Do Perceptions of Control and Uncertainty Predict Supernatural Beliefs?

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Abstract

Previous research suggests that perceiving a lack of control can result in various compensatory control strategies. This research has shown that one of the consequences of lack of control is magical thinking, which is the general belief that one's thoughts or actions can affect magical forces and change outcomes. The present research aimed to examine the impact of a randomness prime on magical thinking. It also considered the role of two individual difference factors, desirability of control and intolerance of uncertainty, in moderating this relationship.

Two hundred and ninety participants, recruited online, completed the study. They were asked to re-order 12 sentences, which had either negative connotations (e.g., words such as loss, vomit, etc.) or featured words related to randomness or loss of control (e.g., chaotic, mayhem, etc.). This was followed by the individual difference measures.

Moderated regression analysis indicated that the randomness prime had little effect on magical thinking. In some analyses, however, when intolerance of uncertainty acted as a moderator, the negative prime resulted in higher levels of magical thinking. Desirability of control was not a significant moderator.

This research's failure to reproduce the findings of previous studies raises some questions regarding the effect of negative information on magical thinking, as well as the efficacy of priming randomness in this way.

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Attestation of Authorship

I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person (except where explicitly defined in the acknowledgements), nor material which to a substantial extent has been submitted for the award of any other degree or diploma of a university or other institution of higher learning.

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Date: 04.06.2021

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Ethics Approval

Approved by the Auckland University of Technology Ethics Committee on 27/05/2020,

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Literature Review

Introduction

Despite increasing education and scientific knowledge in recent decades, various kinds of magical thinking have continued to thrive. Over a third of Americans still believe in psychic powers, extrasensory perception and psychic healing (Rice, 2003; The National Science Foundation, 2002) while astrological forecasts continue to follow the news in numerous European countries (Lindeman & Aarnio, 2006). Beliefs in magic and superstitions generally correlate with poor psychological outcomes, such as high trait anxiety, low self-efficacy, and psychopathology (Wiseman & Watt, 2004) – suggesting that the continued prevalence of magical thinking may not be helpful. The effects of religiosity are less clear-cut, with some authors arguing that can serve a psychologically-protective function (Ferraro & Koch, 1994) and others suggesting the harm outweighs any benefits (Ellis, 1986; Asser & Swan, 1998). Keysar and Navarro-Rivera (2013) estimate that 80-90% of people around in the world profess belief in a god or gods. Why magical thinking holds such appeal in some places and to some people is also not entirely clear, with some conflicting findings around education and personality (Aarnio & Lindeman, 2005; Chauvin & Mullet, 2021).

The present research aims to examine how perceiving the world as random affects magical thinking. Magical thinking is taken to include magical beliefs, spirituality and links between thought and action that defy physics and biology (Subbotsky, 2014). This can include such varied items as the use of magic spells, belief in spirits, use of good luck charms and many others. As noted by Subbotsky (2014), these range from adaptive coping strategies to the reactions of a troubled mind (such as in the case of some schizophrenic individuals). There has been extensive debate about the merits and dangers of magical thinking, in particular, religion. Pargament (2002a, p.168) describes religiousness as containing "the bitter and the sweet". It offers a powerful means of coping with trauma, for example, but the deferral of responsibility (to a god) is also associated with lower self-esteem. It also seems to be more helpful/harmful to some than others and more useful in particular times (such as in times of great stress)

(Pargament, 2002b). The present research does not focus on the net gain or loss from magical thinking, but it is worth considering this briefly in order to make sense of the many impacts of magical thinking and to fully grasp its importance.

How people see the world also seems to be an important determinant in whether magical thinking appeals as a coping strategy. A large body of research has found links between stress and uncertainty and various forms of magical thinking, as will be outlined in some detail in later sections (Laurin et al., 2008; Felson & Gmelch, 1979; Rothbaum et al., 1982; Kay et al., 2008; Malinowski, 1948; Whitson & Galinsky, 2008; Padgett & Jorgenson, 1982; Burger & Lynn, 2005; Kay, Moscovitch, & Laurin, 2010; Kay, Shepherd, et al., 2010; Keinan, 1994; Burger & Lynn, 2005). Essentially, it seems that if a person believes that outcomes in the world are arbitrary or in the hands of a powerful other, magical thinking will become more appealing (Kay, Gaucher et al., 2010; Kay et al., 2009; Keinan, 1994; Whitson & Galinsky, 2008; Burger & Lynn, 2005). One example of this can be found in communities that live in dangerous environments, such as in areas prone to natural disasters. Bentzen (2013) found this to be the case across 800 subnational regions, with those closer to natural disaster zones showing higher levels of religiousness. This pattern is also evident in the period following natural disasters, such as after the 2011 Christchurch earthquake in New Zealand, which resulted in a significant increase in religion among those affected (Sibley & Bulbia, 2012). Evidently, life experiences can have a significant effect on how people perceive the world, though there are also other factors at play. These may include how people tolerate stress and uncertainty, as will be discussed further. The present research aims to induce in (some) participants the sense that the world is a chaotic and uncontrolled place and then examine how this affects belief in various forms of magical thinking, such as the efficacy of good luck charms and dangers of tempting fate.

Previous research has examined this relationship between control and belief in the supernatural in some depth, ultimately concluding that magical thinking can serve as a form of compensatory control when other sources are lacking, due to personal circumstances (e.g., living in a volatile

environment) or experimental manipulations. This\ can include putting one's faith in luck, gods, fate or supernatural forces, and has been documented in a wide range of populations (Burger & Lynn, 2005; Felson & Gmelch, 1979; Kay, Gaucher et al., 2010; Kay, et al., 2008; Kay, Moscovitch, & Laurin, 2010; Kay, Shepherd, et al., 2010; Kay et al., 2009; Keinan, 1994; Keinan, 2002; Laurin et al., 2008; Padgett & Jorgenson, 1982; Whitson & Galinsky, 2008). Some authors have argued that excessive or irrational faith in societal structures, such as the judicial system, is also a source of compensatory control (Kay, Shepherd et al., 2010). The motivations for these behaviours appear to differ between people, but they often serve to mitigate anxiety around unpredictable events (Jannof-Bulman, 1989; Kay et al., 2008; Kay, Gaucher, et al., 2010; Rothbaum et al., 1982; Laurin et al., 2008; Whitson and Galinsky, 2008). Individuals also differ in the extent to which they employ compensatory control strategies. Three stable, personal differences have been identified as factors: *Locus of Control* (Rotter and Mulry, 1965); *Desirability of Control* (Burger and Cooper, 1979); and *Intolerance of Uncertainty* (Carleton et al., 2007). Desirability of control measures the extent to which a person feels the need to control the events in their life, while intolerance of uncertainty focuses on the discomfort a person experiences in the face of uncertainty. These are included in the present research because it is expected there will be some relationship between these constructs and compensatory control mechanisms. It seems reasonable to assume that individuals with greater need for control and certainty may have more use for compensatory control mechanisms, such as the use of magical thinking.

Defining Magical Thinking

Malinowski's (1948) seminal work on magical thinking describes the function of magic as a means to "ritualise man's optimism, to enhance his faith in the victory of hope over fear" (p.90) and, in many ways, this definition has been supported by more recent reports. These include studies, such those by Felson and Gmelch (1979), who detailed the protective functions of superstitions in dealing with exam stress. Broadly speaking, magical thinking has been defined as the belief that one's thoughts and actions are linked in ways which contradict physics (Bocci & Gordon, 2007). This includes religion and spirituality, beliefs around the paranormal,

superstitions, energy transfer, evil spirits, etc. (Eckblad & Chapman, 1983). A key element often seems to be the "deferring" of responsibility to some alternative power (e.g., gods or fate), which Pargament (2002a) argues is a widespread cultural construct. This appears to be especially true among some populations, such as students, athletes and gamblers (Burger & Lynn, 2005). These ideas are evident in The Twelve Steps of Alcoholics Anonymous, which continues to be an influential organization worldwide. Steps such as "admitting we were powerless (over alcohol)" and deciding to "turn over our will and our lives to the care of God" appear to align very closely with magical thinking (Alcoholics Anonymous, 1981). These steps are strong examples of the deferral of responsibility that Pargament (2002a) describes. The success of the Alcoholics Anonymous programme is testament to the power of this style of magical thinking (Kelly, 2016).

Numerous authors have noted the incredible prevalence of magical thinking around the world and across time, with Kay, Moscovitch and Laurin. (2010) stating that it has permeated "every culture the world has seen" (p.216) (Burger & Lynn, 2005; Keinan, 2002). Various authors have speculated that, in order to remain important in such varied circumstances, magical thinking must serve an important function. Similarly, it has been noted that there seems to be a correlation between these beliefs and a perceived or real lack of control. A range of authors have speculated regarding the exact nature of this relationship, which continues to be contested. Some authors, such as Burger and Lynn (2005) have suggested that individuals who believe in chance, fate, luck, etc., are forced to turn to superstition, as a result of these beliefs. Other authors, such as Keinan (2002), suggest that the beliefs come about due to stress and lack of personal control. In these cases, they serve to restore some sense of control and thus lessen anxiety. As will be discussed further, the exact relationship between low control and magical thinking remains slightly unclear.

How Magical Thinking Relates to Compensatory Control

The specific ways in which magical thinking facilitates compensatory control mechanisms seem to be numerous. Various authors have suggested structures that could explain these systems,

which tend to focus on mitigating anxiety and restoring perceived control (Rothbaum et al., 1982; Keinan, 2002; Burger & Lynn, 2005; Kay, Gaucher, et al., 2010). Kay, Gaucher, et al. (2010) split types of compensatory control into volitional and epistemic. Epistemic control comes from belief in the objective truth of one's beliefs and identification with others, which appears to relate more to mitigating anxiety and confusion. This kind of compensatory control is often evoked in situations of uncertainty, such as in McGregor and Marigold's (2003) work on religious zeal. Keinan (2002) stresses how these strategies can make the unpredictable seem predictable, and in this way, make life less stressful. Volitional control differs from this, in its focus on personal control over events. Kay, Gaucher et al. (2010) suggest that religions that offer specific guidelines for living (e.g., ten commandments, four pillars) can give a person a sense of efficacy and confidence in their choices. Volitional control differs from Rothbaum et al's (1982) concept of vicarious control, in which a person may choose to "ride the coattails" (p.20) of a powerful other, such as gods or sporting heroes. Rothbaum et al. (1982) argue that the strong feelings many people have when their nation succeeds in sport is an example of this, since spectators do not in fact have any control over the outcome but feel pride regardless. Vicarious control appears to offer access to these feelings of accomplishment and pride, which Rothbaum et al. (1982) equate to control. Taken together, Kay, Gaucher et al.'s (2010, p.44) assertion that religion, as a form of magical thinking, offers a "balanced repertoire of compensatory control strategies" seems fair.

There is also some evidence that magical thinking can function as a psychological defence from the emotional discomfort of perceived chaos (Laurin, et al., 2008). As mentioned earlier, there is evidence that randomness, confusion and uncertainty can cause anxiety, which Kay et al. (2008) suggest often motivates compensatory control strategies. Kay, Gaucher, et al. (2010) note that religious beliefs appear to lessen activity in the anterior cingulate cortex, which is an area associated with errors, conflict and violated expectations (Inzlicht et al., 2011). Inzlicht et al (2011) used brain scans to examine activity in the anterior cingulate cortex and found that religious zeal had a protective effect. Higher levels of reported religious beliefs correlated with significantly lower levels of error-related activity in this region of the brain. Kay, Gaucher et al.

(2010, p.45) describe this effect as a form of "neural insulation", wherein magical thinking can reduce sensitivity to anxious alarm. This may be reflected in studies such those conducted by Felson and Gmelch (1979), in which students reported little faith in the efficacy of their superstitions, but that the rituals gave them some comfort. American and Irish university students were asked about their superstitions before exams, sporting events, etc., and 76% and 71% respectively reported that using these rituals to bring luck helped reduce their anxiety. Laurin et al. (2008) also found a link between anxiety, control and magical thinking. In this study, participants were asked to imagine being chased by an attacker and then either being saved by a passing police officer or calling the police and then being rescued. Both conditions were intended to provoke anxiety, however, only the first condition was intended to induce feelings of low personal control. A manipulation check during pilot testing found this to be the case. Ultimately, the combination of anxiety and low personal control (condition one) resulted in higher levels of belief in a controlling God. It does not seem unreasonable to generalise from this research and speculate that there is some link between anxiety, control and magical thinking.

How Low Control is Induced

Researchers have induced low personal control in a number of ways, with varying degrees of success. One method that seems to be effective is asking participants to recall or imagine an event in which they experienced a lack of control, as was done by researchers including Kay et al., (2008); Laurin et al., (2008); Shepherd et al., (2011) and Whitson and Galinsky (2008). As described above, Laurin et al., (2008) asked participants to imagine being chased by an attacker and then saved by a passing police officer for the low control condition, which a manipulation check suggests was effective. Other methods include asking participants to play chance-based games (Burger and Cooper, 1979); a survey item asking to what extent people have "complete free choice and control over their lives" (Kay et al., 2008, p.26); and giving random feedback on participant performance (Whitson and Galinsky, 2008). Kay, Moscovitch and Laurin (2010) asked participants to unscramble sentences, which either had negative or random/low control

connotations. This research did not include a manipulation check but did find significant effects for the random condition.

Other research has created a quasi-experimental, low-control condition through the use of independently occurring events, such as economic crashes, which are presumed to lower perceived personal control due to the threat of unemployment, uncontrollable inflation, etc. Similarly, Keinan's (1994) research compared residents of Israeli neighbourhoods with different bomb threats during the Gulf War, which did indeed show different levels of perceived personal control. Some other research has focused on areas of life where chance plays a greater role, such as Burger and Lynn's (2005) research on baseball.

Evidence for Links Between Perceived Control and Magical Thinking

Inducing a lack of control in experimental settings has yielded some support for the idea that lessened personal control may induce changes in how an individual places themselves relative to powerful forces, such as fate or gods (Whitson & Galinsky, 2008, Rothbaum et al., 1982; Goetz & Dweck, 1980; Diener & Dweck, 1978; Seligman, 1975). Rothbaum et al. (1982) classified these changes as "inward behaviours" (p.5), including passivity, withdrawal and submissiveness. They took these changes to represent a shift in perceived control, arguing that responsibility was passed from the individual to chance or a powerful other of some kind. Whitson and Galinsky's (2008) experiments found a more direct link between induced lack of control (via random feedback) and illusory perceptions. Participants were asked to find patterns where they did not exist, such as in series of random black and white dots or grainy images. As predicted, those participants who had received random performance feedback reported more patterns. They were also more likely to endorse conspiracy theories, perceive patterns in random stock market fluctuations, and believe in superstitions (such as knocking on wood). Whitson and Galinsky (2008) concluded that lack of control can distort perception, in order to restore control and make sense of confusing events.

There is also some experimental research that documents this relationship between magical thinking and anxiety or uncertainty (Laurin, et al., 2008; Kay, Moscovtich, & Laurin, 2010; Burger & Lynn, 2005; Keinan, 2002; Ayeroff & Abelson, 1976). Laurin et al. (2008) found that combining anxiety with a low control condition (participants imagined a stressful scenario in which they either had some personal control or not) resulted in stronger religious beliefs - whereas the anxiety and high control condition did not. Keinan (2002) found links between anxiety and superstitious behaviours by asking students questions designed to elicit "knock on wood" responses, in either a high stress condition (before an exam) or a neutral condition, which resulted in a significant effect for the stress condition. The studies mentioned here mostly used fairly small samples and rarely considered individual difference factors[1]. Low personal control and anxiety were also operationalised in varied ways. The present research aims to build on this foundation and incorporate the individual difference factors of desirability of control and intolerance of uncertainty. Considering these two constructs may allow us to reach some conclusions about the origins of magical thinking – specifically, whether a predisposition is needed, or if it is always due to circumstance. This would also shed some light on who is particularly susceptible to these kinds of illusory beliefs.

There is a vast wealth of research that documents correlations between magical thinking and uncertainty (Kay et al., 2009; Kay et al., 2008; Padgett & Jorgenson, 1982; Sales, 1972; Kay, Shepherd, et al., 2010; Pargament, 2002b; Bullman & Wortman, 1977; Park, 2002; Malinowski, 1948; Burger & Lynn, 2005). One especially compelling piece of research comes from Padgett and Jorgenson (1982), which details the popularity of astrology and mysticism with reference to economic crashes in Germany. As stated by famous (and fraudulent) medium, Lamar Keene, "all mediums would agree…wars, depressions and disasters spell prosperity for us" (Padgett &

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[1] It is important to note that a memory-based experimental control threat did not have any effect on belief in a controlling god in Hoogeveen et al.'s (2018) research with 829 US and Dutch participants. Hoogeveen et al. (2018) suggest that experimental manipulations of personal control may be ineffective in altering religiosity, but that individual experiences of control may relate to religiosity in a way that is consistent with CCT. This is based, in part, in the finding that the US sample showed an inverse relation between feelings of personal control and belief in a controlling god (though the Dutch sample did not).

Jorgenson, 1977, p.736). This idea is reflected in the research, such as Keinan's (1994) findings regarding Israeli citizens living through the Gulf War. This research found that participants who lived in areas that were bombed more frequently were more prone to magical thinking, especially if they also scored highly in intolerance of ambiguity. This relationship seems to apply on a minor scale as well. Krause (1998) found that living in a more dilapidated neighbourhood facilitated more religious coping, which he suggests is due to stress. Other authors have suggested that this idea could be reflected in the high levels of religiosity in minority groups in America as well, who often have less control over life outcomes (Kay et al., 2008; Pargament, 2002).

Religious coping also seems to gain in popularity in the face of personal disasters (e.g., trauma, terminal illness, etc.) and wider societal uncertainty (Bullman & Wortman, 1977; Park, 2002; Cole & Pargament, 1999). Of particular note is the kind of religion that gains popularity in uncertain times. Sales (1972) makes a strong case for authoritarian religions as the "opiate of the masses" (p.427) when times are tough. Less severe churches, such as the Presbyterian Church, suffered relative losses in popularity in Sales's (1972) research, which he suggests is due to their limited ability to offer vicarious control. This aligns with Kay, Shepherd, et al.'s (2010) theories on the appeal of a controlling God, in which a religion that stresses God as a controller (versus creator) offers more vicarious control. As such, religions that stress God as a controlling force show increased popularity in times of uncertainty (e.g., preceding an election) (Kay, Shepherd, et al., 2010). This research will be discussed in greater detail in the coming paragraphs.

Some authors have argued that other sources of compensatory control are equally noteworthy, such as socio-political systems and social support networks. For example, Kay, Shepherd, et al. (2010) found that invoking low personal control in participants resulted in increased faith in either gods or governmental institutions and, on this basis, they argue that institutions can function in a similar way to religions. This idea was also reflected in Kay et al.'s (2008) analysis of perceived personal control and support for controlling governments, which was

conducted with data from 67 countries. They found that (controlling for left-right political orientation) perceiving less personal control was correlated with support for more government control. This effect was strongest in countries where the government was perceived as benevolent (as opposed to corrupt). Kay et al. (2008) lowered perceived personal control via a memory task and found that this resulted in greater support for the participants' socio-political systems. Laurin, et al. (2009) tested this idea with social support networks as the source of compensatory control, and also found that those in low-control conditions predicted more and better support from others. There is some argument that the relationship between these sources is hydraulic, so individuals with less faith in governmental institutions are more likely to put their faith in religion. On this basis, individuals who are isolated or living under unstable governance are most likely to rely on magical thinking (Kay et al, 2008).

"Where governments fail, God never fails." These words from Reverend Jeremiah Wright seem to summarise how many people respond to shifts in national stability (Wright, 2003, as cited in Kay, Shepherd et al., 2010, p.725). Kay, Shepherd, et al. (2010) measured perceived stability and support for the government and levels of religiosity among Malaysian citizens before and after an election. It was assumed that in the two weeks prior to the election, perceived stability would be less, while two weeks after the election it would be greater. This research found that in the pre-election period, stability was perceived to be less, and, of note, religiosity was higher. Support for a controlling god was especially high, which they suggest may be due to a lack of compensatory control available from the government in this period of relative instability. This relationship was also evident in a laboratory setting, wherein participants were exposed to articles undermining government stability (or not) and then reported their religious beliefs (Kay, Shepherd et al., 2010). A similar experiment was also conducted by Kay, Gaucher et al. (2010), in which lowering governmental trust correlated with increased faith in God. On this basis, the authors argued that both socio-political institutions and religion can serve as sources of compensatory control. In the present research, only magical thinking (including religion) has been measured, but the findings described above suggest that socio-political context may be relevant to these findings.

Alternative Explanations

There have been some questions raised regarding the importance of control in magical thinking. There are several other psychological needs which are served by magical thinking, and on this basis, several theories which could explain many of the results discussed previously (Shepherd et al., 2011). Prominent among these is Terror Management Theory, which states that religious faith acts primarily to protect the individual against the fear of dying (Solomon et al., 2004). This is supported by findings such as those by Jonas and Fischer (2006), in which increasing mortality salience increased religious conviction, in the same way that a personal control threat (recalling a situation in which participants did not have control) resulted in greater religious conviction for Kay et al. (2008). This raises some questions regarding how possible it is to invoke a lack of personal control without increasing mortality salience. Similarly, proponents of Uncertainty Management Theory (Brashers, 2001) would argue that having strong religious convictions allows people to believe that their lives have purpose, which protects them from uncertainties around the self (McGregor, 2001). This suggests that the purpose of magical thinking, such as religious beliefs or belief in fate, could be to mitigate feelings of uncertainty around the self specifically and to avoid the feeling that one's life is without purpose. This could be especially valuable with regard to personal suffering, as in Bullman and Wortman's (1977) study on burn victims. They found that nearly all participants had developed some kind of explanation for their accident, in terms of "God's plan" or similar. They suggest that this belief that there was a reason or purpose for their suffering made the experience more tolerable. Similarly, there are also a number of theories based around meaning-making, notably the Meaning Maintenance Model (Heine et al., 2006; Rothbaum et al., 1982). A focus on meaning-making suggests that magical thinking serves to make sense of random outcomes, especially those that are unpleasant, and in this way, makes it easier to live with the things that happen to us. Each of these theories appear to be possible as explanations for the popularity of magical thinking.

However, some research has argued that control threats do have a unique effect, which cannot be explained by the theories mentioned above. One noteworthy study comes from Shepherd et al. (2011), in which control and mortality threats were directly compared with regard to support for different kinds of politicians. While the mortality threat condition resulted in more support for politicians who focused on national culture and identity, the low control condition led to support for a more order-focused politician. On this basis, Shepherd et al. (2011) argued that a perceived lack of control leads to a specific need for alternative sources, such as socio-political systems. This finding was supported by Echebarria-Echabe (2013), who concluded that death-thought avoidance and need for certainty were distinct processes, though they could produce similar results. Whether religion could be a source of compensatory control in the same way as socio-political systems is less clear, but Kay, Shepherd, et al's (2010) research supports this idea. They found that participants who read about governmental success in the provision of order and control reported lower levels of religiosity, whereas there was no effect for those who read about cultural provisions. Taken together, it seems reasonable to conclude that the Compensatory Control Model is a plausible explanation for magical thinking's mass appeal, though this evidently is not completely certain.

Individual differences

There are some individual differences in how people perceive control, in terms of its necessity and availability, which seem to be fairly stable and reliable. These include locus of control, desire for control, and intolerance of uncertainty or ambiguity, some of which have been linked to differences in magical thinking (Rotter & Mulry, 1965; Rothbaum et al., 1982; Burger & Lynn, 2005; Keinan, 2002; Keinan, 1994). Rotter and Mulry (1965) state that individuals differ reliably in the extent to which they perceive various outcomes to be within their own control, across various situations and ages. Those who perceive more outcomes to be controlled by their own actions are considered to have an internal locus of control, while those who perceive outcomes to be controlled by fate, gods or others are considered to have an external locus of control (Rotter & Mulry, 1965). Rothbaum et al. (1982) argued that this links to compensatory control, citing the popularity of chance-based games, fortune tellers and horoscopes among

those with an external locus of control. This would fit with other theories regarding magical thinking as a source of compensatory control, which is particularly needed when personal control is perceived to be low. An additional issue to consider is the effect of cultural norms. A number of studies have documented less belief in personal control in Asian countries compared to American (Hamid, 1994; Hui, 1982; Smith et al., 1995; Weisz et al., 1984). A 2001 study (Spector et al.) across 24 nations found work locus of control to relate consistently to national levels of collectivism or individualism. New Zealand, France, Sweden and South Africa scored highest in individualism, whereas China, several Eastern European nations (e.g., Romania), Taiwan and India scored lowest. It seems reasonable, on this basis, to assume that the ethnic composition of the present research will therefore be of relevance.

The Desirability of Control (DC) measure was developed by Burger and Cooper (1979) and attempts to measure individual differences in levels of motivation to control the events in one's life. Those high in desire for control expect and prefer to have more influence over situations and are often described as decisive and strong-minded, while those low in this quality are more likely to defer to external influences and be described as uncertain or submissive (Fritz & Gallagher, 2020). This personality difference has been found to correlate with levels of magical thinking in athletes, especially when the sport in question is one with more uncontrollable outcomes (Burger & Lynn, 2005). Keinan (2002) also found that participants with higher levels of DC were more inclined to "knock on wood" when primed with questions that could "tempt fate". This relationship was also noted by Burger and Cooper (1979, p.390) with a small sample of undergraduates, who showed more illusion of control behaviours when higher in DC. One possible explanation for this is that those high in desire for control may more readily put their faith in other sources (e.g., luck, superstition) when their personal control is threated. Individuals low in desire for control are perhaps more able to tolerate a dip in their perceived control, without seeking an alternative source. The present research aims to expand on this foundation, by considering DC with reference to magical thinking in a more specific sense and with a larger sample. This should result in some information also about which particular needs are met by magical thinking. Examining DC's interaction with feelings of low personal control

is also intended to generate some new information on who is susceptible to the effects of a temporary shift in perceived personal control.

Tolerance of uncertainty and ambiguity has also been found to function as a stable personality trait and to relate to some compensatory control behaviours (Keinan, 1994). Both the Tolerance of Ambiguity Questionnaire (MacDonald, 1970) and Intolerance of Uncertainty (Carleton et al., 2007) measure how unacceptable or threatening uncertainty and ambiguity seem to an individual. Intolerance of uncertainty has been described as a way of perceiving the world, in which uncertainty is a major source of stress. It has strong links to worry, obsessions/compulsions and panic sensations (Buhr & Dugas, 2002). On the basis of the DC research mentioned above (Keinan, 2002; Burger & Cooper, 1979; Burger & Lynn, 2005), and wider theories of compensatory control (Kay, Gaucher, et al., 2010), it seems likely that this factor has some relationship with magical thinking. Keinan (1994) found that intolerance of ambiguity had a significant main effect on magical beliefs among Israeli citizens living though the Gulf War. Since this measure appears to have much in common with the IU, it is predicted that a similar relationship may be found with magical thinking in the present research. It is worth noting that while uncertainty is a dimension of Desirability of Control, the IU focuses on uncertainty specifically and it is expected to generate some different information.

The Present Research

The existing research presents a clear picture of magical thinking's prevalence, and it seems likely that this relates to perceived control. Compensatory control strategies are evidently widely used, across different cultures and life circumstances. The correlational evidence for compensatory control theory is plentiful and existing experimental studies appear to support these links. The role of individual difference factors, such as desirability of control and intolerance of uncertainty, is less clear. The present research aims to clarify the ways in which these relate to compensatory control strategies, as well as replicating the findings of Kay,

Moscovitch and Laurin (2010). This involves a replication of their methods[2], wherein

participants are asked to unscramble sentences that are intended to prime either negativity or

randomness (this will be discussed in further detail). In addition, participant scores on the

Desirability of Control (DC) and Intolerance of Uncertainty (IU) will be considered. In general,

this research aims to extend on Kay, Moscovitch and Laurin's (2010) work with a larger sample

and more specific measure of magical thinking. Their study included 37 participants and two

quite broad questions to measure magical thinking, so it is expected that the present research

can expand on these findings with more specific information on different forms of magical

thinking and from a more representative sample. There is also the inclusion of two individual

difference factors, which is expected to yield some new information.

Research Questions

The primary research question in in the present research is as follows: how does a sense of the

world being uncontrolled and chaotic affect levels of magical thinking? In considering the

answer to this question, there is a substantial body of evidence to consider. This includes

Malinowski's (1948) reports on the need for magic in uncertain waters; Whitson and

Gallinsky's (2008) findings on how random feedback results in the perception of illusory

patterns; Laurin et al's (2008) research on the combined effects of low control and anxiety; and

Kay, Shepherd et al's (2010) results on the appeal of a controlling God in times of political

uncertainty. This research collectively provides support for the idea that believing outcomes to

be out of one's control and decided by chance correlates with more magical thinking (in various

forms). On this basis, it is hypothesised that increasing participant perceptions of the world as a

random and chaotic place will result in higher levels of magical thinking.

The second question this research aims to answer is about high levels of desire for control and

how these relate to both magical thinking and the effect of inducing the sense of randomness

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[2] The present research uses the same primes as Kay, Moscovitch and Laurin (2010), but a different
measure of magical thinking (the IBI) and is conducted online. This study was chosen as its results
seemed intriguing and worth expanding on.

described above. Some research has found higher levels of desire for control to correlate with more magical thinking, such as Keinan's (2002) results on superstition and Burger and Cooper's (1979) findings of illusion of control behaviours. However, research on this topic appears to be fairly limited, so it is with caution that the researcher hypothesises that higher levels of desire for control will result in more magical thinking. It is also predicted that higher levels of this trait will result in a larger effect from the randomness prime.

The third research question considers the same questions as above, but with reference to intolerance of uncertainty. Research on this question is fairly thin on the ground, but Keinan's (1994) findings suggest that intolerance of ambiguity had a significant, positive effect on magical beliefs among Israeli citizens living through the Gulf War. It also seems logical that intolerance of uncertainty/ambiguity would lead to greater need for compensatory control strategies, including the use of magical thinking. On this basis, it is hypothesised that higher levels of intolerance of uncertainty will increase the effect of the randomness prime and result in higher levels of magical thinking.

Finally, the last research question considers the interaction of demographic variables (age, gender, ethnicity and education levels) with inducing a sense of lowered personal control and magical thinking. Previous research, such as Wolfradt (1997) has found gender to be an important predictor of certain magical beliefs, so on this basis, it is predicted that female participants will report higher levels of magical thinking. It is predicted that the other demographic variables will not have an effect.

Methods

Design

This research used a one-way, between participants study design. Moderated regression was used to determine the impact of randomness (versus the control condition) on magical thinking (as measured by the *Illusory Beliefs Inventory*). Participants were asked to re-order different sentences in each condition, which either had negative or random connotations. This exercise was intended to alter participant perceptions of how ordered and controllable the world is, which was expected to affect levels of magical thinking. IBI scores acted as the dependent variable and the two individual difference measures (Desirability of Control and Intolerance of Uncertainty) acted as moderators.

Participants

Participants were recruited during May and June 2020 through various avenues. These included posting information about the research to Facebook groups ("Dissertation Survey Exchange - Share your Research Study, Find Participants"; "Paid studies, study swap, participant recruitment"; "Student survey exchange"; "Survey participants and respondents for dissertation, thesis, exchange, swap"; and "Birkenhead and Northcote Community"). The researcher also shared the link to the questionnaire on her personal Facebook page. It was also posted to *Neighbourly* (a New Zealand based website for sharing information within communities) for the researcher's area[3]. A small number of flyers were posted in public places and businesses in Auckland, including libraries, community centres and cafes. The link or QR code followed online or from the flyers brought potential participants to the information sheet on the Qualtrics

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[3] There are some obvious disadvantages to collecting data through social media exchanges, in particular, that it results in an unusual sample. Most respondents from these pages were also completing research for a masters or honours thesis, so are assumed to be younger and more educated than the general population. The nature of exchanges also meant that respondents often completed the questionnaire and then requested the researcher to participate in their research, which may have resulted in rushed or distracted responses. Similarly, asking the researcher's own friends to participate may have biased the sample towards younger people (or other demographics). These methods were chosen due to necessity. New Zealand was in a period of quarantine, due to the COVID19 pandemic, which made access to participants (outside the internet) difficult.

platform, from which they could decide to continue to the questionnaire. See Appendix A for the information sheet and ethics approval.

The initial goal was to reach 200 participants, since this seemed a reasonable number of participants for the researcher to source and a reasonable sample from which to draw conclusions. This happened much more quickly than anticipated, so the researcher elected to continue data collection until the end of June. A total of 290 responses were included. A number of participants chose not to continue from the information sheet, so these responses were not counted. A small number (21) partially completed the questionnaire, so these were also discounted. See CONSORT diagram in Appendix B for details.

Of the 290 participants, most were female (80%), identified as European/Caucasian (74%) and lived in New Zealand (69%). A comparison of the control/negative and random conditions indicates that these were, on the whole, equivalent (see Table 1, Appendix B). Participant age ranged from 18 to 86, with a median of 32. Further information on this is available in Appendix B Tables 1 to 6.

Measures and Instruments

Randomness Prime

The randomness prime was intended to increase participant perceptions of the world as a chaotic place wherein outcomes are arbitrary and out of one's personal control. It asked participants to re-order 16 groups of five words into four-word sentences. Eight of these sentences were neutral in tone and the same in both conditions (e.g., toss the ball normally). In the random condition, eight of the sentences featured words related to chance or disorder (e.g., haphazard, chaotic, random); while, in the control condition, eight sentences featured negative words (e.g., loss, vomit, rat). Other research, such as Keinan (1994), has found links between negative mood states and magical thinking, so the control condition featured negative sentences to ensure any difference between conditions was not merely due to the randomness prime worsening participant mood.

The sentences were a replication of the primes used by Kay, Moscovitch and Laurin (2010) and are available in Appendix C. From Kay, Moscovitch and Laurin's (2010) study, it seemed the prime's effect was reliant on participants reading the words and thinking briefly about them, which seemed a reasonable task for participants in an uncontrolled environment. Asking them to imagine a scenario where they had more or less control, such as in Laurin et al's (2008) research, for example, seemed as if it may be less effective via an online survey. However, there was likely still some interference from distracting home environments, rushed responses, etc.

Magical Thinking

Magical thinking was measured with the Illusory Beliefs Inventory (IBI), which is a 24-item measure developed by Kingdon et al. (2012). It asks participant to indicate on a scale of 1*(don't agree at all/never do this*) to 5 (*agree absolutely/always do*) the extent to which they agree with various statements about magic, luck, spirituality and superstition. These included statements such as "magic causes miracles to happen" and "you should never tempt fate" (See Appendix C for the full list of items). Participant scores were calculated as the average of their 1-5 responses over the 24 items (9 reverse-coded).

The IBI contains three subscales: magical beliefs; spirituality; and internal state and thought-action fusion. The first of these focuses on magic, luck and fate (e.g., "I avoid unlucky numbers") and contains 10 items, two of which are reverse-coded. The spirituality subscale contains 9 items regarding spiritual forces, the soul, and (reverse-coded) the explanatory power of science. The third subscale contains items such as "I have sometimes changed my mind because I had a bad feeling" and statements on thoughts affecting reality (e.g., "If I think too much about something, it will happen"). Mean and standard deviation values for each subscale can be found in Table 7.

The Cronbach's Alpha coefficient in this research was .91 for the scale as a whole; .83 for the magical beliefs subscale; .84 for the spirituality subscale; and .84 for the internal state and thought action fusion subscale. These values all indicate good internal consistency and are

similar to Kingdon et al.'s (2012) values. (α = .93 for the scale as whole; α = .84 for subscale 1, α = .87 for subscale 2, and α = .85 for subscale 3).

Intolerance of Uncertainty (IU)

The original version of the Intolerance of Uncertainty Scale (IU) was developed by Freeston et al. (1994) and contained 27 items. Buhr and Dugas (2002) describe intolerance of uncertainty as a filter through which uncertainty is viewed as unacceptable and must be avoided. It also includes the ideas that uncertainty reflects badly on a person, results in stress and frustration and prevents action. Carleton et al.'s (2007) shortened version of the scale uses 12 items but has shown near perfect correlation with the original scale's scores ($r =.96$) and excellent internal consistency ($a = .91$). The items in the shortened scale include statements such as "uncertainty keeps me from living a full life" and "I can't stand being taken by surprise". In the present research, participant scores were calculated by averaging their (1-5) responses from the 12 items (none of which were reverse-coded).

Carleton et al.'s (2007) factor analysis isolated two subscales, prospective and inhibitory anxiety, both of which showed acceptable internal consistency ($a = .85$ for both). The prospective anxiety subscale contains 7 items, which focus on fear around future events and anticipatory feelings (e.g., "unforeseen events upset me greatly"). The inhibitory subscale contains 5 items that describe the restriction of action or experiences ("when it's time to act, uncertainty paralyses me"). Participants indicated how typical these statements were of them on a scale from 1 (*not at all characteristic of me*) to 5 (*entirely characteristic of me*) (see Appendix E for further items). As with the other measures, each participant's score was the average of their responses.

The Cronbach's Alpha coefficient was .90 for the scale as a whole; .88 for inhibitory anxiety; and .84 for prospective anxiety. These values indicate good internal consistency. They are also very similar to Carleton et al.'s alpha values, which were .91 for the scale as a whole and .85 for each subscale.

Desirability of Control (DC)

The second moderator was the Desirability of Control scale by Burger (1979). This contained

20 statements to assess a person's motivation to control the events of their lives, such as "I

enjoy being able to influence the actions of others" and "when it comes to orders, I would rather

give than receive them" (see Appendix C). These were coded from 1 (*this does not apply to me*

at all) to 6 (*this always applies to me*). Acceptable internal consistency and test-retest reliability

have been found in past research, as well as links to related behaviours, such as speech patterns,

gambling, and health-related behaviour (Burger & Hemans, 1988; Dembroski et al., 1984;

Burger & Smith, 1985; Smith, et al., 1984). In the present research, participant score was

calculated as an average of the 20 items, 5 of which were reverse-coded. The scale aims to

assess leadership, decisiveness and general desire for control. The Cronbach's Alpha coefficient

was .77, indicating acceptable internal consistency.

Procedure

Most (97%) participants accessed the research by clicking on a link on a social media page,

though some (3%) scanned a QR code from a poster around Auckland. Both of these routes

brought them to the information sheet and electronic consent form (see Appendix A). Having

clicked a box to indicate their consent, participants were randomly assigned one of two

conditions. They were then asked to complete either the randomness prime or control condition

exercise, which involved re-ordering 16 sets of words into sentences and typing these answers

in the appropriate boxes.

After this, participants were directed to complete a measure of magical thinking (the IBI). From

here, participants clicked a "next" button and were directed to complete the DC and IU scales.

Having completed the measures above, participants were asked a series of demographic

questions. The IBI was presented first to ensure that participant responses here were not

influenced by the individual difference measures or demographic questions. DC and IU scores

are relatively stable, and demographic details are unlikely to change, so having these follow the

IBI was intended to prevent any undue influence on the main dependent variable (the IBI) (Burger and Cooper, 1979; Carleton et al., 2007).

At the end of the questionnaire, participants were asked if they would like to participate in a prize draw for a gift card (as had been mentioned in the information sheet). Those who indicated yes were then directed to a new Qualtrics page to enter their email address (this was to ensure that the email address was not connected to the participant response).

Results

Preliminary analyses included testing for normality, calculating correlations between subscales, and generating descriptive statistics per scale and subscale. Moderated regression was then conducted to assess support for the hypotheses: that the randomness prime would increase levels of magical thinking; and that participants with higher DC and IU scores would show more magical thinking and response to the randomness prime. The PROCESS Macro was used for all regression analyses (Hayes, 2021).

Preliminary Analysis

Exclusion Criteria

Participants who did not complete the entire questionnaire were excluded from analysis, as were those who wrote nonsense words (or "no") in response to the primes.

Normality

The Kolmogorov-Smirnov statistic, Q-Q Plots and histograms were used to evaluate normality, which overall indicated normal distribution of the data from the three measures (IBI, IU and DC).

Correlational analysis

      Illusory Beliefs Inventory.

The three sub-scales of the IBI were moderately correlated (r = .54**[4], r = .59**, r = .48** respectively) as can be seen in Table 2. This suggests that each subscale measures a separate, though related, concept. The mean scores indicate moderate levels of belief in each of the three

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[4] * = correlation is significant at the .05 level; ** = correlation is significant at the .01 level.

factors: magical beliefs (M =2.35); spirituality (M = 2.96); and internal state and thought-action fusion (M = 2.60).

Intolerance of Uncertainty.

The mean participant score (M = 2.51) indicated a moderate level of intolerance of uncertainty among the sample. The factors within this scale (inhibitory and prospective anxiety) showed a strong, positive correlation (r = .69**).

Scale Correlations.

The correlational values for all three variables are presented in Table 2. The magical thinking subscale (1) was significantly and positively correlated with the two IU factors and overall IU score; indicating that higher levels of magical thinking correlate with higher levels of intolerance of uncertainty. The internal state and thought-action fusion subscale (3) also was positively correlated with total DC score, indicating higher desire for control correlates with more of this kind of magical thinking. Higher levels of internal state and thought-action fusion also linked to lower tolerance of uncertainty. These results are fairly unsurprising, as they fit the general hypothesis that a greater need for control and certainty results in more reliance on magical thinking. Similarly, DC score shows a negative correlation with the inhibitory anxiety subscale (factor 1) of the IU indicating that a higher desire for control correlates with a lower tolerance of uncertainty. All other correlations between scales did not reach significance.

Table 2

Descriptive Statistics and Correlations for Scales

Subscale/Scale	*M* (SD)	Pearson Correlations							
		IBI 1	IBI 2	IBI 3	IBI total	IU 1	IU 2	IU total	DC total
IBI 1	2.35 (0.80)	--				.28**	.19**	.25**	.08
IBI 2	2.96 (1.00)	.54**	--			.07	-.03	.02	.08
IBI 3	2.60 (0.99)	.59**	.48**	--		.29**	.22**	.28**	.18**
IBI Total	2.63 (0.77)	.86**	.86**	.76**	--	.24**	.13*	.19*	.12*
IU 1	2.23 (0.95)					--			-.17**
IU 2	2.71 (0.83)					.69**	--		.12*
IU Total	2.51 (0.81)					.90**	.93**	--	-.01
DC Total	4.25 (0.58)								--

Notes: IBI 1-3 = Illusory Beliefs Inventory subscales 1-3; IBI total = Illusory Beliefs Inventory total scale; IU 1 and 2 = Intolerance of Uncertainty subscales 1 and 2; IU total = Intolerance of Uncertainty total scale; total = Desirability of Control total scale; * = correlation is significant at the .05 level; ** = correlation is significant at the .01 level.

Regression Analysis

Moderated regression analyses were used to examine the effect of the randomness prime on IBI

scores, as moderated by the DC and IU. This resulted in 12 (separate) main analyses, in addition

to those that examined demographic factors. All were conducted using 10,000 bootstrap

samples. Linearity, homoscedasticity, and independence of observations were checked, which

overall indicated that the data met the assumptions for regression.

Research Questions

The following sections consider each research question with reference to the analyses described

above.

1. How does a randomness prime affect magical thinking (operationalized by scores in the

   IBI)?

Contrary to the hypothesis, the randomness prime was not significant for total IBI score,

magical beliefs (subscale 1) or internal state and thought-action fusion (factor 3) (all p values

> .13). Its effect on spirituality (subscale 2) was marginal ($\beta = -.20$, $p = .09$), suggesting that the

randomness prime decreased spiritual beliefs very slightly. A comparison of mean scores is

presented below in Figure 2. Evidently, the difference between conditions is minimal.

Figure 2

Mean Spirituality (IBI2) Scores by Prime Condition

Notes: error bars represent SD
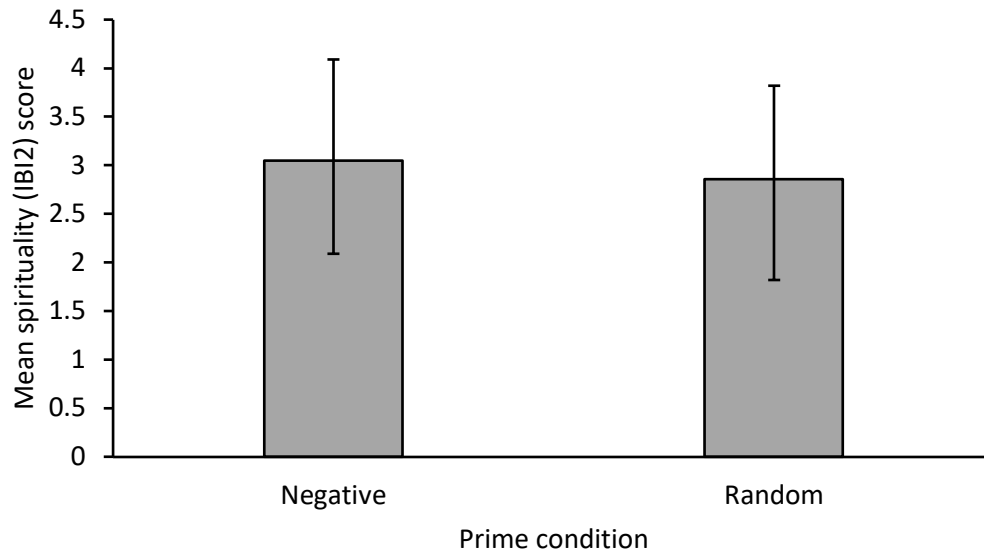
Further details on these analyses are available in Table 8, Appendix D.

There were some other models in which the randomness prime was significant: namely, when inhibitory anxiety (IU factor 1) and highest tertiary qualification were used as moderators. These will be discussed further under research questions three and four.

The randomness prime was not significant in any other analyses (p >.13). None of these results supported the hypothesis that the randomness prime would result in higher levels of magical thinking (IBI scores).

2. How do higher levels of DC relate to magical thinking and the impact of the randomness prime?

Contrary to the hypothesis, DC scores did not interact with the prime in any significant way (p > .32 for all analyses). However, DC had a marginal, positive effect when predicting total IBI

score (β = .19, p = .08) and internal-state and thought-action fusion (factor 3) (β = .24, p = .09). This suggests that higher levels of DC may have a small, positive effect on levels of magical thinking. In all analyses with DC as a moderator, the randomness prime did not have a significant effect (p > .40). More information on these models is available in Table 9, Appendix D.

3. How do higher levels of IU relate to magical thinking and the impact of the randomness prime?

Higher levels of IU were expected to correlate with higher IBI scores, which was the case for some dimensions of the IBI. IU had a significant effect on total IBI score (β = .18, p = .02), as well as magical thinking (factor 1) (β = .23, p < .01) and internal state and thought-action fusion (factor 3) (β = 0.40, p < .001). This was not the case for spirituality (factor 2) (p = .92). These results suggest that intolerance of uncertainty results in higher levels of some kinds of magical thinking, specifically magical beliefs and thought-action fusion.

IU did not interact with the randomness prime in any significant way, on the whole, though there was one exception. With inhibitory anxiety as a moderator, the randomness prime's (negative) effect on spirituality (IBI subscale 2) reached significance (β = -.61, p > .03). This information is shown below in Figure 3 and suggests that low levels of IU resulted in the largest difference between condition. Participants low in IU reported lower IBI scores in the random condition, whereas there was minimal difference between conditions for those with high IU scores.

Figure 3

Illusory Beliefs Inventory Scores Relative to Intolerance of Uncertainty Levels Across Random and Control Conditions
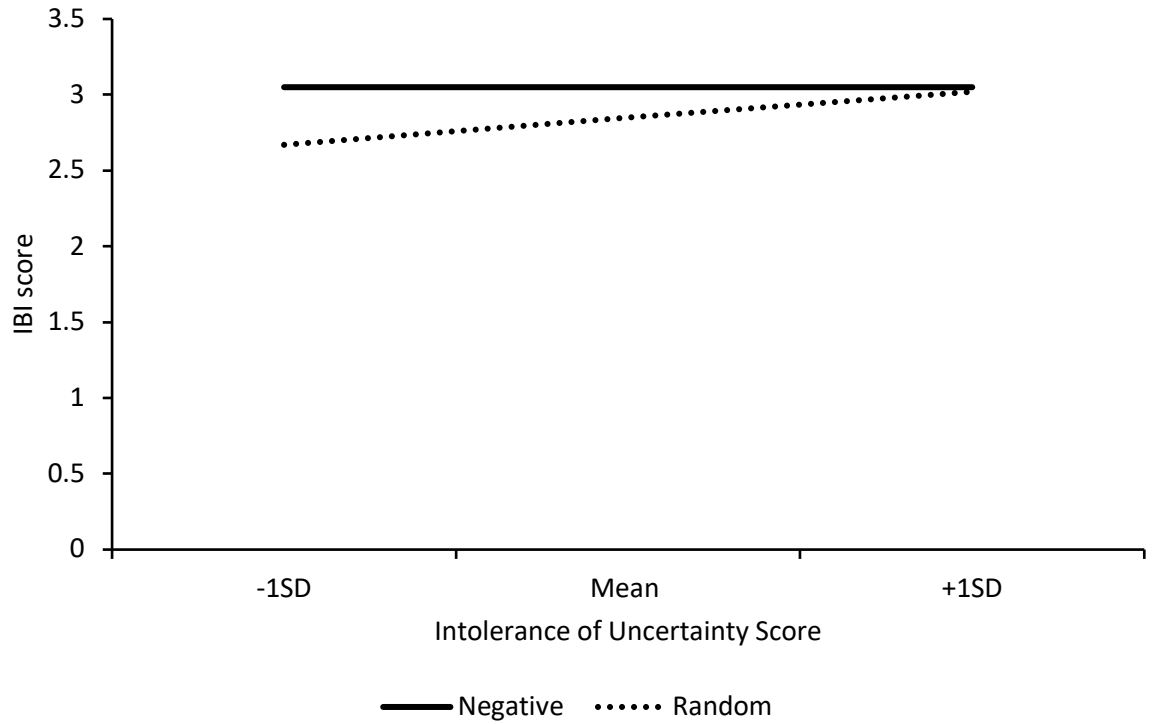
The randomness prime also had a marginal effect on magical beliefs (IBI subscale 1) when inhibitory anxiety (IU factor 1) was used a moderator ($\beta = -.43$, $p = .07$). Here the effect was also negative, suggesting that the randomness prime resulted in slightly lower levels of magical beliefs than the negative prime/control condition.

In all other models, neither the randomness prime was significant ($p > .28$) nor the interaction of the prime and IU scores ($p > .12$).

4. Do age, gender, ethnicity and education levels have any effect of magical thinking and the impact of the randomness prime?

Gender and Age.

Female participants were expected to report higher IBI scores, but this was not the case. The effect of gender was not significant ($p = .14$) and the randomness prime was non-significant ($p = .40$) in this model. Age was also non-significant in all analyses (see Table 11, Appendix D).

Education.

In answer to the research question: it seems that higher qualifications generally correlated with less magical thinking. Having qualifications beyond secondary school had a significant, negative effect ($\beta = -.33$, $p = .05$) on total IBI score and the effect of further tertiary qualifications was also significant ($\beta = -.16$, $p < .01$). This information is shown below in Figures 4 and 5.

Figure 4

Mean Illusory Beliefs Inventory Score for Participants with and without Tertiary Qualifications
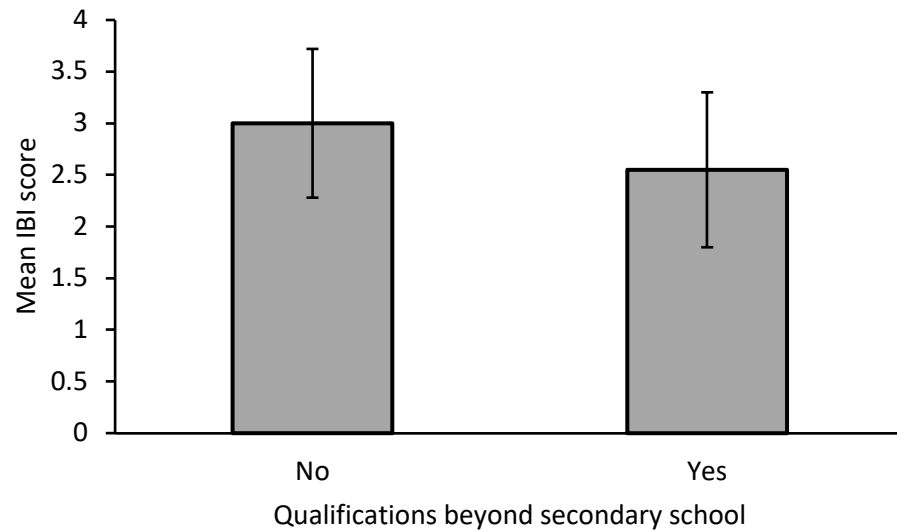
Notes: error bars represent standard deviation.

Figure 5

Mean Illusory Beliefs Inventory Score by Highest Tertiary Qualification

Notes: error bars indicate SD

Highest tertiary qualification also proved to be significant when considering spirituality (factor 2 of the IBI). In this case, the effect was negative (β = -.14) and significant (p = .05), indicating

that higher tertiary level qualifications were associated with lower levels of spirituality. This is shown in Figure 6 below. The main difference seems to between the diploma/certificate level and all others, suggesting that bachelor's degrees and beyond correlate with weaker spiritual beliefs. However, it is worth noting that only three respondents reported PhDs, so these findings do not carry a great deal of weight.

Figure 6

Mean Spirituality (IBI subscale 2) Score by Highest Tertiary Qualification
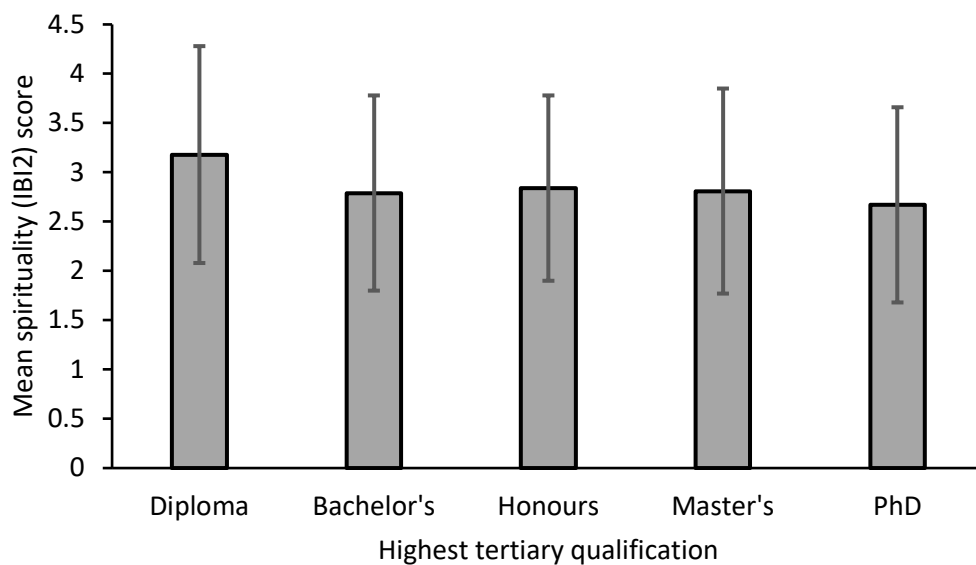
Notes: error bars show SD

When highest tertiary qualification was as a moderator, the randomness prime also had a significant effect. The interaction between these was marginal (p = .06). In this model, the prime's effect was negative (β = -.56, p = .01) indicating that, again, the negative/control condition resulted in higher levels of magical thinking. This same relationship was found between the prime, highest tertiary qualification and spirituality (IBI subscale 2) (β = -.86, p > .03). This information is shown below in Figures 7 and 8.

Figure 7 shows that IBI scores were higher in the negative condition for participants with diplomas or bachelor's degrees, but similar or slightly lower for those with higher

qualifications. It appears that the effect of the negative/control primes on magical thinking decreased as participants reported more qualifications.

Figure 7

Mean IBI Scores Relative to Highest Tertiary Qualifications by Prime Condition
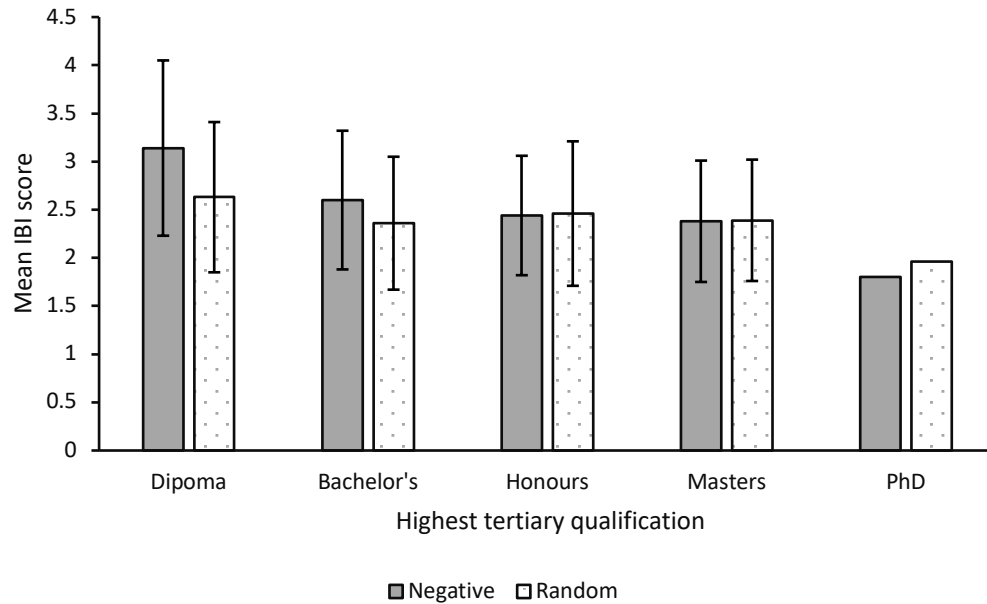
Notes: error bars indicate SD

Figure 8

Spirituality (IBI Factor 2) Scores Relative to Highest Tertiary Qualifications by Prime Condition
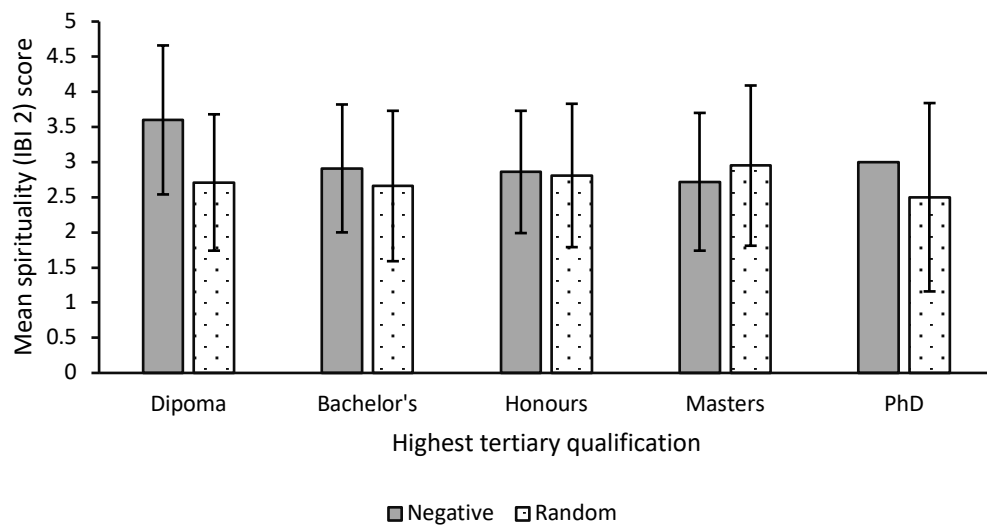
Notes: error bars indicate SD

In Figure 8, it appears that spirituality levels stay fairly stable in the random condition across all qualification levels, while the negative/control condition shows quite varied levels. This also seems to be where the largest difference is between diploma and other degree holders.

Ethnicity.

Finally, ethnic group was also a significant predictor of IBI scores ($\beta = .09$, $p < .01$). As can be seen in Figure 9, European/Caucasian participants reported the lowest levels of illusory beliefs ($M = 2.50$, SD $= 0.69$) while Māori participants reported the highest ($M = 3.90$, SD $= 0.78$). A more detailed breakdown on IBI scores can be found in Table 12, Appendix D. Ethnic group's interaction with the prime was not significant ($p = .56$).

Figure 9

Mean Illusory Beliefs Inventory Score by Ethnic Group
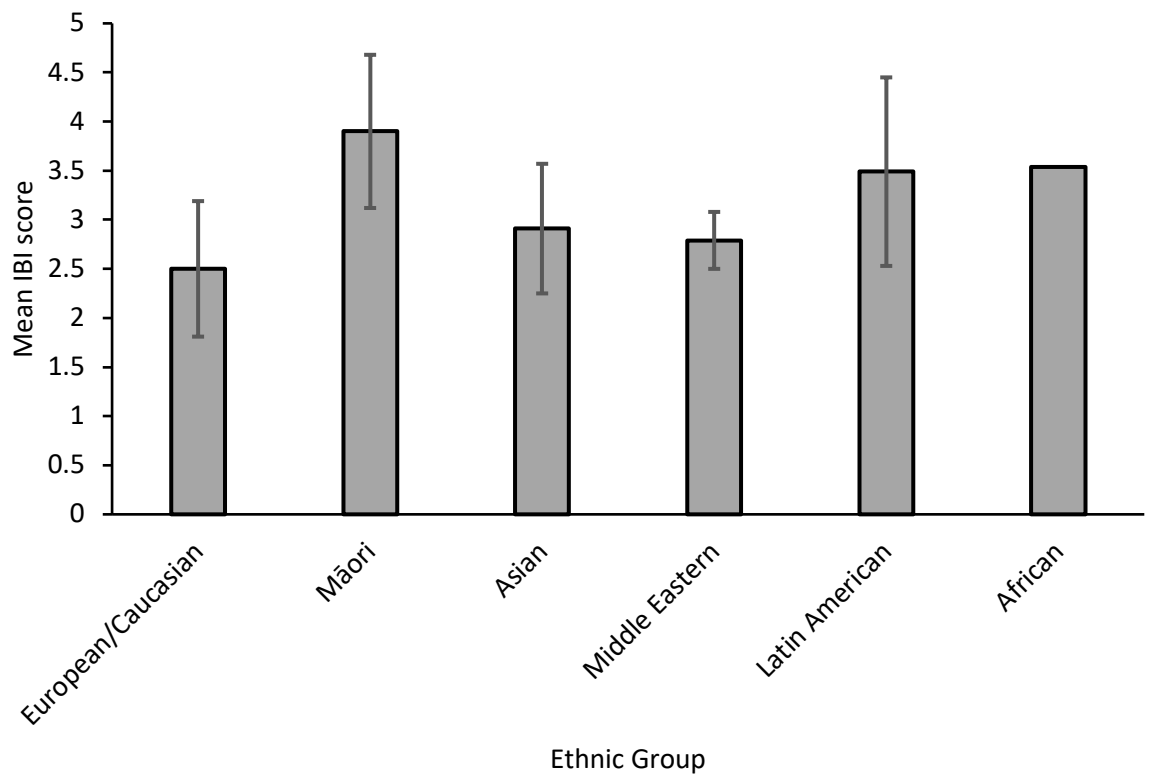
Notes: error bars show SD.

Country of residence information was collected, but since most participants were from a small range of countries, it is difficult to draw conclusions. Most respondents were from New Zealand (69%), with the next largest groups from the US (8%) and UK (5%). New Zealand and the UK showed similar mean IBI scores ($M = 2.56$ and $M = 2.51$ respectively), while the US reported a higher mean ($M = 3.19$). Most other categories contained fewer than five participants, which prohibited the use of inferential statistics. This information is shown below in Figure 10.

Discussion

Hypotheses

The aim of this study was to explore how perceiving the world as a chaotic and random place affects magical thinking, with the additional question of how this relates to an individual's general need for control and certainty. In short, this research found very few links between perceiving the world as "perilously random" and levels of magical thinking (Kay, Gaucher et al., 2010, p.38). A person's general need for certainty did show a number of links to magical thinking, in particular, magical beliefs and thought-action fusion. In this case, people with lower tolerance for uncertainty tended to show higher levels of magical thinking. Interestingly, this was also one of the few analyses in which the priming had a significant effect. Contrary to expectations, exposure to negative sentences resulted in more magical thinking, in particular for those low in intolerance of uncertainty, the implications of which will be discussed further.

Demographic factors were also examined with regard to magical thinking levels, with the expectation that female participants would report stronger illusory beliefs. This was not the case. Instead, education levels proved to be the most important factor, with a general decline in magical thinking as tertiary qualifications increased. There were also some unexpected interactions with the randomness prime, which will be discussed further.

Randomness and Magical Thinking

That priming randomness did not, on the whole, affect levels of magical thinking raises some questions. A large body of research has found connections between perceiving the world as more random or arbitrary and increased magical thinking, such as Kay, Gaucher et al. (2010), Keinan

(1994) and Padgett and Jorgenson (1982). Experimental studies, such as Laurin et al. (2008) and

Whitson and Galinsky (2008) have also documented this link, though most of these used slightly

different constructs. Kay, Moscovitch and Laurin (2010), however, used the same word re-ordering

task as in the present research and attributed 23% of the variance in supernatural beliefs to these

randomness primes ($\eta^2_p = .23$). This finding lends some support to the efficacy of the primes in the

present research, but does not seem strong enough to rule out a methodological issue as explanation

for the lack of difference between conditions.

Priming Randomness Specifically

 It may also be worth considering how certain it is that other research really did prime randomness

specifically and how perceiving the world in this way relates to anxiety. Evoking a sense of the

world as a chaotic and uncontrolled place seems quite likely to increase anxiety and uncertainty, at

least for some participants. Researchers such as Malinowski (1948) and Felson and Gmelch (1979)

have argued that magical thinking serves primarily to mitigate anxiety around uncertainty or danger,

which suggests that identifying specific control needs might be difficult. In this research, it is not

certain that the different primes targeted these different needs successfully. Reading a sentence such

as "athletes have bloody injuries" (a negative prime) seems, at face value, at least, as likely to make

a person feel anxious or uncertain as "the athletes perform unpredictably" (a randomness prime).

Without being sure that the random sentences primed uncertainty in a different way to the negative

sentences (e.g., through a manipulation check), it is difficult to draw firm conclusions regarding

Compensatory Control Theory.

Measures of Magical Thinking

That the present research used a more detailed measure of magical thinking (which included

magical beliefs, spirituality and internal state and thought-action fusion) could explain some of the

differences in findings. Kay, Moscovitch and Laurin (2010) relied on three items to measure magical thinking; participants indicated on a scale the extent to which they agreed that the universe is controlled by God or similar (two questions on this) and that the universe is governed by a supernatural order, such as karma. These questions evidently focus on spirituality and presumably do not cover magical beliefs or internal-state and thought-action fusion, so differ from the IBI in this way. The spirituality subscale showed the strongest (though still marginal) effect from the primes, but in the opposite direction to Kay, Moscovitch and Laurin's (2010) findings. Re-ordering the negative sentences resulted in a very slight increase in spirituality scores, which brings into question what exactly these sentences primed. Authors such as Hollander (2017) and Chauvin and Mullett (2011) would argue that neuroticism (including anxiety) is enough to predict magical thinking, though this research tended to focus on anxiousness as a stable personality trait. Whether a temporary increase in anxiety could be enough to increase magical thinking is less clear, as is that the negative sentences would definitely worsen mood. Studies such as Knuppenburg and Fredericks (2021) have found that reading words with negative connotations can have a detrimental effect on mood, but this was not tested in the present research. Given that eight of the 16 sentences were neutral in both conditions, it does not seem likely that the effect of the negative sentences would be especially strong.

Other research, such as Keinan (2002) and Burger and Cooper (1979), relied on a particular illusions of control behaviour, such as knocking on wood, which would also result in different magical thinking scores than the IBI. Overall, the ways magical thinking has been operationalised across the relevant literature are quite varied, which could explain some of the different findings in the present research.

Sample Differences

It may also be worth noting differences in sample. Previous research has found relatively low levels of religiosity/magical thinking in New Zealand (Statistics New Zealand, 2019), especially for those of European descent (Statistics New Zealand, 2018). Americans consistently report higher levels of religiosity (Crabtree, 2010) and even in the present research, showed a higher mean IBI score. However, comparing mean IBI scores in the present sample with other research, such as Kingdon et al. (2012) indicates very similar levels of magical thinking across the samples ($M = 2.63$ in this research and $M = 2.64$ for Kingdon et al., 2012). This suggests that any sample differences were not significant in terms of this construct.

Desire for Control

That desirability of control was also, on the whole, non-significant for magical thinking was also an unexpected finding. Burger and Cooper's (1979) research with American undergraduate students found a significant link between high levels of this measure and magical thinking, in the form of thought-action fusion. In this research, magical thinking was operationalised by measuring how much control participants seemed to believe they had over how a die landed. They were asked to bet chips either before or after the die was rolled (in the after condition, it was hidden under a cup). It was assumed by Burger and Cooper (1979) that the relative number of chips bet in each condition indicated how much control participants believed they had over how the dice landed. This seems to be a form of thought-action fusion, wherein a person believes their thoughts alone have some effect on reality. Keinan's (2002) research also used quite a specific measure of magical thinking, namely how many times participants "knocked on wood" in response to particular questions. Evidently, these are quite different measures of magical thinking to the Illusory Beliefs Inventory (used in the present research). The IBI contains 23 items that cover magical beliefs, superstition, and internal state and thought-action fusion. It is conceivable that these differences in measures explain some of the difference in results, if, for example, Desirability of Control relates to this type of thought-action fusion specifically, but not magical beliefs or spirituality.

An alternative explanation of these findings is that magical thinking is not in fact informed by desire for control, but by other factors, such as need for certainty or anxiety-mitigation. Research on the role of DC in magical thinking, such as Keinan (2002) and Burger and Cooper (1979) has found correlations between greater desire for control and magical thinking, but this research is fairly limited. There does not appear to be a vast body of research on this topic, and existing studies, such as Keinan (2002) and Burger and Cooper (1979) rely on quite small and limited samples. Finding that uncertainty was, on the whole, a more important factor in magical thinking in the present research also raises some questions. This suggests that magical thinking could serve a slightly different purpose to restoring control, such as decreasing uncertainty. The importance of certainty in the use of magical thinking will be discussed further.

Magical Thinking Measures

It may also be worth noting that Burger and Cooper (1979)'s research on DC relied on a different measure of magical thinking from the present research. Participants were asked to bet on the rolling of a dice before or after it happened (i.e., the experimenter had either done it already and the dice was concealed). How willing participants were to put money on the outcome in the before condition (relative to the after) was assumed to indicate how much control participants believed they had over the outcome (how the dice landed). Based on the number of chips bet in each condition, Burger concluded high DC levels had a significant effect ($p = .05$). Participants were 40 undergrads who took the DC 8 weeks earlier and were at least 1SD above or below the mean.

Intolerance of Uncertainty

 Findings from the present research on the role of uncertainty in magical thinking seem to fit, overall, with the existing research. As with need for control, there does not appear to be a vast wealth of research on this relationship, but one that suggests a correlation is Keinan (1994). In these

studies, Keinan (1994) found that lower tolerance of ambiguity correlated with more superstitious behaviours in a student population, measured primarily by how many times they "knocked on wood" in response to questions. This fits with the Compensatory Control Model (Kay et al., 2009), which states that magical thinking serves the purpose of restoring control and certainty. It seems logical, therefore, that individual with more need for certainty would rely more on strategies such as magical thinking. The present research's findings support this idea, in particular with regard to magical beliefs and internal-state and thought-action fusion. Intolerance of uncertainty also showed a strong correlation with magical thinking in general. That this was not the case for DC, as discussed above, suggests that perhaps need for certainty was a more important factor than need for control in magical thinking in the present sample.

Re-ordering words related to chance and chaos also seemed to also have a greater effect on spirituality for participants with higher levels of intolerance of uncertainty. Levels of spirituality tended to increase with greater need for certainty in this condition, which was not the case for participants who re-ordered words with negative connotations. This is unlike all other analyses with IU and magical thinking, suggesting that spirituality may be motivated by different needs to the other kinds of magical thinking measured. It may be worth considering this with regard to the measures of magical thinking used in other research and if this could explain any discrepancies.

Inhibitory Anxiety

Key analyses tended to be those used the inhibitory anxiety subscale of the IU, as has been discussed above. This subscale focuses on uncertainty that inhibits action or experience, e.g., "when it's time to act, uncertainty paralyses me". This contrasts with the prospective anxiety subscale, which focuses on anxiety around future events. Why these constructs had different relationships with magical thinking is difficult to establish, this could perhaps be a worthwhile avenue for future research.

Demographic factors

Gender

Contrary to expectations, gender was not significant in predicting levels of magical thinking. Numerous studies have found women to report stronger beliefs in the paranormal and other kinds of magical beliefs, such as Wolfradt (1997). Vyse's (2014) review noted that women were twice as likely to be bothered by staying on the 13th floor of a building, for example, though men were more likely to report believing in supernatural creatures (such as the Loch Ness Monster). He concluded that women were, on the whole, more superstitious, particularly with regard to the paranormal. That gender was not significant in the present research is therefore an unexpected finding, though there are a number of potential explanations for this. Perhaps the most likely is that the sample in the present research was overwhelmingly female (80%), which makes it difficult to draw conclusions regarding the few (52) male participants. An additional, minor consideration is the cultural background of participants. Numerous studies (Freese, 2004; Hackett et al., 2016; Lummis,2004; Sullins, 2006) have reported higher levels of religion among women in Western countries, but this does not appear to be the case in New Zealand. Smith (2013) reported that gender was no longer a significant factor in religiosity in this country, which, given the high proportion of New Zealand participants (69%) could explain that this was not an important factor in the present research.

Education Levels

The general pattern in the present research was higher levels of education correlating with lower levels of magical thinking. Having any qualifications beyond secondary school had a negative effect on illusory beliefs, though this effect was stronger when examining highest tertiary qualification. Here there was a notable difference between diploma/certificate level and the other qualifications (bachelor's (with honours), master's and PhD). This is a slightly surprising finding also - as

numerous authors have noted, higher education does not make one immune to superstition (Vyse, 2014). Rice (2003) notes that better educated Americans are more likely to believe in telepathy and deja-vu, but less likely to believe in ghosts, astrology and reincarnation. Vyse (2014) concludes that higher education may facilitate scepticism, which would perhaps fit with the present research's findings. That the primary difference is between diploma/certificate level and the other qualification raises some questions – is it possible that critical thought is less of a focus at this level? It seems impossible to consider doing a PhD without using critical thought, but perhaps not inconceivable to complete a certificate in a vocational area without much time spent on this skill. It may be worth reiterating, though, that only three participants reported PhDs in the present research, so it may be unwise to generalise.

Country of Residence

Where participants lived had a significant effect on levels of magical thinking, though, as noted earlier, the data were quite limited. Participants were mostly from New Zealand, with the next largest groups from the US and the UK. New Zealand and the UK showed similar levels of magical thinking, while America was notably higher. This fits with research such as Kay, Shepherd et al. (2010) which explains high levels of religiosity in America with reference to the extremely varied life outcomes of different groups. They note that wide gaps between rich and poor mean that many do not experience personal stability. In addition to this, a consistent influx of migrants from less developing countries has resulted in a large population used to fragile government and economic systems. While the data from the present study is very limited, it lends some support to these ideas.

Ethnic Group

Similarly, the findings on ethnic group are limited due to sample but seem to fit with existing research. The overall trend involved lowest levels of magical thinking among European/Caucasian respondents, with higher levels for Māori and Latin Americans. Egan (2019) describes the

importance of spiritualities for different Māori groups and argues that this (among other kinds of spirituality) is "seeding and shaping" (p.1032) many aspects of life in New Zealand. Māori reporting higher levels of spirituality also fits with Deprivation Theory (Glock & Stark, 1965; Stark & Bainbridge, 1980), which states that magical thinking can be a means of coping with the strain of disadvantaged social and economic status. Māori in New Zealand experience a range of disadvantages in health, education, housing and various socio-economic measures, so this may also be applicable (Ministry of Social Development, 2016). Spirituality is also described as integral to Latin American worldviews (Campesino & Schwarz, 2006) though here the sample is extremely limited (N = 9) so it seems unwise to generalise from these results.

Limitations

Manipulation Check

Including a manipulation check to ensure that the randomness prime did in fact increase participant perceptions of the world as random and uncontrolled would have made it much easier to draw conclusions from the present research. Without this, it is not certain that the manipulation had any effect, so it is unclear if the similarity between conditions is due to a methodological issue or reflects an important, conflicting finding in the compensatory control literature. Choosing not to do a manipulation check was based, in part, on Kay, Moscovitch and Laurin's (2010) findings. In this research, the same primes were used and those to do with randomness resulted in significantly stronger beliefs in the supernatural. Kay, Moscovitch and Laurin's (2010) sample of 37 Canadian undergraduates was assumed to be fairly similar to the predicted sample for this research. It was expected that the present research would generate similar results, so the efficacy of the primes was not expected to be a major issue.

Sample

As has been mentioned earlier, the sample in the present research was also not entirely representative. Participants chose to participate after seeing a social media post or flyer, which presents issues with self-selection bias (Lavrakas, 2008). This was especially evident in social media posts, where the researcher noted individuals often "tagged" people they knew to have an interest in the supernatural. This may have resulted in higher levels of magical thinking among the present sample than is representative of the wider population. Bethlehem (2010) argues that self-selection is an inherent problem in online research, pointing to the inaccuracy of online election polls, even when a large number of respondents are included. As she notes, participants are those who happen to have internet access, visit the website in question, and then decide to take part. Unequal access to internet is also an issue inherent in online research. In New Zealand, this means the exclusion of more Māori and Pacifica, those who are unemployed, in social housing, disabled, living in rural towns or elderly (Grimes & White, 2019). In particular, poor internet access was reported by those living in Housing New Zealand properties (71% relative to 91% for the general population); those who are disabled (71%) and Pacifica students (72% relative to 85% to the entire student sample) (Grimes & White, 2019). The present research did not collect data on housing or disabilities and did report very few Pacifica respondents. Given the information on internet access, it seems reasonably likely that the groups mentioned were under-represented in the present research.

There is also a probable issue with inattentive participants. Inattentive responding has been well-documented as an issue in internet studies, with estimates varying from 3% to 46% (depending on measurement) (Meade & Craig, 2012). It is characterised by participants responding without regard for the items they are presented with, such as by choosing random points on scales or the same response for each item (Huang et al., 2015; Berry et al., 2019). This was fairly easy to identify in response to the primes, such as when participants responded with random letter sequences (and were therefore excluded) – but was effectively uncontrolled in the other sections of the

questionnaire. Given the uncertainty regarding the prevalence of this problem, it is difficult to account for the effect these responses may have had on the present research.

In addition, it seems likely that participant responses would be affected by demand characteristics. Orne's (1959, 1962) theories argued that participants are influenced by social cues and a desire to be helpful to the researcher, especially when they believe in the importance of science (McCambridge et al., 2012). This seems especially likely when the sample is made up of the researcher's friends and other postgraduate students. Similarly, participants may have been able to get an idea of the hypothesis from the information they were given - these effects may have exaggerated any positive findings.

Type 1 Errors

Due to running a large number of analyses, there is also some risk of Type 1 error in the present research. 12 main analyses (moderated regression models) were run, excluding those considering demographic factors. However, most of the primary analyses were non-significant, so Type 1 errors are not possible here.

Social Desirability Bias

Another potential issue in the present is the effect of social desirability on how participants responded to the questions to magical thinking. Participants may have been reluctant to agree with statements such as "I believe in magic spells" or other items in the magical beliefs subscale in particular. However, the potential impact of this bias would be presumably fairly even across conditions, so it seems unlikely to have distorted results in a significant way.

Future Directions

Expanding on this research, or Kay, Moscovitch and Laurin's (2010), with the inclusion of a

manipulation check would be a useful way to establish some clearer conclusions regarding the

efficacy of priming randomness and how this affects levels of magical thinking. As discussed under

limitations, without this knowledge, it is difficult to judge if the minimal effects of the prime on

randomness reflect a methodological issue or a real issue in compensatory control theory.

On a related note, research that focused on identifying the specific needs that magical thinking

serves would be a useful way to build on the present findings. There is evidently some contention

regarding the role of control, certainty and mitigating anxiety (and other factors) and the existing

evidence is quite mixed. That the present research did not find any real links between desire for

control and magical thinking raises questions about this relationship. Studies such as Burger and

Cooper (1979) and Keinan (2002) provide some support, but are relatively few and with fairly small

effect sizes. Similarly, that uncertainty proved the more important factor in the present research

provides support for a fairly small body of research, such as Keinan (1994). Since this research is

also quite limited, expanding on these studies with larger samples and perhaps broader measures of

magical thinking could be a worthwhile exercise.

Conclusions

The present research produced some unexpected findings that have raised further questions

regarding compensatory control and magical thinking. Inducing a sense of the world as a chaotic

and uncontrolled place did not appear to increase magical thinking, as has been found in other

studies. Using the same manipulation as Kay, Moscovitch and Laurin (2010) was expected to

generate similar results, but this was not the case. Priming randomness in this way had very little

effect, the reasons for which are a little unclear. It is possible that the manipulation did not prime

randomness, as was intended, but an alternative construct or nothing at all. Alternatively, the prime

may have been effective, but randomness just did not relate to magical thinking. If this were the case, these results would contrast with existing compensatory control research and bring into question some aspects of this theory. Ultimately, however, it seems more likely to have been a methodological issue, though confirmation through further research is certainly needed.

The findings on how desire for control affected magical thinking were fairly limited. A marginal effect was documented between high desirability of control and total magical thinking, while there was a small (significant) effect on internal state and thought-action fusion. The other forms of magical thinking were found to be unrelated to desirability of control. This differs slightly from prior studies. Existing research, such as Burger and Cooper (1979) and Keinan (2002), documents a link between higher levels of DC and magical thinking, but this research is quite limited. The discrepancies with the present study's results seem unlikely to be a methods issue, which also presents questions. It is possible that the sample was responsible for these differences, but there is no obvious reason for this. Most participants were from New Zealand and the level of education was quite high, but there is no clear explanation for why this would affect the relationship between desire for control and magical thinking. Bearing this in mind, the findings from this study suggest that the role of desire for control in total magical thinking may be relatively unimportant.

In contrast, intolerance of uncertainty proved an important predictor of magical thinking in the present research. Inhibitory anxiety was evidently the more important subscale, suggesting that it is a specific set of responses to uncertainty that correlate with magical thinking. The relationships with different kinds of magical thinking were slightly varied, with spirituality showing weaker links to IU levels than magical beliefs or internal state and thought-action fusion. The general pattern of higher IU correlating with higher levels of magical thinking fits the existing research, however and supports the idea that magical thinking serves as a way of mitigating anxiety about uncertainty.

A slightly unexpected finding with IU levels was found in their interaction with the negative/control primes. Participants in the negative/control condition showed higher levels of magical thinking when low in intolerance to uncertainty, but the difference between conditions was minimal for participants with higher levels of IU. There is no obvious explanation for this result – it does not appear to align with any previous research or compensatory control theories.

The relationships between magical thinking and various demographic variables were also not as expected. Gender did not prove a significant predictor of illusory beliefs, which conflicts with research from various Western countries, but looks like it may fit with New Zealand cultural/societal trends specifically. Levels of education were the most noteworthy demographic factor, with a general decline in magical thinking as qualifications increased. Existing research on this relationship seems to be very mixed, so these findings lend some support to theory that magical thinking declines with education.

Overall, the present research delivers a range of unexpected and frankly confusing results. It seems that the relationships between control, certainty and how people perceive the world are neither clear nor consistent, leaving many avenues for future research open.

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Appendices

Appendix A: Ethics

[Information Sheet]

Perceptions of uncertainty and supernatural beliefs

Q1.1 Date Information Sheet Produced: 5th March 2020
Project Title: How do personal perceptions and personality differences affect the beliefs we hold?

An Invitation

Dear Participant,

I'm conducting some research on various aspects of people's personalities and how they affect the beliefs we hold, as part of my Master's degree in psychology. You are invited to take part in this research, though this is completely voluntary. Your participation would be greatly appreciated, as this research needs to reflect the experiences of a range of different people. For this reason, and to compensate for your time, there is the opportunity to enter a prize draw. The questionnaire will take 10 to 20 minutes to complete, is completely anonymous and contains no distressing material.

Many thanks for your consideration.

Best wishes,
Beth McMahon

What is the purpose of this research?
The data collected in this research will be used to write my thesis, as part of a Masters of Arts in psychology at AUT. This thesis will explore how different perceptions affect beliefs, and if this interacts with personality factors. This research aims to build on an existing foundation and expand knowledge of the role of individual difference factors in certain beliefs. These findings may be used for academic publications and presentations.

How was I identified and why am I being invited to participate in this research?
This research was promoted online and in various physical spaces in Auckland, New Zealand. To get here, you must have followed a link or QR code from one of those places.
To be included in this research, you must be 16 years of age or older, and able to speak, read and understand English. Students in the classes of the project's supervisors (Jay Wood and Erik Landhuis of AUT) are also excluded for ethical reasons.

How do I agree to participate in this research?
Your participation in this research is voluntary (it is your choice) and whether or not you choose to participate will neither advantage nor disadvantage you. You are able to withdraw from the study at any time, though it will not be possible to remove your data once you've submitted your responses. By submitting your responses, you are agreeing to participate in the research and consenting to the use of your data in the analysis.

What will happen in this research?
If you agree to participate in this research, you will need to spend 10-20 minutes filling in an online questionnaire. This will include a word-unscrambling exercise, a measure of beliefs, and two measures that look at individual differences in personality. The word-unscrambling exercise you complete will be one of two versions, which are intended to prime different ways of thinking.

What are the discomforts and risks?
This research will not present any risk or major discomfort. You'll need to think about your personal beliefs and complete a word-unscrambling task.

How will these discomforts and risks be alleviated?
As above, I don't anticipate that you will experience any discomfort or risk. However, you're able to withdraw from the questionnaire at any time, if you find the content unpleasant or difficult in any way.

What are the benefits?
By participating in this research, you'll be given the opportunity to enter a prize draw for one of 23 Prezzy Cards (one for $250, and the other 22 for $25 each). If you're interested to know the findings of the research, you'll be able to read them. At the end of the questionnaire, you will be given a link to a website where the results be presented when they are available.

Additionally, taking part in research like this contributes to the knowledge pool of psychology as a whole. It's important for research to represent all of us, so we need people from all walks of life to contribute their experience and help us create an accurate picture. This research will also assist me greatly in obtaining my Master's degree in psychology.

How will my privacy be protected?
Your answers to the questionnaire will remain anonymous. You can choose to provide your email address for the prize draw, but this won't be connected to your answers. The data may be

provided to other researchers, for further analysis or verification, but your responses will not be identifiable. The results of the study may also be published.

What are the costs of participating in this research?
Completing the questionnaire will take between 10 and 20 minutes of your time. You can do it on your phone or a computer where you have internet access.

What opportunity do I have to consider this invitation?
Participants will be accepted until the required number is reached. This is expected to be approximately the end of June 2020.

Will I receive feedback on the results of this research?
If you are interested, you can read the results of the research at a link which I will share with you at the end of the questionnaire. The results will be summarised there as soon as the data has been analysed.

What do I do if I have concerns about this research?
Any concerns regarding the nature of this project should be notified in the first instance to the Project Supervisor: Jay Wood
Email address: jay.wood@aut.ac.nz
 Phone: +64 9 921 9999 extension 8506

Concerns regarding the conduct of the research should be notified to the Executive Secretary of AUTEC, *ethics@aut.ac.nz* , (+649) 921 9999 ext 6038. You can provide the ethics approval number (20/148) as reference.

Whom do I contact for further information about this research?
Please keep this Information Sheet and a copy of the Consent Form for your future reference. You are also able to contact the research team as follows:
 Researcher Contact Details:
 Beth McMahon: nvy8565@autuni.ac.nz
 Project Supervisor Contact Details:
 Jay Wood; jay.wood@aut.ac.nz; +64 9 921 9999 extension 8506
 Erik Landhuis; erik.landhuis@aut.ac.nz; +64 9 921 9999 extension 6645

[AUTEC Approval]

27 May 2020

Jay Wood
Faculty of Culture and Society

Dear Jay

Ethics Application: 20/148 **Do perceptions of control and uncertainty predict supernatural beliefs**

We advise you that a subcommittee of the Auckland University of Technology Ethics Committee (AUTEC) has **approved** your ethics application.

This approval is for three years, expiring 20 May 2023.

Non-Standard Conditions of Approval

1. In the Information Sheet and the poster, state which students are excluded (Supervisors).
2. In the Information Sheet, 3rd line under Dear Participant 'delete the unfinished sentence 'by completing questionnaire'.

Non-standard conditions must be completed before commencing your study. Non-standard conditions do not need to be submitted to or reviewed by AUTEC before commencing your study.

Standard Conditions of Approval

1. The research is to be undertaken in accordance with the Auckland University of Technology Code of Conduct for Research and as approved by AUTEC in this application.
2. A progress report is due annually on the anniversary of the approval date, using the EA2 form.
3. A final report is due at the expiration of the approval period, or, upon completion of project, using the EA3 form.
4. Any amendments to the project must be approved by AUTEC prior to being implemented. Amendments can be requested using the EA2 form.
5. Any serious or unexpected adverse events must be reported to AUTEC Secretariat as a matter of priority.
6. Any unforeseen events that might affect continued ethical acceptability of the project should also be reported to the AUTEC Secretariat as a matter of priority.
7. It is your responsibility to ensure that the spelling and grammar of documents being provided to participants or external organisations is of a high standard and that all the dates on the documents are updated.

AUTEC grants ethical approval only. You are responsible for obtaining management approval for access for your research from any institution or organisation at which your research is being conducted and you need to meet all ethical, legal, public health, and locality obligations or requirements for the jurisdictions in which the research is being undertaken.

Please quote the application number and title on all future correspondence related to this project.

For any enquiries please contact ethics@aut.ac.nz. The forms mentioned above are available online through http://www.aut.ac.nz/research/researchethics

(This is a computer-generated letter for which no signature is required)

The AUTEC Secretariat

Auckland University of Technology Ethics Committee

Cc: bethmcma@gmail.com; erik.landhuis@aut.ac.nz

Appendix B: Frequency Tables of Participant Demographics

Table 1

Comparison of Condition Demographic Information

Demographic Categories		Conditions		
		Control	Random	Total
		Frequency		
Gender				
	Male	28	24	52
	Female	123	109	232
	Non-binary	2	4	6
Ethnicity				
	No response	19	15	34
	European/ Caucasian	110	105	215
	Maori	3	1	4
	Middle Eastern	3	1	4
	Asian	3	4	7
	Latin American	6	3	9
	Pacific Peoples	0	2	2
	Other ethnicities	9	6	15
Country of residence				
	New Zealand	102	99	201
	Australia	1	4	5
	US	24	16	40
	Canada	3	2	5
	UK	15	10	25
	Other European countries	7	3	10
	Asian countries	1	0	1
	African countries	0	1	1
	Middle Eastern countries	0	1	1
	Latin American countries	0	1	1
Age				
	Under 24	20	26	46
	25-34	54	47	101
	35-44	35	27	59
	45-54	17	18	35
	55-64	17	12	29
	65-74	6	7	13
	75-84	1	0	1
	85-94	1	0	1

Table 2

Participant Gender

Gender	Frequency	Percent
Male	52	17.9
Female	232	80.0
Gender diverse	6	2.1
Total	290	100

Table 3

Participant Country of Residence

Country of residence	Frequency	Percent
Afghanistan	1	0.3
Australia	5	1.7
Austria	1	0.3
Cameroon	1	0.3
Canada	5	1.7
France	1	0.3
Germany	2	0.7
Greece	1	0.3
Ireland	1	0.3
Italy	1	0.3
Mexico	1	0.3
Netherlands	2	0.7
New Zealand	201	69.3
Turkey	1	0.3
United Kingdom	25	8.6
USA	40	13.8
Vietnam	1	0.3
Total	290	100

Table 4

Participant Ethnicity

Ethnic group	Frequency	Percent
No response	2	.7
European/Caucasian	215	74.1
European/Caucasian, Māori	11	3.8
European/Caucasian, Māori, Pacific Peoples	3	1.0
European/Caucasian, Māori, Asian	1	.3
European/Caucasian, Māori, Other ethnicity	1	.3
European/Caucasian, Pacific Peoples	3	1.0
European/Caucasian, Asian	1	.3
European/Caucasian, Middle Eastern	1	.3
European/Caucasian, Latin American	2	.7
European/Caucasian, Other ethnicity	4	1.4
Māori	4	1.4
Māori, Pacific Peoples	1	.3
Māori, Other ethnicity	1	.3
Pacific Peoples	2	.7
Asian	7	2.4
Asian, Middle Eastern	1	.3
Asian, Latin American	1	.3
Middle Eastern	4	1.4
Latin American	9	3.1
African	1	.3
African, other ethnicity	1	.3
African American/Afro-Caribbean/Black	2	.7
Other ethnicity	12	4.1
Total	290	100.0

Table 5

Participant Education Levels

Qualifications beyond secondary school	Frequency	Percent
Yes	242	83.4
No	48	16.6
Total	290	100

Table 6

Highest Qualifications of Participants

Highest qualification	Frequency	Percent
No response	2	0.8
Certificate or Diploma	53	21.9
Bachelor's Degree	90	37.1
Bachelor's Degree with Honours	47	19.4
Master's Degree	39	16.1
PhD	3	1.2
Other	8	3.3
Total	242	99.8

Figure 1

CONSORT Diagram


```
                    ┌─────────────────────────────────┐
                    │ Assessed for eligibility (n= 318)│
                    └─────────────────────────────────┘

  ┌──────────────┐
  │  Enrollment  │                    Excluded  (n= 10)
  └──────────────┘                    ♦ Declined to participate
                                        (n= 10)

                    ┌─────────────────────┐
                    │ Randomized (n= 308) │
                    └─────────────────────┘

Allocated to intervention (n=        Allocation      Allocated to control
145)                                                 condition (n= 163)
 ♦ Received allocated                                 ♦ Received allocated
   intervention (n= 145)                                intervention (n= 163)

Discontinued intervention (did       Follow-Up       Discontinued intervention
not complete questions) (n=                          (did not complete
7)                                                   questions) (n= 8)

Analysed  (n= 139)                   Analysis        Analysed  (n=155)
 ♦ Excluded from analysis (poor                       ♦ Excluded from analysis
quality responses) (n= 2)                            (poor quality responses) (n=
                                                     2)
```

Appendix C: Scale Items and Primes

Scrambled Sentence Primes

Random condition:

committee the door chaotic is
brown play desk the is
systematic sew anarchists disorder hurdle orange at he random chose
easily paper store ripped the
ball the hoop toss normally
the haphazardly flew for robin
athletes the perform confusion unpredictably sky the seamless is ruddy
forget not try fool to
send I mail it over
long the today is book seven
faith virtue is a mayhem
that garbled spoke nonsense Mary
Dennis flat chance a takes
big chairs they box are

Negative condition:

committee the door lazy is
brown play desk the is
systematic sew armies fear hurdle orange very he poorly chose easily paper store ripped the ball the
hoop toss normally
eat slimy worms for robins athletes bloody have table injuries sky the seamless is ruddy
forget not try fool to
send I mail it over
long the today is book seven
faith virtue is a vomit
teammates loss hated idiotic Mary Dennis flat rat a sees
big chairs they box are

Illusory Beliefs Inventory Items

1. I do something special to prevent bad luck .
2. I avoid unlucky numbers.
3. Magic causes miracles to happen.
4. Magical forces have impacted on my life.
5. Most things that happen to us are the result of fate.
6. It is not possible to cast a magic spell.
7. Good luck charms do not work.
8. I believe in magic.
9. You should never tempt fate.
10. I do not believe in a spiritual presence.
11. I believe in a higher power or God.
12. The soul does not continue to exist after death.

13. I believe guardian angels or other spiritual forces protect me.
14. It is just a matter of time until science can explain everything.
15. There is an invisible force guiding us all.
16. Science is the key to understanding how things happen.
17. I use prayer to ward off misfortune.
18. Life is nothing more than a series of random events.
19. If I think too much about something, it will happen.
20. If I think too much about something bad, it will happen.
21. My thoughts alone can alter reality.
22. Sometimes I get a feeling that something is going to happen before it happens.
23. I have sometimes changed my plans because I had a bad feeling.

Intolerance of Uncertainty Scale Items

1.Unforeseen events upset me greatly.
2. It frustrates me not having all the information I need.
3. Uncertainty keeps me from living a full life.
4. One should always look ahead so as to avoid surprises.
5. A small unforeseen event can spoil everything, even with the best of planning.
6. When it's time to act, uncertainty paralyses me.
7. When I am uncertain I can't function very well.
8. I always want to know what the future has in store for me.
9. I can't stand being taken by surprise.
10. The smallest doubt can stop me from acting.
11. I should be able to organize everything in advance.
12. I must get away from all uncertain situations.

Desirability of Control Scale Items

1. I prefer a job where I have a lot of control over what I do and when I do it.
2. I enjoy political participation because I want to have as much of a say in running government as possible.
3. I try to avoid situations where someone else tells me what to do.
4. I would prefer to be a leader than a follower.
5. I enjoy being able to influence the actions of others.
6. I am careful to check everything on an automobile before I leave for a long trip.
7.Others usually know what is best for me.
8. I enjoy making my own decisions.
9. I enjoy having control over my own destiny.
10. I would rather someone else take over the leadership role when I'm involved in a group project.
11. I consider myself to be generally more capable of handling situations than others are.
12. I'd rather run my own business and make my own mistakes than listen to someone else's orders.
13. I like to get a good idea of what a job is all about before I begin.
14. When I see a problem, I prefer to do something about it rather than sit by and let it continue.
15. When it comes to orders, I would rather give them than receive them.
16. I wish I could push many of life's daily decisions off on someone else.
17. When driving, I try to avoid putting myself in a situation where I could be hurt by another person's mistake.

18. I prefer to avoid situations where someone else has to tell me what it is I should be doing.

19. There are many situations in which I would prefer only one choice rather than having to make a decision.

20. I like to wait and see if someone else is going to solve a problem so that I don't have to.

Appendix D: Models of Regression

Table 8

Regression Models with Randomness Prime and Illusory Beliefs Inventory Scores

Model of Regression		β (s.e)	p
Randomness prime --- IBI			
	r	-.14 (0.09)	.128
Randomness prime --- IBI 1			
	r	-.07 (0.10)	.494
Randomness prime --- IBI 2			
	r	-.20 (0.12)	.094
Randomness prime --- IBI 3			
	r	-0.17 (0.12)	.134

Notes: r = randomness prime, IBI = total IBI score, IBI1-3 = Illusory Beliefs Inventory subscales 1 to 3.

Table 9

Models of Regression with Desirability of Control as a Moderator

Model of Moderated Regression		β (s.e)	p
r + DC --- IBIT			
	r	0.14 (0.66)	.827
	DC	0.19 (0.11)	.080
	Int_DC x r	-0.07 (0.15)	.671
r + DC --- IBI1			
	r	0.11 (0.70)	.877
	DC	0.13 (0.11)	.248
	Int_DC x r	-0.04 (0.16)	.806
r + DC --- IBI2			
	r	0.66 (0.86)	.446
	DC	0.22 (0.14)	.112
	Int_DC x r	-0.20 (0.20)	.320
r + DC --- IBI3			
	r	-0.72 (0.84)	.400
	DC	0.24 (0.14)	.085
	Int_DC x r	0.13 (0.20)	.512

Notes: r = randomness prime, DC = Desirability of Control scale, IBIT = total IBI score, IBI1-3 = Illusory Beliefs Inventory subscales 1 to 3, Int_ x r = interaction of moderator and randomness prime.

Table 10

Models of Regression with Total Intolerance of Uncertainty Score as a Moderator

Model of Moderated Regression		β (s.e)	p
r + IU --- IBIT			
	r	-0.22 (0.29)	.445
	IU	0.18 (0.08)	**.021**
	Int_IU x r	0.03 (0.11)	.808
r + IU --- IBI1			
	r	-0.20 (0.30)	.498
	IU	0.23 (0.80)	**.004**
	Int_IU x r	0.05(0.11)	.685
r + IU --- IBI2			
	r	-0.42 (0.39)	.281
	IU	-0.01 (0.10)	.919
	Int_IU x r	0.09 (0.15)	.557
r + IU --- IBI3			
	r	0.09 (0.36)	.803
	IU	0.40 (0.10)	**.000**
	Int_IU x r	-0.12 (0.14)	.393

Notes: r = randomness prime; IBIT = total Illusory Beliefs Inventory score; IBI1 = magical beliefs subscale (IBI factor 1); spirituality beliefs subscale (IBI factor 2); IBI3 = internal state and thought-action fusion subscale (IBI factor 3); Int_x r = Interaction between moderator and randomness prime.

Table 11

Models of Moderated Regression with Demographic Moderators

Model of Moderated Regression		β	p
r x Gender --- IBIT			
	r	-0.34 (0.40)	.398
	Gender	0.22 (0.15)	.139
	Int_Gen x r	0.11 (0.21)	.617
r x Age --- IBIT			
	r	-0.04 (0.55)	.949
	Age	-0.01 (0.004)	.205
	Int_Age x r	-0.001 (0.01)	.856
r x Country --- IBIT			
	r	0.07 (0.33)	.833
	Country	0.01 (.002)	**.004**
	Int_Country x r	-0.001 (0.002)	.593
r x Ethnicity --- IBIT			
	r	-0.07 (0.12)	.580
	Ethnicity	0.09 (0.03)	**.002**
	Int_Eth x r	-0.002 (0.05)	.555
r x Highest Qualification -- IBIT			
	r	-0.56 (0.22)	**.010**
	HQ	-0.16 (0.05)	.002
	Int_HQ x r	0.15 (0.08)	.064
r x Highest Qualification -– IBI 2			
	r	-0.86 (0.29)	**.004**
	HQ	-0.14 (0.07)	**.047**
	Int_HQ x r	0.24 (0.11)	**.026**
r + Tertiary Qualifications			
	r	0.32 (0.44)	.475
	Tertiary Quals	-0.33 (0.17)	**.049**
	Int_tertiary quals x r	-0.25 (0.24)	.287

Notes: r = randomness prime; IBIT = total Illusory Beliefs Inventory score; IBI2 = Illusory Beliefs Inventory subscale 2: spirituality; Highest qualification = highest qualification earned beyond high school; tertiary qualifications = having a qualification beyond secondary school; Int_x r = interaction of moderator and randomness prime.

Table 12

Mean Illusory Beliefs Inventory Scores by Ethnic Group

Ethnic group	Mean IBI Score(SD)
European/Caucasian	2.50 (0.70)
European/Caucasian, Māori	3.05(0.92)
European/Caucasian, Māori, Pacific Peoples	2.85 (0.86)
European/Caucasian, Māori, Asian	3.50
European/Caucasian, Māori, Other ethnicity	3.42
European/Caucasian, Pacific Peoples	2.79 (0.29)
European/Caucasian, Asian	1.99
European/Caucasian, Middle Eastern	1.67
European/Caucasian, Latin American	2.69 (0.97)
European/Caucasian, Other ethnicity	2.22 (1.17)
Māori	3.90 (0.78)
Māori, Pacific Peoples	2.75
Māori, Other ethnicity	4.33
Pacific Peoples	2.92 (0.41)
Asian	2.91 (0.66)
Asian, Middle Eastern	3.83
Asian, Latin American	3.58
Middle Eastern	2.79 (0.29)
Latin American	3.49 (0.96)
African	3.54
African, other ethnicity	4.04
African American/Afro-Caribbean/Black	3.58
Other ethnicity	2.74 (0.60)