12	.19*	.20*	2.96	1.49	.70	

Note. $N = 180$. Revised Paranormal Belief Scale (R-PBS), Launey-Slade Hallucination Scale-Revised (LSHS-R), Vivid dreams (Vivid d.), Clinical Auditory Hallucinations (CAH), Vivid thoughts (Vivid t.), Subclinical Auditory Hallucinations (S-CAH), and Extraordinary Life Forms (ELF).

* $p < .007$. Probabilities are one-tailed.

delusions and hallucinations. However, delusions showed a significant positive correlation with hallucinations, $r(178) = .59, p < .001$. (see Table 1).

The relationships between the paranormal belief subscale (religion, witchcraft, psi, spiritualism, superstition, ELF, and precognition) and the BDEFS-SF (time-management, problem-solving, self-restraint, self-motivation, and emotion regulation), MAI (declarative knowledge, procedural knowledge, conditional knowledge, planning, management, comprehension, debugging strategies, and evaluation), and the LSHS-R (vivid dreams, clinical auditory hallucinations, vivid thoughts, and subclinical auditory hallucinations) subscales were further examined. (see Table 2, Table 3, and Table 4).

Significant positive correlations were found between traditional religious beliefs and clinical auditory hallucinations, $r(178) = .13, p = .006$. Witchcraft showed significant positive correlations with vivid dreams, $r(178) = .20, p = .004$; clinical auditory hallucinations, $r(178) = .31, p < .001$; vivid thoughts, $r(178) = .22, p = .001$; and subclinical auditory hallucinations, $r(178) = .27, p < .001$.

Psi possessed significant positive associations with clinical auditory hallucinations, $r(178) = .29, p < .001$; and subclinical auditory hallucinations, $r(178) = .24, p = .001$. While it had a significant negative relationship with declarative knowledge, $r(178) = -.14, p = .006$.

Spiritualism had significant positive correlations with deficits in self-restraint, $r(178) = .17, p = .005$; self-regulation of emotions, $r(178) = .23, p = .001$; and time-management, $r(178) = .13, p = .004$. It also displayed significant positive associations with vivid dreams, $r(178) = .35, p < .001$; clinical auditory hallucinations, $r(178) = .37, p < .001$; vivid thoughts, $r(178) = .31, p < .001$; and subclinical auditory hallucinations, $r(178) = .30, p < .001$. Moreover, a significant negative relationship emerged with information management strategies, $r(178) = -.13, p = .003$.

Superstition displayed significant positive correlations with procedural knowledge, $r(178) = .16,$

$p = .006$; conditional knowledge, $r(178) = .17, p = .005$; planning, $r(178) = .14, p = .006$; debugging strategies, $r(178) = .26, p < .001$; evaluation, $r(178) = .17, p = .001$; deficits in time-management, $r(178) = .27, p < .001$; problem-solving, $r(178) = .31, p < .001$; self-motivation, $r(178) = .28, p < .001$; and self-regulation of emotions, $r(178) = .31, p < .001$; vivid dreams, $r(178) = .27, p < .001$; clinical auditory hallucinations, $r(178) = .21, p = .002$; and vivid thoughts, $r(178) = .22, p = .002$.

Further, extraordinary life forms demonstrated significant negative associations with comprehension monitoring, $r(178) = -.15, p = .004$, whereas significant positive correlations were exhibited with deficits in self-restraint, $r(178) = .16, p = .004$; self-regulation of emotions, $r(178) = .18, p = .006$; and self-motivation, $r(178) = .13, p = .002$; vivid dreams, $r(178) = .34, p < .001$; clinical auditory hallucinations, $r(178) = .21, p = .002$; vivid thoughts, $r(178) = .34, p < .001$; and subclinical auditory hallucinations, $r(178) = .19, p = .006$.

Finally, precognition displayed significant positive relationships with deficits in time-management, $r(178) = .17, p = .001$; problem-solving, $r(178) = .18, p = .006$; self-motivation, $r(178) = .14, p = .005$; and self-regulation of emotions, $r(178) = .23, p = .001$; debugging strategies, $r(178) = .19, p = .005$; vivid dreams, $r(178) = .31, p < .001$; clinical auditory hallucinations, $r(178) = .31, p < .001$; vivid thoughts, $r(178) = .28, p < .001$; and subclinical auditory hallucinations, $r(178) = .20, p = .004$.

Regression Analysis

Assumptions were tested prior to multiple regression analysis to assure that this was a reliable means of analysis. Standardised residuals showed that data satisfied the assumptions of no outliers (Std. Residual Min = -2.40, Std. Residual Max = 2.38). Collinearity tests indicated that there was no multicollinearity (executive functioning, Tolerance = .65 VIF = 1.54; metacognition, Tolerance = .76, VIF = 1.32; delusions, Tolerance = .64, VIF = 1.58; hallucinations, Tolerance = .60, VIF = 1.66). The assumptions of independent

Table 5. Summary of regression analysis scores for predicting Paranormal Beliefs (R-PBS)

	Unstandardised coefficient (B)	B (Std. Error)	Standardised coefficient (β)	t	Sig. (p)
Constant	18.45	16.62		1.11	.268
BDEFS-SF	-.09	.23	-.03	-.38	.704
MAI	.06	.27	.02	.22	.823
PDI	.26	.07	.32	3.74	< .001
LSHS-R	.69	.36	.20	1.93	.006

Note. $N = 175$. Barkley Deficits in Executive Functioning Scale-Short Form (BDEFS-SF), Metacognitive Awareness Inventory (MAI), Delusions Inventory (PDI), and Launey-Slade Hallucination Scale-Revised (LSHS-R).

errors were also met (Durbin-Watson value = 1.87). Finally, the last assumptions of homoscedasticity and linearity were satisfied, as was demonstrated by the scatterplot, histogram, and normal P-P plot of standardised residuals.

A multiple regression analysis was conducted to examine the extent to which the variables “executive functioning” deficits, “metacognition”, “delusions”, and “hallucinations” were predictors of paranormal beliefs and tested against the Bonferroni-adjusted alpha level of .01 (see Table 5). The sex-gender variable was controlled due to gender differences in previous studies, as reported in the introduction (Irwin et al., 2012). In addition, enter selection—a method which enters predictor variables at the same time—was used, because it was not known which independent variables would result in the best prediction equation; meaning that equal importance was given to all variables. The prediction model that emerged was statistically significant ($F(4, 175) = 15.50, p < .001$), with a weak relationship between variables ($R = .43$) and accounted for approximately 19% ($R^2_{adj} = 17\%$) of the variance in paranormal belief scores. Out of the four variables, delusions were the strongest predictor of paranormal beliefs in relation to the others, $\beta = .32, t(175) = 3.74, p < .001$; while hallucinations were also significantly predicted by paranormal beliefs, $\beta = .20, t(175) = 1.93, p = .006$.

Discussion

Paranormal beliefs and executive functioning

The present study revealed significant positive correlations between paranormal beliefs and executive functioning deficits. Accordingly, hypothesis 1 was accepted. This evidence supports the notion that whether individuals inhibit their impulsivity and think more critically or use their internal predisposition to think, they may be related to their propensity to believe in the paranormal (Diamond, 2012). While Lindeman and Aarnio (2006) demonstrated this measuring general cognitive

processes, this research contributes to the highly prevalent association between the two variables by presenting the role of the advanced functions of the brain in relation to paranormality.

Further analysis of these factors revealed that some of the subscales of the R-PBS also had significant positive correlations with certain cognitive characteristics of the BDEFS-SF, providing additional evidence for the strong association. For example, superstitious beliefs were significantly correlated with deficits in time-management, problem-solving, self-motivation, and regulation of emotions. Consistent with Harada and Hunter’s (2012) explanation, superstitious beliefs are linked to irrational thinking and reasoning; thus, those who hold these beliefs and behave under the influence of their emotions when they are required to control an uncertain situation are often overwhelmed with negative emotions to alleviate this distress which in turn motivates superstitious beliefs (Carlow et al., 2008). In the same context, precognition belief displayed significant positive associations with deficits in problem-solving, self-motivation, and emotion regulation. This suggests that individuals who cannot cope with challenging or stressful situations alone strive to predict what the future holds to avoid negative outcomes (Callaghan & Irwin, 2003; Irwin, 2005). Regarding the extrasensory life form beliefs, their strong relationships with difficulties in self-motivation and emotion regulation may have resulted from the high levels of passivity and the low confidence of these believers in their ability to perform, as was previously pointed out by Judge and Ilies (2002).

Nevertheless, the findings that spiritualism significantly positively correlated with deficits in time-management, emotion regulation, and self-restraint do not agree with previous literature, as in meta-analysis research, it was found that this factor provides coping resources to individuals to deal with a situation, as well as triggers their higher levels of

functioning (Koenig, 2012).

Further, exploration of PDI and LSHS-R measures demonstrated that deficits in executive functioning have a large effect on the proneness to delusions and hallucinations, suggesting that such high functions are central factors for the control of behavioural responses (Orellana & Slachevsky, 2013). The findings of the current study provide supplemental evidence for the role of executive functioning deficits in the formation of paranormal beliefs. However, a further investigation into the cognitive characteristics of the paranormal beliefs which were found to be unrelated to executive functioning deficits should take place.

Paranormal beliefs and metacognition

As previously defined, the limited research into paranormal beliefs and metacognition has concerned delusion-associated metacognitive beliefs (Irwin et al., 2012). With regards to the present study's innovative exploration of metacognitive components, it was revealed that no significant associations existed between them and belief in the paranormal. Therefore, hypothesis 2 was rejected. Seemingly, this appears to contrast with previous researchers (Carlson et al., 2015; Devine & Hughes, 2014; Meta & Almeida, 2014), who concluded that executive functioning is necessary for metacognitive control which in turn regulates and corrects paranormal beliefs (Halonen & Dunn, 2020). However, their research has focused on children's self-regulation and did not consider the distinguishable development of executive functioning and metacognition over time, which could explain the strong positive relationships found in the current study between executive functioning deficits and higher metacognitive awareness.

Moreover, when exploring the subscales of metacognition, the findings revealed significant positive correlations of superstitious beliefs with most of the metacognitive components, results that contradict all existing literature (Carlson et al., 2015; Dagnall et al., 2007; Mata & Almeida, 2014). The reason for this lies in the fact that most of the MAI's subscales may have been a factor of a discrepancy, as their internal reliability demonstrated unacceptable values. Although, most importantly, these are primary explanatory evidence in a field where knowledge has certainly been lacking and without further examination, very little can be concluded. However, present research seems to shed light on the distinct higher-order processes of which metacognition and its possible inability to regulate false beliefs constitute a valuable starting point.

Paranormal beliefs, delusions, and hallucinations

Continuing with psychotic-like experiences, it was found that paranormal beliefs demonstrated significant positive correlations with delusions and hallucinations. These results are in parallel with Peltzer (2003), who came to the same conclusion regarding these factors. Furthermore, regression analysis indicated that both delusions and hallucinations significantly predicted paranormal beliefs, with the former being the strongest, meaning hypotheses 3 and 4 were accepted. As results display that individuals with psychotic-like experiences are indeed paranormal believers, it indicates that there could be merit to Peter's et al. (2014) argument that such experiences share the same cognitive biases with paranormal beliefs. More importantly, this notion was further enhanced when the associations between the subscales of paranormal beliefs and hallucinations were examined. All subscales of the R-PBS measure demonstrated significant positive associations with at least one type of hallucination, indicating people with paranormal beliefs would be difficult to reject random information before deciding as they are possessed by their intuitive thoughts, resulting in the misinterpretation of the event (Brugger & Taylor, 2003). Hence, the findings of the present research provide supplementary evidence to support the assertion that paranormal beliefs underlie the formation of delusions and hallucinations in the non-clinical population.

Limitations

Certain potential limitations of the research should be identified. As mentioned above, the sample consisted primarily of females. Although this does not pose a major concern, researchers admit that the findings' generalisability may be restricted (Drinkwater, 2017; Irwin et al., 2015). To further explore the factors in the present research, future studies could collect data from more diverse populations in the hope of uncovering more widely applicable results. Besides, it is suggested by Irwin (2004) that self-report measures may limit the research. Indeed, in the current study when internal consistency was explored of the subscales, some of them exhibited unacceptable values, as a result, the findings could be disputed. Alternatively, Irwin (2004) recommends measures of performance that could be incorporated where applicable by subsequent examinations. Finally, this study utilised translated measures into Greek for respondents who were struggling with the English language. However, the cultural adaptation was missing as items remained the same and preliminary pilot testing was not followed after

translation to assess its comprehensibility and acceptability (Fenn et al., 2020). For this reason, a multistep strategy is required, including a bilingual expert panel, pretesting, test revision, and back translation (Alhaji et al., 2018), to ensure the reliability and validity of the measures if they were to be widely used.

Implications

In summary, belief in the paranormal displayed significant positive correlations with executive functioning deficits, delusions, and hallucinations, whilst they did not demonstrate any relationships with metacognition awareness. Both delusions and hallucinations significantly predicted paranormal beliefs. Regarding the implications of this research, it contributes to the scientific basis concerning the correlations and predictors of paranormal beliefs while it sheds light on the cognitive characteristics of individuals who embrace paranormal phenomena. This has implications for future research since it emphasises the need for a better understanding of the connections that are held; particularly in relation to the distinct components of paranormal beliefs. The evidence of this study also implies how scientific knowledge can be applied to paranormal beliefs—a topic that appears to be the polar opposite of scientific knowledge at first glance. In addition, research in this area has the potential to expand our worldview and pave the way for future endeavours in a less well-studied area of psychology. To build on this, a cluster analysis of data evaluating comparable variables could be carried out, aiming to detect and interpret groups of participants with similar beliefs.

Conflicts of Interest

Author has no conflict of interest to declare.

Contributorship Statement

The author K.S. confirms sole responsibility for the following: study conception and design, data collection, analysis and interpretation of results, and manuscript preparation.

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