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Media Messaging with Undergraduate Students**

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Magical Science: Discriminating Science and Pseudoscience in Media Messaging with Undergraduate Students

ABSTRACT

Magical beliefs and paranormal thinking exist in the public and amongst university students. Researchers have suggested that media can influence such beliefs. A 2012 study suggested pseudoscientific rationales can influence acceptance of reported paranormal phenomena. Using a paranormal belief survey and controlled experiment this work explores the paranormal beliefs and test the effects of three versions of a supernatural news article on undergraduate professional students. One version of the story presented a simple news story, another same with a pseudoscientific rationale, and another gave a discrediting scientific critique. Results confirmed that many students do hold magical beliefs but discriminated between scientific and pseudoscientific narratives. However, pre-existing paranormal beliefs were associated with an increased likelihood of students finding paranormal reports scientific, believable and credible.

Keywords: Science and media, Science education, Science communication

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Context

A number of surveys have reported that paranormal beliefs are widespread in the general public. An Ipsos Reid poll in Canada in 2005 revealed that 47% of Canadians believed in ghosts. More recently a 2014 US Harris poll found that 46% of participants believed in ghosts (Harris Interactive, 2014) and a 2016 YouGov survey in the UK revealed that 28% of participants believed in ghosts (YouGov, 2016). Previous work has also identified that media messaging, and the types of media engaged with, can influence such magical beliefs and how people perceive reports of paranormal events (Brewer & Ley 2013; Brewer, 2012; Nisbet, 2006; Sparks, Hansen, & Shah, 1994). However, there is a lack of empirical work exploring the nature of these beliefs in students, and a consideration of what sort of things might influence the ongoing prevalence of such beliefs by those engaged in science-based professional education. This research explores these earlier findings in the new context of nursing and education professional students.

Two geographically, professionally and culturally disparate Bachelor of Science student cohorts were selected to investigate evidence of magical thinking and ability to discriminate the influence of pseudoscientific media. One group were undertaking their final year of nursing studies in Vancouver, Canada, and the other their final year of education studies before qualifying as school teachers in Plymouth in the UK. Both of these programs exposed students to content on scientific inquiry and evidence-based practice as a part of their professional disciplinary training. The two cohorts were selected in order to provide a diverse sample of students, with a similar level of scientific preparation, and to mitigate potential cultural and professional biases that could exist within a single program. Both had undertaken two research methods courses, and a course specifically examining evidence-based practice and the critical analysis of research in their programs. This study examined the nature of supernatural beliefs by these students and whether attributing an authority-based scientific or pseudoscientific narrative to a short article would influence their acceptance of it. Perceptions of believability (acceptance of its being true), credibility (trustworthiness) and how scientific (based on the methods and principles of science) the article was seen to be, were examined.

Literature Review

Critical Reasoning and Criticality

Cardinal Newman originally suggested the aim of higher education was to “educate the intellect to reason well in all matters, to reach out toward truth, and to grasp it” particularly arguing this should be outside of the influence of religious bodies of the time (Newman, 1897). In the age of *alternative facts* considering how we best educate students to discriminate between competing truths has become even more pressing. Some (Dunne, 2015; Flaming, 2001),

have argued for a focus on phronesis (to act virtuously) as a corrective dimension to modern sciences over-emphasis on *techne* (focused on the practical mechanics of decision-making) this developing *riticality*. Nevertheless, discriminating between competing solutions to complex ill-defined problems characterizes real-world professional practice, and these arguments offer few solutions on how to develop such skills in students. Also, disentangling improved outcomes through the practical application of phronesis distinct from *techne* seems practically impossible. Alternatively, Kreber (2014) argued that practical critical reasoning does not derive from the application of abstract principles nor is it a skill; it is about the development of a certain kind of person. This person should, as Sullivan and Rosin (2008) describe, be “disposed towards questioning and criticizing for the sake of more informed and responsible engagement.” Such dispositions form the basis of critical thinking in professional studies, and are key in making autonomous rational choices in practical applications. This approach embodies both phronesis and criticality to support a higher-level of reasoning.

The influence of misinformation, and its correction though critical analysis has also been highlighted by Lewandowsky et al. (2012). They suggest a number of good practices to engender criticality. In particular, they suggested that developing scepticism is an important skill, in that it can reduce susceptibility to misinformation effects if it prompts people to question the origins of and nature of information. Likewise, active analysis of one’s own worldview/beliefs and of new information to see if it confirms or refutes one’s worldview and consideration of how it relates to personal identity are seen as important skills here.

Generally, science-based higher education programs aim to develop such skills, allowing students to more readily engage analytically with information and data, and discriminate between competing arguments effectively. It follows that the development of criticality should then form a key component of any science-based professional curriculum and therefore, it is important for educators to consider the factors that may influence it.

Magical Thinking

Magic is typically practiced through prescribed rites of precisely defined actions, often verbal, to produce such mysterious effects, whilst magical thinking is the cognitive process that embodies magical belief (Vyse, 2014; Hergovich & Arendasy, 2005; Tobacyk & Wilkinson, 1990; De Busscher, 1957). The nature of magical thinking is complex and most modern theories tend to explain this as a belief that supernatural or paranormal forces can affect causality in some way and belief in the paranormal represents a modern manifestation of this (Vyse, 2014; Rosengren & French, 2013; De Busscher, 1957;). This may involve the manifestation of spiritual forces to cause a specific effect, or a ritualistic act that can produce a result elsewhere. Fundamentally, magical thinking represents an attempt to explain, understand, experience or influence the world though the supernatural, using rituals, symbols, actions, gestures and language rather than

by empirical or scientific means. It involves acceptance of the power of unexplained supernatural or mystical forces to explain or influence events (Hergovich & Arendasy, 2005; Tobacyk & Wilkinson, 1990). Although magical thinking is broadly considered here as a separate phenomenon from religion here, it is acknowledged that some aspects of religion may also incorporate it. It has also been argued that magic is largely a polemical framework used by the scientific community to differentiate and validate their own beliefs and practices, and to discredit those of others (Rosengren & French, 2013; Hanegraaff, 2005).

Work exploring the impact of magical thinking on critical reasoning is limited, although studies suggest it may have an influence. A 2005 study found subjects with lower reasoning ability demonstrated higher paranormal belief and new age philosophy beliefs than did subjects with higher reasoning abilities (Hergovich & Arendasy, 2005). This suggests that those who have better reasoning abilities scrutinize to a greater extent whether their experiences are sufficient justification for belief in the reality of these phenomena. More recent work also found the perception of randomness was less strongly associated with belief in the paranormal. Dagnall et al. (2007) suggested that while belief in the paranormal in undergraduate students is not necessarily associated with weakness in probabilistic reasoning, it is more strongly related to weaknesses associated with their understanding of randomness and misunderstanding of chance factors.

The Influence of Media on Magical Beliefs

A number of studies have suggested that media influences magical thinking and shapes paranormal beliefs about reported paranormal events such as telekinesis, mind-reading, clairvoyance or hauntings that are usually argued as being beyond the scope of conventional scientific understanding. In experiments conducted by Sparks and collaborators in 1994 researchers manipulated exposure to an episode of a television series about paranormal investigations (Sparks, Hansen, & Shah, 1994). They found that exposure to one particular episode led participants to express greater belief in paranormal phenomena. On the other hand, exposure to a version of it that included a disclaimer reduced belief in such phenomena. Paul Brewer found similar results in his work in 2012; he examined beliefs about paranormal phenomena such as ghosts and haunted houses and the influence that media messaging about paranormal investigations had on perceptions of how scientific and credible such investigators were. His experiment tested the effects on the public of three different versions of a news story about paranormal investigators. One version presented the news story in terms of traditional supernaturalism, another presented the story with the “trappings of science” including pseudoscientific technology and jargon, a third, discredited the story with the use of a scientific critique. The study tested whether these different forms of media supported predictions of belief and credibility in the paranormal phenomena, and how scientific the paranormal investigators were seen to be. The results suggested that inclusion of a pseudoscientific narrative in the media

story did influence the credibility of the story, and a belief in the paranormal (Brewer, 2012).

The dilemma researcher's face is that of determining whether viewing media such as television, causes changes in brain and behaviour, or whether if pre-existing personal traits or other conditions predispose people to excessive media use (Takeuchi et al., 2015; Schwartz and Beaver, 2015; Plomin et al, 1990). Nevertheless, work by Gary Small at UCLA reported that experienced web users had developed distinctive neural pathways (Small et al, 2009). Therefore, it is at least reasonable to hypothesize that use of specific media may lead to observable neurological or behavioural changes. Some research has also suggested that the web is a more powerful influence than television, as it is a more active medium (Ferguson and Perse, 2000), whilst the combination of television and web-based media has been suggested to increase perceived message credibility (Chang & Thorson, 2004).

Another aspect of this research has targeted the relationships between the type and quantity of media use and people's paranormal beliefs. Many sceptics express concern that the media may help to foster belief in the paranormal and perceptions of paranormal research as scientific, particularly in the light of uncritical coverage of paranormal research (Brewer & Ley 2013; Brewer, 2012; Hill 2012; Nisbet 2006). Sparks, Nelson, & Campbell (1997) explored cultivation theory to argue that exposure to television programming could influence viewers' beliefs concerning the paranormal. The definitive version of this theory suggests that the televisual medium as a whole has the power to affect viewers' perceptions of reality (Shanahan & Morgan, 1999). In a similar study, Sparks and his colleagues examined how both overall television viewing and the viewing of paranormal-themed programs were related to paranormal beliefs. They found no clear evidence that the former predicted beliefs in the paranormal, but they did find that the latter was positively related to belief in supernatural beings. A follow-up study produced similar findings (Brewer, 2012; Sparks & Miller, 2001).

Overall, this work highlights the potential for magical thinking embodying paranormal beliefs to influence criticality, and for particular genres of media to influence viewers' perceptions (Brewer, 2012; Morgan & Shanahan, 2010). To further our understanding of the effects of magical thinking and the influence of media in university students who had been exposed to education and training in critical thinking, a study was undertaken repeating Brewers earlier work but using final year students in professional disciplines as the population of interest.

Research Questions

The study examined:

- Is there evidence of magical thinking amongst professional nursing and education students, and if so how it is enacted?

- Are professional nursing and education students more likely to believe in magical explanations if they read an article from authority that uses pseudoscientific language to describe the phenomena?
- Do factors such as media type, exposure, and pre-existing beliefs influence belief, credibility and the perception of the scientific value of reports of paranormal events?

Effect of Pseudoscientific and Scientific Rationales

Specifically, the following hypotheses were investigated:

Hypothesis 1A:

Students exposed to a news story from authority about a paranormal phenomenon using a pseudoscientific explanation of it will be more likely to see it as scientific, credible, or to believe in the phenomenon described, compared with those reading a simple news story giving a supernatural explanation.

Hypothesis 1B:

Students exposed to a news story from authority about a paranormal phenomenon using a pseudoscientific explanation of it will be more likely to see it as scientific or credible, or to believe in the phenomenon described, compared with those reading a story from authority providing a scientific rebuttal.

Hypothesis 1C:

Students exposed to a news story about a paranormal phenomenon from authority providing a scientific rebuttal will be less likely to see it as scientific, or credible, or to believe in the paranormal phenomenon described, compared to those reading a simple news story giving a supernatural explanation.

Additionally, the following hypotheses were tested to explore any potential relationships between specific covariates and student reactions to the stories. As with Brewers 2012 study these reflected visual media habits regarding watching paranormal or science TV programs, web use, and web-browsing habits, and also personal paranormal experience and the influence of pre-existing paranormal beliefs.

Effect of Visual Media

Hypothesis 2A:

Time spent viewing television will be positively correlated with seeing the paranormal explanation as scientific, seeing the paranormal phenomenon as credible, and with believing in the paranormal phenomenon.

Hypothesis 2B:

Time spent web-browsing will be positively correlated with seeing the paranormal explanation as scientific, seeing the paranormal phenomenon as credible, and with believing in the paranormal phenomenon.

Effect of Paranormal Media

Hypothesis 3A:

Viewing paranormal reality television shows will be positively correlated with seeing the paranormal explanation as scientific and seeing the paranormal phenomenon as credible, and with believing in the paranormal phenomenon.

Hypothesis 3B:

Browsing websites exploring the paranormal will be positively correlated with seeing a paranormal explanation as scientific, and seeing the paranormal phenomenon as credible, and with believing in the paranormal phenomenon.

Effect of Science Media

Hypothesis 4A:

The time spent watching science documentary shows on television will be negatively correlated with seeing the paranormal explanation as scientific, seeing the paranormal phenomenon as credible, and to believing in the paranormal phenomenon. Significant results would be expected to contrast with Hypothesis #4, if watching scientific television shows has the effect of making students believe less in the reported paranormal phenomenon.

Hypothesis 4B:

Browsing science sites on the web will be negatively correlated with seeing the paranormal explanation as scientific, seeing the paranormal phenomenon as credible, and to believing in the paranormal phenomenon. Significant results would also be expected to contrast with hypothesis 4, and be similar with Hypothesis #8, if this has the effect of making students believe less in the reported paranormal phenomenon.

Effect of Personal Experience

Hypothesis 5:

Reported personal paranormal experience will be positively correlated with seeing the paranormal explanation as scientific, and seeing the paranormal phenomenon as credible, and with believing in the paranormal phenomenon.

Effect of Preexisting Paranormal Beliefs

Hypothesis 6:

Increased paranormal beliefs (Revised Paranormal Belief Scale [RPBS] scores) will be positively correlated with seeing the paranormal explanation as scientific, seeing the paranormal phenomenon as credible, and with believing in the paranormal phenomenon.

Methodology

A quasi-experimental research design following the approach of Brewer's original 2012 study was implemented. Quasi-experimental research shares similarities with traditional experimental research designs or randomized controlled trials, but lacks the element of random assignment to a treatment or control group. As we had a small sample for a 3-way comparison a randomised selection would likely have resulted with one group with a disparate number of students with pre-existing paranormal beliefs. Therefore, a matched subject design was used with separate experimental groups for each treatment, but where the groups were matched in terms of the subject's pre-existing levels of paranormal belief. The advantage of this is that it reduces the chances of a confounding variable skewing the results, particularly with smaller samples (Cohen, Manion & Morrison, 2011; Srinagesh, 2006).

Sample

Two accessible but geographically, professionally and culturally disparate cohorts who had been exposed to an evidence-based rationale for practice were selected using a convenience sample of students in their final years of two different professional programs (N=90). In Canada, these consisted of Bachelor of Science in Nursing students in their final year of the program at the University of British Columbia in Vancouver (cohort =119: n= 35). In the UK students were drawn from the Faculty of Education at the University of Plymouth (cohort = 240: n=55), in their final year of a Bachelor of Education degree. Prior to recruitment ethical approval was obtained from the universities' behavioural research ethics boards. Students were then contacted by an initial email, and further encouraged to volunteer through a brief in-class presentation of the study. As it was important not to prompt the students as to the actual nature of the research and thereby affect their behaviour, some degree of deception was required. Therefore, the work was introduced as a survey exploring conventional and unconventional beliefs in professional students. An incentive of cinema vouchers was offered to all participants to encourage participation. Those interested were sent an initial contact letter detailing the terms of the project and research requirements. Consent forms were also provided to students at this time.

Procedures

In order to match them into three equivalent groups in respect to paranormal beliefs all participants undertook a short online questionnaire using a validated psychometric tool: The Revised Paranormal Belief Scale (Dagnall et al., 2016; Bouvet et al., 2014; Tobacyk, 2004). In order to misdirect participants as to the focus of the research some additional distractor questions on general beliefs about health and society randomly interspersed with the real questions were included. These questions results were discarded prior to

analysis. After obtaining RPBS scores from the participants they were divided into three matched sub-groups of 30 each, so that based on their scores, each group had a balanced mix of students. The mean RPBS survey scores for each group were: group 1: 69, group 2: 70.1 and group 3: 70.6.

The three treatment groups were then each exposed to one of three different versions of a paranormal news story about the ghostly apparition of a murdered girl appearing in a photograph of an old school building. As per Brewer's (2012) study the story was different for each group: Group One read a newspaper article from a correspondent on the appearance of the ghost written in everyday language, explaining it simply as a paranormal event. This represented the control variable, as no explanatory argument or was used, other than a brief referring to the apparition as a paranormal phenomenon. Group Two read the same story, but from a correspondent identified as a PhD prepared social scientist but with an alternative explanatory paragraph using pseudoscientific language to support an explanation of the phenomenon. The third group read a newspaper article from a correspondent identified as a PhD prepared science correspondent on the appearance but with an alternative explanatory paragraph giving a scientific rebuttal of the phenomenon. All students were also provided with a second distractor article was a story about a potential Ebola vaccine, unrelated to the focus of this study other than to distract students from its real purpose. Each participant read these two short newspaper articles (both derived from actual news stories). Accompanying the stories were instructions that asked them to read the two articles, and answer some questions about what they thought of them.

Double-blinding was used to provide an experimental procedure to help guard against both experimenter bias and placebo effects (Cohen, Manion, & Morrison, 2011). The investigators were unaware which group received which story until after the initial data analysis as they were randomly renamed by an independent third party "News Article 1, 2, or 3." The participants were sent the materials by the research assistant and did not know that they were receiving different articles to read, and at first glance the different paranormal news stories would have appeared the same. Participants then completed a short post-exposure web survey to rate how compelling they found the arguments in both of the papers they read (the research paper and the distractor). They were specifically asked how credible they were, how scientific and how likely they were to believe in the phenomenon based on the story. Seven point Likert scale attitudinal questions were used to score each of these items (e.g. How scientific do you think the paper was? Score: highly scientific to highly unscientific). This survey also included some items capturing other independent variables for analysis including daily hours of web-browsing, daily television exposure, viewing of paranormal television shows and web-sites, and any personal experiences with paranormal phenomena.

Responses for the paranormal stories were analysed whilst those for the Ebola (distractor) story were discarded. Quantitative data from the surveys was analysed using descriptive and inferential statistics to test the hypotheses between the three groups. In order to maintain blinding the initial analysis was

undertaken by a professional statistician from the Applied Statistics and Data Science Group at UBC using R Software for Statistical Computing. An ANOVA was performed on the hypothesis 1A-C results and for the covariate hypotheses (hypotheses 2-6) an ANCOVA for interval data and 2-Way ANOVA for the nominal data. Also, post hoc T-Tests were used for pairwise group comparisons of covariates to explore whether various forms of media use correlated with beliefs about the paranormal phenomenon, as well as whether any of the hypothesized relationships varied with self-reported personal paranormal experiences.

Results

RPBS Survey

No significant differences were seen between the Canadian and the UK based student cohorts for any of the questions explored in the study, and so the results described here reflect the combined products from all participants. From the initial RPBS scale relating to the religious and spiritual beliefs, 45% of respondents believed in a god, and 52% believed that the soul continues after death, 43% believed that reincarnation may occur and 31% believed there is a heaven and a hell. These are similar to statistics reported in the general population. However, 33% also believed that it was possible to communicate with the dead, but only 21% reported they believed a devil (e.g. Satan or Iblis) actually existed. Another related aspect of paranormal beliefs explored in the RPBS was that of astral projection (the belief that the spirit can leave the body) and 23% believed that during altered states, such as sleep or trances, the spirit could leave the body. A similar number also believed that the mind or soul could leave the body and travel.

With respect to beliefs concerning psychic prediction and astrology 37% believed that psychics could accurately predict the future. Mind reading and telekinesis were also explored in the survey and 34% of participants believed mind reading was possible. However, few participants believed it possible to levitate or move objects by mental forces (only 13%). With respect to witchcraft and casting magic spells, 32% believed that there were actual cases of witchcraft, and a similar number of participants believed black magic existed and that witches with magic powers existed. However, only 13% reported that they believed it was possible to cast spells on persons.

The lowest RPBS belief scores seem to be related to belief in monsters and luck. Only 23% believed that the Abominable Snowman of Tibet probably existed and less than 14% believed the Loch Ness Monster probably existed. In relation to luck, 22% believed that breaking a mirror would bring bad luck, 17% believed the number 13 was unlucky and 12% of respondents thought black cats would also bring bad luck.

Experiment

A total of 70 students proceeded further in the study to read the papers and complete the post-exposure survey (group 1: n=22, group 2: n=23, and group 3: n=25). In terms of Hypotheses 1A-C (effect of pseudoscientific vs scientific rationales) there were no statistically significant differences between the three groups exposed to the different stories. In terms of how scientific the groups found the various papers, the pseudoscience group trend was slightly higher compared with those who read the simple news story, but this was not statistically significant.

For Hypotheses 2A and B (media) there were also no significant differences between belief, credibility and perceived scientific value of the stories, and no significant between groups differences when accounting for the quantity of television and web use reported by students. For Hypothesis 3A (the impact of the watching paranormal reality television), there was a significant relationship between the watching of paranormal reality television shows and the overall perceived credibility and believability of the stories (Table 1). However, there was no significant difference shown that this affected how scientific the students found the stories, nor between the three different groups when taking watching paranormal reality television into account.

Table 1. Results from R of ANOVA (type II) testing for Students who watched Paranormal Reality Television Shows, and their perceived Credibility and Believability of the Stories

Level of Credibility with Paranormal Reality television

Response: How credible did you find the article?					
Covariate: Do you often watch Paranormal television shows? (Categorical yes/no)					
Group Confidence level used: 0.95					
Contrast	Estimate	SE	df	t.ratio	p.value
Yes - No	0.9856809	0.3576835	66	2.756	0.0076

Level of Believability with Paranormal Reality television

Response: How believable did you find the article?					
Covariate: Do you often watch Paranormal television shows? (Categorical yes/no)					
Group Confidence level used: 0.95					
Contrast	Estimate	SE	df	t.ratio	p.value
Yes - No	2.254246	0.4016933	66	5.612	<.0001

For Hypothesis 3B, which explored the impact of browsing paranormal web-sites on how believable, credible and scientific the students found the stories, there were significant relationships between all of these items (Table 2). Again, this factor also had no impact on the between group comparisons when this was accounted for in the statistical analysis.

Table 2. Results from R of ANOVA (type II) Testing for Students who engaged in Browsing Paranormal Web Sites, and their perceived Credibility and Believability of the Stories

Level of Credibility with Paranormal Web-browsing

Response: How credible was the article?					
Covariate: Do you often browse paranormal web sites? (Categorical yes/no)					
Group Confidence level used: 0.95					
Contrast	Estimate	SE	df	t.ratio	p.value
Yes - No	1.516745	0.4280968	66	3.543	0.0007

Level of Believability with Paranormal Web-browsing

Response: How believable was the article?					
Covariate: Do you often browse paranormal web sites? (Categorical yes/no)					
Group Confidence level used: 0.95					
Contrast	Estimate	SE	df	t.ratio	p.value
Yes - No	2.447017	0.3964533	66	6.172	<0.0001

Perception of story as Scientific with Paranormal Web-browsing

Response: How scientific was the article?					
Covariate: Do you often browse paranormal web sites? (Categorical yes/no)					
Group Confidence level used: 0.95					
Contrast	Estimate	SE	df	t.ratio	p.value
Yes - No	0.9008373	0.3688874	66	2.442	0.0173

For Hypotheses 4A and B, examining the impact of science media, no significant effects were observed overall, nor between groups. Similarly, for Hypothesis 5, exploring the impact of any reported personal paranormal experiences on the student’s perceptions of the stories, there were no significant differences overall for the scientific value attributed to the stories, nor in their perceived credibility. There was, however, a significant relationship between personal paranormal experience and the perceived believability of the story (Table 3), but once again nobetween group effects for this covariate.

Table 3. Results from R of ANOVA (type II) Testing for Students who reported Personal Paranormal Experience, and their perceived Believability of the Stories

Level of Believability with Reported Paranormal Experience

Response: How believable was the article?					
Covariate: Reported personal paranormal experience (Categorical yes/no)					
Group Confidence level used: 0.95					
Contrast	Estimate	SE	df	t.ratio	p.value
Yes - No	2.035951	0.4153748	66	4.901	<.0001

For hypothesis 6, examining the impact of participants’ pre-existing paranormal beliefs (RPBS scores), higher RPBS scores were significantly correlated with student’s seeing the story as scientific, seeing the paranormal phenomenon as credible, and believing in it (Table 4).

Table 4. Results from R of ANOVA (type II) Comparing Students RPBS Scores, with the perceived Credibility and Believability, and Scientific Value of the Stories

Level of Credibility with RPBS Scores

Response: How credible was the article?						
Covariate: RPBS Scores						
Group Confidence level used: 0.95						
Trend	SE	df	lower.CL	upper.CL	t.ratio	p.value
0.02980713	0.006568308	66	0.01669308	0.04292118	5.059	<.0001

Level of Believability with RPBS Scores

Response: How believable was the article?						
Covariate: RPBS Scores						
Group Confidence level used: 0.95						
Trend	SE	df	lower.CL	upper.CL	t.ratio	p.value
0.04755973	0.005482712	66	0.03661314	0.05850632	8.674	<.0001

Perception of Story as Scientific with RPBS Scores

Response: How scientific was the article?						
Covariate: RPBS Scores						
Group Confidence level used: 0.95						
Trend	SE	df	lower.CL	upper.CL	t.ratio	p.value
0.02675128	0.005259363	66	0.01625063	0.03725194	5.086	<.0001

Additionally, in the between group comparison there was a borderline significant difference between the simple story versus the rebuttal story groups for their perceived scientific value of the story when corrected for the RPBS scores (Table 5).

Table 5. Post Hoc T-Tests for Pair wise between Group Comparisons using RPBS Scores

Group Comparisons

Groups: Control, Rebuttal, Pseudoscience					
Response: How scientific was the article?					
Covariate: RPBS Scores					
Group Confidence level used: 0.95					
Contrast	Estimate	SE	df	t.ratio	p.value
Simple - Rebuttal	0.7461194	0.3784324	66	1.972	0.0528
Simple - Pseudoscience	0.5854559	0.3716302	66	1.575	0.1200
Rebuttal - Pseudoscience	-0.1606635	0.3671573	66	-0.438	0.6631

Discussion

Well-established levels of magical belief were evident in the students, but lower than in previously reported work (Peltzer, 2003; Aarnio and Lindeman, 2005). However, these were based on larger samples comprised of different age groups and in wider populations. Nevertheless, the level of magical beliefs

encountered was surprising, given that these students were studying professional degree programs in nursing and education. It may be assumed that students arrive at university with their belief in the supernatural already established, but what is interesting here, is the degree to which their field of study challenges those beliefs. Some of these beliefs persisted in spite of exploration of empirical scientific methods to substantiate phenomena, the discrimination between specious arguments, recognition of flawed logic and fallacies, probability theory and the use of inferential statistics. For established core personal beliefs, it would seem although undergraduate education offered challenges to individual belief systems, this was insufficient to significantly change them.

Nevertheless, students from both the UK and Canadian cohorts provided similar evaluations on all three test articles and the use of a pseudoscientific and authoritative narrative did not seem to influence their views. This is an intriguing finding as it is contrary to some of the outcomes of prior work (Brewer, 2012; Peltzer, 2003; Aarnio and Lindeman, 2005). This likely reflects the higher educational accomplishment in the sample, whereas previous work was based on the general public or outside of professional science-based education. This may also reflect greater criticality and promotion of critical thinking skills frequently associated with professional degree level studies (Kreber, 2014).

Hypotheses 2-4 explored the impact of exposure to different forms of media on perceived believability, credibility and scientific value of the stories, and once again no significant differences were found between those students who watched television or surfed the web a lot and those who did not. Volume of media exposure seemed to have no discernible effect here. However, responses to questions around more specific media behaviours did yield some interesting results. Those students who watched paranormal reality television shows displayed significantly different responses to the stories than those students who eschewed such predilections. Similarly, those who visited websites dealing with the supernatural also displayed different results from their counterparts (see Tables 1 and 2). Overall, students who watched paranormal reality TV found stories they were given to be more credible and believable, and those who browsed a lot of paranormal websites, found them more credible, believable and scientific. This suggests that students' criticality and critical thinking skills might be influenced by these specific forms of media. Browsing paranormal websites may also have a larger influence on perception of the scientific value ascribed to paranormal narratives than watching paranormal television. This may also reflect the widespread growth in production of paranormal focused media in recent years, with the differentiation between reportage and drama becoming increasingly blurred (such as the trend in the found video footage drama genre: Heller, 2014). Overall, these findings give some validation of the influence of specific forms of broadcast media and the web on students' ability to appraise and evaluate reportage and to potentially support a belief in the paranormal (Sparks & Pellechia, 1997).

The analysis also suggests that students who reported a personal paranormal experience thought the stories were more believable than those

who did not. It appears that personal experience and perception is as powerful as any form of media influence and also supports earlier findings in the general public (Brewer, 2012). Regardless of causation, this supports the view that the criticality and scientific rationale engendered during an education process may be insufficient to influence a pre-existing personal belief based on personal experience. This presents an interesting paradox. On the one hand those students who report some form of personal paranormal experience are no more likely to see reported supernatural events as being scientific or credible than those who have not. However, their personal experience clearly influences their believability and their recognition of the impact of any potential bias based upon personal experience being applied here was limited. It might be expected that belief in the existence of supernatural phenomenon might be raised in such students, but in this case, they found a very implausible and poorly evidenced ghost story more believable than their counterparts. Despite equal preparation on the fallibility of individual human perception, and the nature of evidence-based practice, these students still seemed swayed by individual experience. Their ability to apply a scientific critique was affected.

Watching science shows on television or science related web-browsing did not affect the credibility, believability or perceived scientific value of the stories by the students (Hypotheses 4A & B). This contrasts with Brewer's earlier study findings where differences were noted. Reasons for this are unclear, but it appears that watching paranormal reality television and reading websites had a more pronounced effect on our sample than watching science shows and browsing science websites. This may be related to issues around the more populist formats of media presentations in this genre.

The analysis of data for Hypothesis 6 confirmed that overall higher paranormal belief scores can usefully predict an increased likelihood of students finding paranormal reports scientific, believing them and finding them credible (Table 4). Additionally, the effects of accounting for the RPBS scores in the between group comparisons confirmed that those people with higher levels of pre-existing paranormal beliefs exposed to a simple supernatural story would be more likely to regard it as having scientific value, compared to those with a similar level of paranormal belief exposed to the same story with a scientific rebuttal (Table 5).

Many of the students retained belief in the paranormal, despite being taught a critical rationale and an evidence-based standard in their program, providing a paradoxical disjuncture or compartmentalization of belief systems supported by conflicting epistemological stances. Possibly, the alignment of professional nursing and education studies with broader postmodern forms of inquiry, rather than a scientific paradigm, may have had an influence here (McKenna, Cutcliffe & McKenna, 1999). For example, both nursing and education have now become more aligned with the disciplines of the arts and social sciences. This has resulted in pluralistic curricular developments. For example, there has been a movement to introduce postmodern inquiry as the epistemological centre of nursing supporting relativistic inquiry based on multiple ways of knowing rather than science (Garrett & Cutting, 2014). Although these are

important aspects to explore in modern professional curricula, such diverse approaches may leave students with the impression that science, relativistic constructed knowledge and alternative intuitive explanations of phenomena are all equally valid as a basis for professional knowledge. For the students with personal paranormal beliefs, this may have encouraged a more pluralistic intuitive analysis rather than a more critical scientific analysis of the story.

More recent trends towards evidence-based practice (Lipscomb, 2015) have resulted in contemporary scientific theory such as hypothesis construction, the notion of falsifiability, experimental design, probability theory, analysis of logical fallacies and bias in published work all being central elements in the study of critical inquiry in the professional curriculum. But in many programs this substantive content may be contrasted or even supplanted with postmodern philosophical material (Locsin & Purnell, 2009, 251). Of concern here, is the possibility that such pluralistic approaches to analytical reasoning may be translated into professional practice (both as nurses or teachers), supporting insufficient academic discrimination of fictions, and promoting susceptibility to accept fabrications and implausible explanations as sufficient evidence for practice.

Given the nature of the participants in this study, these findings have significantly wider implications, particularly in relation to teaching and learning in science-based professional higher education. The impact of magical beliefs exemplified here raise critical questions about the acquisition of the analytical attributes required for critical thinking in higher education, especially in science-based professions. These have been described by Reissner (2010) as “one of the pillars of undergraduate studies.” It is generally well established that critical thinking is an essential characteristic of graduate and professional studies (Reissner, 2010; Garrett & Wulf, 1978) and that critical thinking skills are seen to contribute to graduates’ success in the workplace (Watson & Adamson, 2010; Coetzee 2012). Here are students who have the capability to critically engage with information, evaluate evidence, make rational judgments and draw conclusions; yet these attributes of criticality appear selectively applied and suspended to allow for magical thinking. Here we have identified students who may be able to deploy skills in critical engagement in specific academic settings and in professional placements, but with some lacking an ability to apply those skills in other contexts. In light of these results, educators may wish to consider how best to promote rigorous objective analytical skills in undergraduate science-based programs with the aim of fully realizing what Barnett (2007) called “the formation of critical being (p160).”

Limitations

The study had a number of limitations. Given the fairly small sample size for exploration of the key dependent a fully randomized trial was not appropriate, and so a quasi-experiential approach was adopted. Given this, it is acknowledged that the statistical analysis might not detect small effects of the

treatments. This may influence generalizability of the results in a larger or different populations. Also, as it is impossible to completely rule out zero-order or spurious and suppressor relationships between covariates, here, we should be cautious with inferences about the influence of media on thinking. As with other reports of these phenomena, a relationship does not indicate causation. It may simply be that students with a predilection for paranormal media may be more susceptible to its influence on their criticality in certain circumstances. However, it was evident that criticality was negatively influenced by pre-existing paranormal beliefs, and this did not appear to have been influenced by the educational processes undertaken.

Conclusions

A primary aim of this study was to explore evidence of magical beliefs and thinking amongst professional nursing and education students, and to explore to what extent the use of pseudoscientific language influenced the degree to which these students regarded the validity of media reports. Principally it attempted to evaluate and validate the influence of bogus authority through the use pseudoscientific language, as detected in previous work (Brewer, 2012). Allied to this, however, was a secondary aim; namely to establish whether students' reactions to different styles of reporting were influenced by their own personal perspectives, in this case their level of belief in the paranormal. A final aim also investigated aspects of media behaviour within the cohort, including estimated time spent watching television as well as web use. It also established the inclination of students to watch paranormal television shows.

Aside from religious beliefs, well-established levels of magical belief remained evident in the students. There was however, no significant difference in this, or any of the variables examined between the UK and Canadian cohorts. The first hypotheses (1A-C) did not establish any significant differences in believability and credibility or perceived scientific value attributed to the different stories, based on their use of authority, scientific and pseudoscientific narratives. Overall this would suggest that the nature of the narrative presented did not affect the students' belief in the phenomenon nor how credible or scientific they saw the different stories to be.

Nonetheless, the study found that RPBS scores can usefully predict the likelihood of students finding paranormal reports scientific, believing them and finding them credible. Although the students here differentiated between scientific and pseudoscientific rationales, pre-existing supernatural beliefs did significantly influence their thinking. Students with high levels of paranormal beliefs demonstrated this influenced their ability to critically discriminate presentations of unscientific material. The results indicate that those students with higher levels of paranormal belief exposed to a simple ghost news story would be more likely to perceive it as being scientific compared to those with a similar level of paranormal belief exposed to the same story but with a scientific rebuttal. Distinguishing the scientific validity of a simple bogus news story is a

skill required for both nursing and educational professionals, if discrimination of veracity of a narrative remains significantly influenced by personal magical beliefs, then the assumption of the educational experience developing criticality may not be met. This at the least raises questions as to the expectations for scientific preparation in professional programs, and to what degree material on objectively analysing specious arguments (irrespective of personal beliefs) is necessary.

No significant difference was established between the reactions to the papers and the hours of general television viewing and web usage reported by the students. The degree of electronic media utilization or exposure to science television and websites likewise did not appear to influence believability, credibility or perception of scientific value of the stories. However, students who browsed a lot of paranormal websites found the stories they were given to be more credible, believable and scientific, than those who watched paranormal reality television found them more credible and believable. The web may have a more persuasive influence than television, as browsing paranormal websites positively influenced how believable, credible and scientific the paranormal stories were seen to be.

The results here undoubtedly show that the students here have developed some of the skills of criticality, discriminating between scientific and pseudoscientific narratives, but also that these skills were somewhat abstracted, being deployed and suspended at different times and in different situations, dependent upon other belief systems. Whether this constitutes authentic critical thinking (a central theme in so-called 'graduate attributes') and the development of what have been called 'critical dispositions' (Barnett, 2007; Kreber, 2014) for science-based disciplines is questionable. These findings stand not as a criticism of personal belief systems, or of susceptibility to paranormal beliefs, but raises questions of how professional degree level programs should best address developing authentic, transformative, critical and scientific thinking as important learning outcomes and skills for professional practice.

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