



Paranormal Beliefs, Uncertainty, Belief in Science, Reality Testing, Schizotypy, and Rationality-Experientiality

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### ABSTRACT

The aim of this study was to assess whether paranormal beliefs were correlated with, or predicted by, emotional response to uncertainty, belief in science, reality testing, schizotypy, and rationality-experientiality. The research utilised an opportunity sample of 153 individuals, who completed six self-report measures. It was hypothesised that belief in science would have significant negative correlations with, and be a significant predictor of, paranormal beliefs. Also, that rationality and experientiality would be significant predictors of paranormal beliefs. Finally, it was hypothesised that uncertainty would have significant positive correlations with paranormal beliefs. Analysis included Pearson correlations, along with 'enter' and 'stepwise' methods of multiple regression. Results showed that paranormal beliefs exhibited significant positive correlations with uncertainty, reality testing, and schizotypy. While, they were found to possess significant negative correlations with belief in science and rationality. Regression analysis indicated that belief in science and reality testing were significant predictors of belief in the paranormal. The 'stepwise' method of regression showed that reality testing explained the largest amount of variance. These results are debated in relation to relevant literature. Limitations, implications, and future directions are also considered.

<b>KEY WORDS:</b>	BELIEF IN SCIENCE	EMOTIONAL RESPONSE TO UNCERTAINTY	PARANORMAL BELIEFS	REALITY TESTING	SCHIZOTYPY
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## Introduction

Even today, several individuals hold some form of paranormal belief; as many as 73% of Americans as reported by the Gallup polls (Blackmore, 1997; Moore, 2005; Irwin, 2009). According to Irwin (2009), these are so widespread that they are present in all cultures to some extent. Yet, there is no consensus of what paranormal beliefs entail, as many of the commonly employed measures include diverse subscales (Thalbourne & Delin, 1993; Tobacyk, 2004). For example, the Revised Paranormal Belief Scale includes witchcraft as an aspect of the paranormal, whereas the Australian Sheep-Goat Scale does not (Thalbourne & Delin, 1993; Tobacyk, 2004;). For this study, paranormal beliefs will refer to acceptance of processes that are beyond current scientific understanding, including extrasensory perception, psychokinesis, religion, and witchcraft among other phenomena (Broad, 1949; Tobacyk & Milford, 1983; Tobacyk, 2004). Despite their endorsement, there also exists no agreement regarding the reasons for their prevalence (Moore, 2005; Lindeman & Aarnio, 2006). Therefore, paranormal beliefs have been the emphasis of much psychological research, with considerable effort directed at exploring how other personality aspects may correlate with and/or predict them (Hergovich et al., 2008).

Many have theorised that paranormal beliefs may be influenced by an individual's worldview (Irwin, 2009). For example, someone who interprets the world more objectively is likely to be sceptical of anything that they are unable to directly perceive (Irwin et al., 2016). As scientific belief is also associated with this objectivity, those who possess high belief in science may reject or be indifferent towards the paranormal due to its inability to be observed (Farias et al., 2013). The relationship between belief in science and the paranormal was explored by Irwin et al. (2016) in a sample of 202 participants, where it was discovered that belief in science did indeed negatively correlate with, and predict, paranormal beliefs. Similarly, Preston and Epley (2009) suggested that religiosity (a subscale of the paranormal in the Manchester Metropolitan University Paranormal Belief Scale) and science are conflicting; belief in one reduces an individual's acceptance of the other (Drinkwater, 2017). However, while some state this is because those with high belief in science simply possess more logic, Irwin et al. (2016) believes this to be an unfair assumption; a notion which appears to be wholly supported by further research (Legare et al., 2012). For example, many studies have suggested that people often simultaneously endorse both paranormal and scientific explanations, while others have been shown to unthinkingly accept science which undeniably requires some faith (Haught, 2005; Evans & Lane, 2011; Legare et al., 2012). Therefore, the relationship between scientific and paranormal beliefs may not be as simple as it originally appears, and thus demands additional consideration which this study will deliver (Legare et al., 2012; Irwin et al., 2016).

Further, thinking style has been of keen interest regarding paranormal beliefs (Lindeman & Aarnio, 2006). Specifically, whether an individual's tendency to think more analytically (possessing rationality), or more intuitively (termed experientiality), relates to or predicts these beliefs (Pacini & Epstein, 1999; Lindeman & Aarnio, 2006). These systems are not inversely associated; rather, Epstein et al. (1996) proposed that they are independent, meaning it is possible for one to be high or low in both thinking styles. Research into the value of these in predicting paranormal

beliefs was conducted by Lindeman and Aarnio (2006). In their study, 3,261 participants completed the Rationality-Experientiality Inventory (REI) to measure the two thinking styles mentioned, along with several measures of paranormal beliefs (Pacini & Epstein, 1999; Lindeman & Aarnio, 2006). The researchers discovered that low rational thinking and high experiential thinking were vital predictors of belief in paranormal processes, with experientiality being the most influential (Lindeman & Aarnio, 2006). These findings are notable for the present study as it possesses many parallels with Lindeman and Aarnio's (2006) research in that it will also utilise the REI, in addition to having a sample consisting largely of university students, meaning similar conclusions may be anticipated. Then again, Lindeman and Aarnio (2006) state that their study was limited in that it was subjected to order effects, which could have impacted any findings. As the current research employs counter-balancing as recommended to ensure these are not an issue, this additional methodological stringency could give rise to contrasting findings than those presented (Lindeman & Aarnio, 2006).

Another factor which has been of interest regarding paranormal beliefs is schizotypy, which Day & Peters (1999) describe as having experiences resembling positive schizophrenia symptoms (e.g. hallucinations) whilst continuing to be an active societal contributor (Andreasen et al., 1990). One piece of research exploring schizotypy and paranormal beliefs was by Hergovich et al. (2008) who, using questionnaires involving 571 adolescents, concluded that schizotypy may be a predictor of paranormal beliefs. However, this study involved adolescents whereas the present study does not, a pertinent point to highlight when it has been indicated that adolescents and adults may vary in their belief structure (Wolfradt & Straube, 1998). Thus, additional research must be considered to gain an improved understanding of the area (Hergovich et al., 2008). A study investigating schizotypy and paranormal beliefs with a sample more aligned with the current research is by Dagnall et al. (2010), who found that schizotypy scores on the Schizotypy Personality Questionnaire-Brief (SPQ-B) were positively correlated with paranormal belief scores (Raine & Benishay, 1995). Drawing further parallels with Dagnall et al. (2010), the current study will also employ the SPQ-B, meaning these results, along with Hergovich et al.'s (2008) conclusions, provide a clearer outlook for potential findings (Raine & Benishay, 1995). Then again, Chequers et al. (1997) found no significant association between schizotypy and belief in extra-terrestrials, a subscale of paranormal beliefs, suggesting the relationship between these two factors could merit further consideration (Drinkwater, 2017). Regardless, Irwin (2009) states that the reason for reported positive correlations between schizotypy and paranormal beliefs is because schizotypy involves a reality testing deficit, meaning positive correlations between these factors may also be anticipated.

Arlow (2018) describes reality testing as the extent to which someone can differentiate the internal (the self) from the external (object) world. Previously, some have theorised that deficits in reality testing may be vital in the development of paranormal beliefs (Irwin, 2003). If this is accurate, those who score high on paranormal belief measures may also score high on reality testing measures, in addition to reality testing deficits being a predictor (Irwin, 2003). This view was maintained by Drinkwater et al. (2012), who demonstrated that reality testing deficits correlated with increased paranormal beliefs in a sample of 136 participants. Similarly, more recent research by Dagnall et al. (2014) established this across three

robust, commonly employed measures of paranormal beliefs. Furthermore, in his replication study using 161 Australian adults, Irwin (2004) discovered reality testing to be a predictor of belief in the paranormal, which he considers support for his earlier assumption that the maintenance and formation of these beliefs may include some deficiency in reality testing. He maintains the reason for this is because individuals with these deficits immediately gravitate towards paranormal explanations for anomalous incidents, without thinking about how logical that attribution may be (Irwin, 2004). Therefore, Irwin (2004) also theorises that deficits in reality testing could be accompanied by more experiential thinking styles, which the present study will consider (Irwin, 2004). While, the discussed research does provide some direction for the current study, the area is an emerging one which therefore requires additional investigation (Irwin, 2003, 2004; Drinkwater et al., 2012).

Contrasting with many of the factors discussed, the role of uncertainty in paranormal beliefs is relatively under researched (Hart et al., 2013). Of the existing literature, much of the focus is on intolerance to uncertainty as demonstrated by Hart et al. (2013), who found it to possess significant positive associations with belief in the paranormal. However, investigation into emotional response to uncertainty in relation to paranormal beliefs is all but absent, which the present study hopes to address (Greco & Roger, 2001). As a result of this omission in the literature, there exists little research which can provide this study with direction of what might be anticipated. Yet, it has been proposed that increases in belief in the paranormal during uncertainty may be due to the emotionality of the situation (Dudley, 2000). If this is indeed the case, then individuals with high emotional responses to uncertain circumstances may be more likely to accept the paranormal (Dudley, 2000). Further, as emotional response to uncertainty is defined by the experienced anxiety of being faced with ambiguity, Persinger's (1985) suggestion that some paranormal beliefs could assist in reducing anxiety may explain any potential associations (Greco & Roger, 2001). For example, those with high emotional responses may use paranormal beliefs as a coping mechanism when faced with uncertainty, as these beliefs are thought to possess their most substantial influence when negative emotions are present (Persinger, 1985; Dudley, 2000).

The aim of this study is to assess whether paranormal beliefs correlate with, or are predicted by, emotional response to uncertainty, belief in science, reality testing, schizotypy, and rationality-experientiality. Although relationships between several of these factors has been somewhat explored previously, the discussed research demonstrates the need for further investigation of many of them (Haught, 2005; Lindeman & Aarnio, 2006; Legare et al., 2012). This study is justified in that it will provide this, while considering the limitations presented (e.g. counter-balancing), in order to gain an improved understanding and add to the evidence base (Lindeman & Aarnio, 2006). Additionally, the unique exploration of a notable omission within the literature, the associations between paranormal beliefs and emotional response to uncertainty (henceforth referred to as uncertainty), provides further rationale for the present study (Greco & Roger, 2001). Thus, the hypotheses are as follows:

**Hypothesis 1:** *Belief in science will have significant negative correlations with, and be a significant predictor of, paranormal beliefs.*

**Hypothesis 2:** *Rationality and experientiality will be significant predictors of paranormal beliefs.*

**Hypothesis 3:** *Uncertainty will have significant positive correlations with paranormal beliefs.*

## Method

### Design

The study utilised a quantitative, non-experimental design of self-report questionnaires measuring seven variables: paranormal beliefs, uncertainty, belief in science, reality testing, schizotypy, rationality, and experientiality. Self-report measures were chosen due to their established practicality, and capacity to provide rich data sets (Paulhus & Vazire, 2007).

### Participants

One hundred and fifty-three individuals participated through opportunity sampling. This involved gathering respondents where available and was selected due to its convenience in gathering large numbers of participants (Fogelman, 2002). There were 109 female participants with a mean age of 23.55 ( $SD = 11.46$ ) and range of 18-88 years, in addition to 44 males with a mean age of 26.89 ( $SD = 15.04$ ) and range of 18-89 years. Overall, participants had a mean age of 24.51 years ( $SD = 12.64$ ), with a range of 18-89 years. Respondents were required to be 18 years of age or above.

The sample comprised of undergraduate students from Manchester Metropolitan University and other universities (83%), along with individuals from the general public (17%). Of the male participants, 70.5% were students while 29.5% were not, and 88.1% of female respondents were students compared to 11.9% who were not. These were recruited from the SONA Participant Pool, MMU campus (e.g. cafés), and local gatherings. Participation was voluntary and could be terminated at any time. Respondents could also withdraw their results afterwards by quoting their unique identifier code to a researcher.

### Measures

This study employed six self-report measures: the Manchester Metropolitan University Paranormal Belief Scale (MMUpbs; Drinkwater, 2017), Uncertainty Response-Emotional factor of the Uncertainty Response Scale (UR-E; Greco & Roger, 2001), Belief in Science Scale (BISS; Farias et al., 2013), reality testing subscale of the Inventory of Personality Organisation (IPO-RT; Lenzenweger et al., 2001), Schizotypal Personality Questionnaire-Brief (SPQ-B; Raine & Benishay, 1995), and the Rational-Experiential Inventory (REI; Pacini & Epstein, 1999).

**Paranormal Beliefs:** The MMUpbs was used to measure paranormal beliefs, which has demonstrated good internal reliability and validity (Drinkwater, 2017). This 50-item questionnaire by Drinkwater (2017) assesses overall belief and eight subscales: hauntings, superstition, religion, extra-sensory perception (ESP), extra-terrestrials/aliens, psychokinesis (PK), astrology, and witchcraft. Respondents rate statements (e.g. “ghosts do not exist”) on a 7-point Likert scale (1 being “strongly disagree” and 7 being “strongly agree”), with high scores indicating high belief (Drinkwater, 2017). The measure includes 12 negatively worded items (e.g. “it is not possible to communicate with the spirit world”) in order to limit response bias, which were reversed prior to analysis (Drinkwater, 2017).

**Uncertainty:** Emotional response to uncertainty was assessed by the UR-E factor of Greco and Roger's (2001) 76-item Uncertainty Response Scale, which has demonstrated high internal and re-test reliability. This measure contains 15 items (e.g. "sudden changes make me feel upset") rated on a 4-point Likert (1 being "never" and 4 being "always"), with high scores indicating a tendency to exhibit maladaptive responses to uncertainty (Greco & Roger, 2001). No items required reversing and there are no subscales (Greco & Roger, 2001).

**Belief in Science:** This was calculated using the BISS, a 10-item scale with high internal reliability and validity (Farias et al., 2013; Irwin et al., 2015). Statements (e.g. "science is the most valuable part of human culture") are rated on a 6-point Likert (1 being "strongly disagree" and 6 being "strongly agree"), with high scores signifying high belief (Farias et al., 2013). Conventions dictate that there are no subscales and no items required reversing, with scores being an average over the 10 items (Farias et al., 2013).

**Reality Testing:** Reality testing was measured by Lenzenweger et al.'s (2001) IPO-RT, a subscale of the IPO that is intended to assess 'capacity to differentiate self from non-self, intrapsychic from external stimuli, and to maintain empathy with ordinary social criteria of reality' (Kernberg, 1996:120). This scale is comprised of 20 statements (e.g. "I have seen things which do not exist in reality") which are rated on a 5-point Likert (1 being "never true" and 5 being "always true"), with high scores representing potential deficits (Lenzenweger et al., 2001). The scale has displayed good retest reliability and construct validity, in addition to being internally reliable with non-clinical samples (Lenzenweger et al., 2001). Traditionally, this measure encompasses four subscales (delusional thinking, confusion, auditory and visual hallucinations, and social deficits); however, Dagnall et al. (2018) states that it should be utilised as a total scale, to which the current study adheres (Lenzenweger et al., 2001).

**Schizotypy:** This was assessed using the SPQ-B, a 22-item scale containing statements (e.g. "I am an odd, unusual person") and questions (e.g. "do you feel that you are unable to get "close" to people?") which are rated dichotomously ("yes" or "no") (Raine & Benishay, 1995). This measure is a brief version of the 74-item SPQ and possesses adequate internal reliability, with three subscales: interpersonal deficits, cognitive-perceptual deficits, and disorganisation (Raine, 1991; Raine & Benishay, 1995; Axelrod et al., 2001). However, Compton et al. (2007) advised utilisation of total scores as opposed to these subscales, which this research follows. No items required reversing, with high scores signifying potential schizotypal personality (Raine & Benishay, 1995).

**Rationality-Experientiality:** Thinking styles were measured by the REI, a questionnaire encompassing 40 items which are rated on a 5-point Likert (1 being "completely false" and 5 being "completely true") (Pacini & Epstein, 1999). This scale contains 19 negatively worded items, and two reliable, independent main scales: rationality and experientiality (Pacini & Epstein, 1999). Further, these each have two reliable subscales: rational ability and rational engagement, and experiential ability and experiential engagement (Pacini & Epstein, 1999). The rationality scale (e.g. "I have a logical mind") assesses participation in analytical thinking, whereas experientiality (e.g. "I believe in trusting my hunches") measures engagement in associative thought (Pacini & Epstein, 1999; Lindeman & Aarnio, 2006).

## **Procedure**

To begin, ethical approval was granted through EthOS and an insurance checklist was completed. Following, respondents were invited to complete a questionnaire on paper, or online through Qualtrics (Qualtrics, 2005). To eliminate order effects, researchers created six variations of the paper booklet, featuring the measures in different orders. For the online version, a randomiser was added to the survey flow. Initially, participants read an information sheet which described the study, before signing a consent form which asked their preferred gender, age in years, whether or not they were a student, and occupation. Succeeding this was the six randomised questionnaires. Participation ended with a debrief sheet, where respondents were thanked and provided with support details. Here, they were given the opportunity to create a unique identifier code and informed of their right to withdraw for up to four weeks, along with information on how to do so. No time limit existed for completion.

## Results

### Reliability Analysis

Cronbach's alpha ( $\alpha$ ) within SPSS was utilised to assess the internal reliability of the six measures (Table 1). The MMUpbs ( $\alpha = .96$ ), UR-E ( $\alpha = .93$ ), BISS ( $\alpha = .92$ ), IPO-RT ( $\alpha = .92$ ), and REI main scales of rationality ( $\alpha = .90$ ) and experientiality ( $\alpha = .90$ ) displayed excellent internal reliability. While, the SPQ-B ( $\alpha = .88$ ) demonstrated good internal reliability. No items were removed from any measure. Summary statistics for total measures are presented in Table 1.

The internal reliability for subscales was also calculated (Table 2 and Table 3). The MMUpbs subscales of hauntings ( $\alpha = .93$ ), extra-terrestrials/aliens ( $\alpha = .93$ ), PK ( $\alpha = .92$ ), and witchcraft ( $\alpha = .91$ ) exhibited excellent internal reliability, while religion ( $\alpha = .89$ ), ESP ( $\alpha = .81$ ), and astrology ( $\alpha = .83$ ) had good internal reliability, and superstition ( $\alpha = .79$ ) demonstrated adequate internal reliability. REI subscales of rational ability ( $\alpha = .82$ ), rational engagement ( $\alpha = .85$ ), experiential ability ( $\alpha = .84$ ), and experiential engagement ( $\alpha = .82$ ) showed good internal reliability.

### Descriptive Statistics

Relationships between main scales were examined using Pearson correlations (Table 1). Corresponding with Drinkwater et al. (2012), this study utilised  $r$  as an indicator of effect size, with .50 signifying a large effect, .30 a medium effect, and .10 indicating a small effect.

**Table 1**

#### Correlations and Summary Statistics for Paranormal Beliefs (MMUpbs), Uncertainty (UR-E), Belief in Science (BISS), Reality Testing (IPO-RT), Schizotypy (SPQ-B), and Rationality-Experientiality (REI)

	1	2	3	4	5	6	7	$\alpha$	$M$	$SD$
1. MMUpbs								.96	164.25	52.72
2. UR-E	.27**							.93	35.10	9.35
3. BISS	-.36**	.00						.92	3.90	1.12
4. IPO-RT	.52**	.36**	-.15					.92	40.50	13.96
5. SPQ-B	.27**	.34**	-.22**	.52**				.88	8.25	5.47
6. REI-Rationality	-.21*	-.16	.18*	-.09	-.02			.90	70.47	12.21
7. REI-Experientiality	.26**	.22**	-.13	.22**	.14	.02		.90	67.62	11.89

**Note:** \*\* Significant at .01 level ( $p < .01$ ; 1-tailed)

\* Significant at .05 level ( $p < .05$ ; 1-tailed)

N = 153

Paranormal beliefs were found to have significant positive correlations with uncertainty,  $r(151) = .27$ ,  $p < .001$ ; reality testing,  $r(151) = .52$ ,  $p < .001$ ; schizotypy,  $r(151) = .27$ ,  $p < .001$ ; and experientiality,  $r(151) = .26$ ,  $p = .001$ . While, significant negative relationships were discovered with belief in science,  $r(151) = -.36$ ,  $p < .001$ ; and rationality,  $r(151) = -.21$ ,  $p = .011$ .

Uncertainty possessed significant positive associations with reality testing,  $r(151) = .36, p < .001$ ; schizotypy,  $r(151) = .34, p < .001$ ; and experientiality,  $r(151) = .22, p = .006$ . Uncertainty did not significantly correlate with belief in science or rationality.

It was discovered that belief in science had significant a positive relationship with rationality,  $r(151) = .18, p = .027$ . However, it had significant negative correlations with schizotypy,  $r(151) = -.22, p = .007$ . No significant correlation existed between belief in science and reality testing, or it and experientiality.

Further, reality testing had significant positive correlations with schizotypy,  $r(151) = .52, p < .001$ ; and experientiality,  $r(151) = .22, p = .007$ . Reality testing showed no significant associations with rationality.

Schizotypy did not significantly correlate with rationality or experientiality.

Further analysis was conducted to explore correlations between MMUpbs subscales and other total measures (Table 2).

**Table 2**

**Summary Statistics for MMUpbs subscales and Correlations with other main scales**

	UR-E	BISS	IPO-RT	SPQ-B	REI-R	REI-E	$\alpha$	M	SD
MMUpbs									
Hauntings	.24**	-.24**	.45**	.26**	-.12	.21**	.93	28.99	12.93
ET/Aliens	.16*	-.06	.34**	.19*	-.12	.05	.93	24.09	10.85
PK	.19**	-.22**	.47**	.15*	-.19*	.12	.92	11.26	6.43
Witchcraft	.24**	-.40**	.39**	.20**	-.12	.12	.91	13.06	7.20
Religion	.09	-.55**	.34**	.21**	-.06	.17*	.89	28.79	11.02
ESP	.30**	-.30**	.45**	.30**	-.16*	.43**	.81	22.10	7.84
Astrology	.16*	-.36**	.38**	.22**	-.33**	.23**	.83	18.00	8.07
Superstition	.27**	.02	.22**	-.01	-.20**	.24**	.79	17.95	7.22

**Note:** \*\* Significant at .01 level ( $p < .01$ ; 1-tailed)

\* Significant at .05 level ( $p < .05$ ; 1-tailed)

REI-R = REI-Rationality; REI-E = REI-Experientiality

N = 153

Hauntings demonstrated significant positive correlations with uncertainty,  $r(151) = .24, p = .002$ ; reality testing,  $r(151) = .45, p < .001$ ; schizotypy,  $r(151) = .26, p = .001$ ; and experientiality,  $r(151) = .21, p = .004$ . Hauntings had significant negative relationships with belief in science,  $r(151) = -.24, p = .002$ . It had no significant correlation with rationality.

Extra-terrestrials/aliens had significant positive relationships with uncertainty,  $r(151) = .16, p = .021$ ; reality testing,  $r(151) = .34, p < .001$ ; and schizotypy,  $r(151) = .19, p = .010$ . However, it had no significant correlations with belief in science, rationality, or experientiality.

Moreover, PK demonstrated significant positive associations with uncertainty,  $r(151) = .19, p = .010$ ; reality testing,  $r(151) = .47, p < .001$ ; and schizotypy,  $r(151) = .15, p$

= .034. It displayed significant negative correlations with belief in science,  $r(151) = -.22, p = .003$ ; and rationality,  $r(151) = -.19, p = .010$ . No significant relationship existed between PK and experientiality.

Witchcraft demonstrated significant positive associations with uncertainty,  $r(151) = .24, p = .001$ ; reality testing,  $r(151) = .39, p < .001$ ; and schizotypy,  $r(151) = .20, p = .006$ . It possessed significant negative correlations with belief in science,  $r(151) = -.40, p < .001$ . No significant correlation was found with rationality or experientiality.

Religion had significant positive relationships with reality testing,  $r(151) = .34, p < .001$ ; schizotypy,  $r(151) = .21, p = .004$ ; and experientiality,  $r(151) = .17, p = .019$ . However, it showed significant negative correlations with belief in science,  $r(151) = -.55, p < .001$ . No association was found with uncertainty or rationality.

ESP possessed significant positive correlations with uncertainty,  $r(151) = .30, p < .001$ ; reality testing,  $r(151) = .45, p < .001$ ; schizotypy,  $r(151) = .30, p < .001$ ; and experientiality,  $r(151) = .43, p < .001$ . However, it showed significant negative relationships with belief in science,  $r(151) = -.30, p < .001$ ; and rationality,  $r(151) = -.16, p = .026$ .

Likewise, Astrology demonstrated significant positive associations with uncertainty,  $r(151) = .16, p = .024$ ; reality testing,  $r(151) = .38, p < .001$ ; schizotypy,  $r(151) = .22, p = .003$ ; and experientiality,  $r(151) = .23, p = .002$ . It had significant negative correlations with belief in science,  $r(151) = -.36, p < .001$ ; and rationality,  $r(151) = -.33, p < .001$ .

Superstition displayed significant positive correlations with uncertainty,  $r(151) = .27, p < .001$ ; reality testing,  $r(151) = .22, p = .003$ ; and experientiality,  $r(151) = .24, p = .001$ . Significant negative correlations were exhibited between superstition and rationality,  $r(151) = -.20, p = .006$ . No significant associations were found with belief in science or schizotypy.

**Table 3**

**Summary Statistics for REI subscales and Correlations with other main scales**

	MMUpbs	UR-E	BISS	IPO-RT	SPQ-B	$\alpha$	<i>M</i>	<i>SD</i>
REI								
Rational Ability	-.25**	-.16*	.23**	-.15*	-.07	.82	36.30	6.14
Rational Engagement	-.14*	-.13	.11	-.02	.03	.85	34.17	7.16
Experiential Ability	.23**	.21**	-.12	.15*	.07	.84	34.52	6.53
Experiential Engagement	.25**	.20**	-.12	.25**	.19*	.82	33.10	6.37

**Note:** \*\* Significant at .01 level ( $p < .01$ ; 1-tailed)

\* Significant at .05 level ( $p < .05$ ; 1-tailed)

N = 153

Regarding REI subscales (Table 3), rational ability had significant positive correlations with belief in science,  $r(151) = .23, p = .003$ ; and significant negative associations with paranormal beliefs,  $r(151) = -.25, p = .001$ ; uncertainty,  $r(151) = -.16, p = .022$ ; and reality testing,  $r(151) = -.15, p = .030$ . No significant relationship was found with schizotypy.

Rational engagement had significant negative correlations with paranormal beliefs,  $r(151) = -.14, p = .046$ . It possessed no significant relationships with uncertainty, belief in science, reality testing, or schizotypy.

Experiential ability demonstrated significant positive relationships with paranormal beliefs,  $r(151) = .23, p = .002$ ; uncertainty,  $r(151) = .21, p = .005$ ; and reality testing,  $r(151) = .15, p = .029$ ; But, it showed no significant correlations with belief in science or schizotypy.

Experiential engagement displayed significant positive associations with paranormal beliefs,  $r(151) = .25, p = .001$ ; uncertainty,  $r(151) = .20, p = .007$ ; reality testing,  $r(151) = .25, p = .001$ ; and schizotypy,  $r(151) = .19, p = .010$ . However, there was no significant correlation with belief in science.

Pearson correlations were also conducted to discover relationships between subscales of the MMUpbs and REI (Table 4).

**Table 4**

**Correlations between subscales of MMUpbs and subscales of REI**

	Rational Ability	Rational Engagement	Experiential Ability	Experiential Engagement
Hauntings	-.18*	-.05	.18*	.21**
ET/Aliens	-.16*	-.06	.01	.07
PK	-.22**	-.13*	.11	.11
Witchcraft	-.19**	-.04	.15*	.08
Religion	-.07	-.04	.16*	.15*
ESP	-.20**	-.10	.39**	.40**
Astrology	-.35**	-.27**	.19**	.23**
Superstition	-.18*	-.19*	.19**	.26**

**Note:** \*\* Significant at .01 level ( $p < .01$ ; 1-tailed)

\* Significant at .05 level ( $p < .05$ ; 1-tailed).

N = 153

Hauntings had significant positive correlations with experiential engagement,  $r(151) = .21, p = .004$ ; and experiential ability,  $r(151) = .18, p = .015$ . It demonstrated significant negative relationships with rational ability,  $r(151) = -.18, p = .015$ . Hauntings did not significantly associate with rational engagement.

Extra-terrestrials/aliens had significant negative correlations with rational ability,  $r(151) = -.16, p = .022$ . It had no significant associations with rational engagement, experiential ability, or experiential engagement.

PK demonstrated significant negative correlations with rational ability,  $r(151) = -.22, p = .004$ ; and rational engagement,  $r(151) = -.13, p = .049$ . However, it did not significantly relate with experiential ability or experiential engagement.

Witchcraft showed significant positive associations with experiential ability,  $r(151) = .15, p = .036$ ; and significant negative correlations with rational ability,  $r(151) = -.19, p = .009$ . No significant relationship was found with rational engagement or experiential engagement.

Religion showed significant positive correlations with experiential ability,  $r(151) = .16$ ,  $p = .023$ ; and experiential engagement,  $r(151) = .15$ ,  $p = .035$ . Though, it demonstrated no significant associations with rational ability and rational engagement.

ESP displayed significant positive associations with experiential ability,  $r(151) = .39$ ,  $p < .001$ ; and experiential engagement,  $r(151) = .40$ ,  $p < .001$ . Whereas, it possessed significant negative relationships with rational ability,  $r(151) = -.20$ ,  $p = .007$ . But, it showed no significant association with rational engagement.

Astrology had significant positive correlations with experiential ability,  $r(151) = .19$ ,  $p = .009$ ; and experiential engagement,  $r(151) = .23$ ,  $p = .002$ . While, it had significant negative relationships with rational ability,  $r(151) = -.35$ ,  $p < .001$ ; and rational engagement,  $r(151) = -.27$ ,  $p < .001$ .

Finally, superstition too had significant positive correlations with experiential ability,  $r(151) = .19$ ,  $p = .008$ ; and experiential engagement,  $r(151) = .26$ ,  $p = .001$ . Similarly, it demonstrated significant negative relationships with rational ability,  $r(151) = -.18$ ,  $p = .012$ ; and rational engagement,  $r(151) = -.19$ ,  $p = .010$ .

## Regression Analysis

Before conducting multiple regression, assumptions were tested to confirm that this was a valid method of analysis. Standardised residuals indicated no outliers (Std. Residual Min = -3.26, Std. Residual Max = 2.20). Tests to ensure data met collinearity assumptions showed that multicollinearity was not a concern (uncertainty, Tolerance = .78, VIF = 1.28; belief in science, Tolerance = .89, VIF = 1.12; reality testing, Tolerance = .67, VIF = 1.49; schizotypy, Tolerance = .67, VIF = 1.49; rationality, Tolerance = .93, VIF = 1.08; experientiality, Tolerance = .91, VIF = 1.10). Data also met assumptions of independent errors (Durbin-Watson value = 1.89), and non-zero variances (paranormal beliefs, Variance = 2779.61; uncertainty, Variance = 87.48; belief in science, Variance = 1.26; reality testing, Variance = 194.78; schizotypy, Variance = 29.89; rationality, Variance = 149.11; experientiality, Variance = 141.30). The histogram, normal P-P plot, and scatterplot of standardised residuals demonstrate that the data satisfied assumptions of homoscedasticity and linearity.

**Table 5**

### Summary of regression analysis for factors predicting Paranormal Beliefs (MMUpbs)

	Unstandardised coefficient (B)	B (Std. Error)	Standardised coefficient (β)	t	Sig. (p)
Constant	130.99	32.32		4.05	<.001
UR-E	.54	.41	.10	1.30	.196
BISS	-13.09	3.22	-.28	-4.07	<.001
IPO-RT	1.68	.30	.44	5.64	<.001
SPQ-B	-.70	.76	-.07	-.92	.359
REI-Rationality	-.45	.29	-.11	-1.57	.120
REI-Experientiality	.52	.30	.12	1.74	.085

**Note:** N = 153

Using the 'enter' method (Table 5), a significant model arose ( $F(6, 146) = 15.54, p < .001$ ). The relationship between variables was strong ( $R = .62$ ), and the model explained 39.0% ( $R^2_{adj} = 36.5\%$ ) of the variance in paranormal belief scores. Of the six factors, reality testing was the strongest predictor of paranormal beliefs,  $\beta = .44, t(146) = 5.64, p < .001$ ; while belief in science was a significant negative predictor,  $\beta = -.28, t(146) = -4.07, p < .001$ . However, paranormal beliefs were not predicted by uncertainty,  $\beta = .10, t(146) = 1.30, p = .196$ ; schizotypy,  $\beta = -.07, t(146) = -.92, p = .359$ ; rationality,  $\beta = -.11, t(146) = -1.57, p = .120$ ; or experientiality,  $\beta = .12, t(146) = 1.74, p = .085$ .

**Table 6****Model summary of stepwise method for factors predicting Paranormal Beliefs (MMUpbs)**

	Adj $R^2$	Unstandardised coefficient (B)	B (Std. Error)	Standardised coefficient ( $\beta$ )	t	Sig. (p)
<b>Step 1</b>						
Constant		85.01	11.26			
IPO-RT	.26	1.96	.26	.52	7.44	<.001
<b>Step 2</b>						
Constant		145.29	17.37			
IPO-RT	.34	1.79	.25	.47	7.12	<.001
BISS		-13.73	3.13	-.29	-4.39	<.001

**Note:** N = 153

Further, the 'stepwise' method was utilised (Table 6). This enters predictor variables one by one, ordered by the strength of their relationship to paranormal beliefs, to discover additive impact (Drinkwater et al., 2012).

The first model that emerged was significant ( $F(1, 151) = 55.34, p < .001$ ). This model ( $R = .52$ ) explained 26.8% ( $R^2_{adj} = 26.3\%$ ) of the variance, and included only reality testing,  $\beta = .52, t(151) = 7.44, p < .001$ .

The second model was also significant ( $F(2, 150) = 40.65, p < .001$ ). This model ( $R = .59$ ) accounted for 35.1% ( $R^2_{adj} = 34.3\%$ ) of the variance, which also included reality testing,  $\beta = .47, t(150) = 7.12, p < .001$ ; along with belief in science,  $\beta = -.29, t(150) = -4.39, p < .001$ .

## Discussion

The current study found that belief in science had significant negative correlations with, and was a significant predictor of, paranormal beliefs. Thus, hypothesis 1 was accepted. These results are in parallel with Irwin et al. (2016), who concluded similarly regarding these two factors. Further, the significant negative relationship between scientific belief and the MMUpbs subscale of religion provides support for Preston and Epley's (2009) notion that these two factors are inversely related (Drinkwater, 2017). As the findings demonstrate that those who view the world in a more objective sense (having high belief in science) are indeed sceptical to accept the paranormal, it suggests that there could be merit to Irwin's (2009) claim that these beliefs could be impacted by individuals' worldview (Irwin et al., 2016). Importantly, this is furthered when examining the correlations between scientific belief and the subscales of the MMUpbs (Drinkwater, 2017). For example, belief in science displayed significant negative associations with every subscale apart from extra-terrestrials/aliens and superstition, where no correlation was present, indicating there could be accuracy in that these people reject or are indifferent towards anything they cannot directly observe (Irwin, 2009; Irwin et al., 2016). Meanwhile, these subscale correlations also appear to contradict Legare et al. (2012) and Evans and Lane's (2011) suggestion of a supposed simultaneous endorsement of scientific and paranormal explanations. Furthermore, while Irwin et al. (2016) proposed it may be unjust to assume that those with high belief in science are more logical, there are indications that these individuals often possess more rational thinking styles as demonstrated through the significant positive correlations found between the two.

Continuing with thinking styles, it was found that paranormal beliefs displayed significant positive correlations with experientiality, while having significant negative associations with rationality. This supports the idea that whether individuals think more analytically, or more intuitively, may relate to their tendency to believe in the paranormal (Lindeman & Aarnio, 2006). Regarding thinking styles as predictors, neither rationality or experientiality were found to be significant predictors of paranormal beliefs in the current study, meaning hypothesis 2 was rejected. Evidently, this appears to contrast with Lindeman and Aarnio (2006), who concluded that low rationality and high experientiality were crucial predictors of paranormal belief. As both the present research and Lindeman and Aarnio (2006) employed the REI to assess thinking styles, along with a sample consisting mainly of university students, it seems unlikely that this disparity could be due to the use of this measure or samples utilised (Pacini & Epstein, 1999; Lindeman & Aarnio, 2006). Rather, this study's implementation of counter-balancing may have been a factor since, as acknowledged, this methodological rigour was lacking in Lindeman & Aarnio's (2006) research and may have led to order effects. Therefore, some may state that this research potentially presents a more valid exploration of these two factors; however, future study should investigate thinking style and paranormal beliefs further.

Examination of schizotypy demonstrated that it did not significantly predict paranormal beliefs, yet a significant positive relationship existed between the two. On the one hand, the latter parallels the findings of Dagnall et al. (2010) who discovered likewise, while the former directly refutes Hergovich et al.'s (2008) conclusions that schizotypy is a significant predictor of belief in the paranormal. The reasons for this could be due to the shared methodology between the current research and Dagnall et al. (2010), in that both utilised the SPQ-B in a sample of

predominantly psychology students from MMU. Whereas, differences in sample may explain the contrasting findings between this research and Hergovich et al. (2008), who's respondents were adolescents recruited from Austrian schools. For example, the cultures involved in both studies may have dissimilarities which bring about these opposing results. Alternatively, it could be that there is accuracy in Wolfradt and Straube's (1998) theory that adolescents and adults have varied factor structures underlying their beliefs, such as those in the paranormal. Further, when exploring the subscales of paranormal belief, the findings contradicted those of Chequers et al. (1997) as schizotypy displayed significant positive associations with extra-terrestrials/aliens. However, measures of extra-terrestrial belief may have been a factor in this discrepancy as Chequers et al.'s (1997) devised questions for specific use within their study, whereas the current research employed the MMUpbs which has demonstrated repeated reliability (Drinkwater, 2017). The results of the current study indeed provide additional evidence for the claim that schizotypy involves a deficit of reality testing because, as expected, these two factors displayed a significant positive relationship (Irwin, 2009).

Corresponding with findings by Drinkwater et al. (2012) and Dagnall et al. (2014), the results showed a significant positive correlation between reality testing deficits and paranormal beliefs. While, Dagnall et al. (2014) demonstrated this using three measures of paranormal beliefs, this study adds to the increasingly prevalent relationship between the two factors by establishing it with a more recent measure in the MMUpbs (Drinkwater, 2017). Analysing these factors further demonstrated that reality testing deficits also had significant positive correlations with every subscale of the MMUpbs, which was not the case with any other main scale, providing supplementary evidence for the strong relationship (Drinkwater, 2017). Moreover, the regression analysis illustrates that reality testing was the strongest predictor of paranormal beliefs which, consistent with Irwin's (2004) study, suggests that there could be accuracy in the idea that these people tend to accept paranormal explanations for anomalous events without considering the logic. This notion may also explain the positive associations found between reality testing deficits and experiential thinking styles, as the paranormal attributions that these people make may be influenced by the reliance on intuition which characterises experientiality, supporting Irwin's (2004) theory regarding the two factors (Pacini & Epstein, 1999). Further, exploration of experientiality subscales demonstrates that experiential engagement, or the enjoyment of relying on feelings in decision making, had the largest effect on reality testing; a result which should be investigated in more detail in future research (Pacini & Epstein, 1999)

As previously established, a large proportion of the limited research into uncertainty and paranormal beliefs has concerned intolerance to uncertainty (Hart et al., 2013). Regarding the current study's novel exploration of emotional response to uncertainty, it was discovered it was not a predictor of paranormal beliefs, but a significant positive relationship existed between it and belief in the paranormal. Accordingly, hypothesis 3 was accepted. In support of Dudley's (2000) theory, these results could indicate that the level of paranormal beliefs held by individuals may indeed be influenced by the magnitude of unpleasant emotion experienced in response to ambiguity. In the context of Hart et al. (2013), this could suggest that emotionality of uncertainty may have mediated the relationship found in their study (Dudley, 2000). Consistent with Persinger's (1985) explanation, it may be that participants in the present study adopted paranormal explanations as a method of coping with a lack of

definitiveness, due to the recognised capacity of these beliefs in reducing the associated anxiety. However, this notion is called into question somewhat when observing the correlations between emotional response to uncertainty and the MMUpbs subscale of religion as, despite religious coping being well-established in literature, no significant relationship was apparent (Persinger, 1985; Ano & Vasconcelles, 2005). Though, importantly, these are initial exploratory findings in an area where understanding was undoubtedly lacking previously, and so very little can be inferred without further investigation. Nevertheless, the current research represents a valuable starting point.

While, this study addressed limitations of previous research, such as a lack of counter-balancing, it is not without its own (Lindeman & Aarnio, 2006). As with much of the research mentioned, the sample was predominantly one consisting of female university students (Drinkwater, 2012; Dagnall et al., 2014; Irwin et al., 2015). While this is not a problem as such, the researchers acknowledge that it may restrict the generalisability of the findings. To investigate the factors in the current study further, future research would be advised to gather respondents from more varied populations, in order to represent a broader range of ages in hopes of discovering results that are more widely applicable. Furthermore, Irwin (2004) suggests that self-report questionnaires can be a limitation in research. Alternatively, he suggests measures of performance, which subsequent investigations may decide to incorporate where appropriate (Irwin, 2004). Continuing with the measures, the current research utilised a brief version of the Schizotypal Personality Questionnaire to ensure the questionnaire booklet was manageable (Raine & Benishay, 1995). However, if desired, researchers could employ the full 74-item scale to examine whether this yields findings that correspond with, or contrast, the results presented (Raine, 1991).

In sum, paranormal beliefs exhibited significant positive correlations with emotional response to uncertainty, reality testing, and schizotypy. While, paranormal beliefs were found to possess significant negative associations with belief in science and rationality. Both belief in science and reality testing were significant predictors of belief in the paranormal. The implications of this study are that it adds to the evidence base regarding paranormal beliefs and its correlates/predictors, in turn increasing our understanding of why individuals may believe in the associated phenomena. To expand on this, a hierarchical cluster analysis could be performed on data assessing similar factors, with the aim to identify in what way participants group together in their beliefs.

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