The Effect of Anxiety on Religious Cognition

Thomas P. D. Swan

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Abstract

Religion is a ubiquitous cultural phenomenon that ordinarily involves shared belief in supernatural beings. Psychological perspectives on religion have tended to include either motivational biases (e.g., beliefs mitigate anxiety), or cognitive biases (e.g., beliefs depend on how information is processed), neither of which has afforded a complete explanation of religious belief. In this thesis, I propose a cognitive-motivational model that incorporates both perspectives to illustrate a path by which beliefs in supernatural beings can form. Ten studies are reported to support the model. In these, the inherent threat potential of supernatural beings is found to improve memory for them, especially among anxious individuals. Furthermore, believable supernatural beings are found to possess features that differ from their secular counterparts, including greater beneficence, ambiguity, ambivalence, and mind-based abilities. These features are found to facilitate processes of motivated reasoning and emotion regulation (e.g., repression), transforming threatening supernatural beings, that are prolifically remembered by anxious individuals, into more believable beings. Finally, individuals identifying as religious are found to use repression more often than non-religious individuals, particularly to form and maintain positive impressions and beliefs about supernatural beings with the aforementioned features. Taken together, these findings support a model in which cognitive biases for threat detection and motivational biases for emotion regulation can be integrated on a causal pathway from anxious states to religious belief. Although the model focuses on positive beliefs about supernatural beings, many other comforting beliefs that appear in religions (e.g., an afterlife) could be attributed to supernatural beings that are perceived in a positive way. The model answers questions that cognitive and motivational perspectives are unable to answer in isolation, such as why only some supernatural beings are worshiped. This has been called the “Mickey Mouse problem” after the cartoon superhero who has never been worshipped as a god. The model further explains the relevance that a known memory bias for supernatural agents (called the MCI effect) has to religious belief. Most importantly, the model describes the role of anxiety in religion. For centuries, scholars have proposed relationships between anxiety and comforting religious beliefs. To my knowledge, this thesis represents the first detailed analysis of how such a relationship could work. In summary, these findings demonstrate the explanatory power of integrative approaches to the study of religion, and the potential for discovery of other cognitive-motivational pathways that may culminate in religious belief within the proposed model.
Acknowledgements

As I complete this thesis, I have to keep reminding myself how lucky I am to have been born into this life. I am thankful to have grown up in a developed country where I had the chance to get an education. I am thankful that my life was not cut short by tragedy or disease. I am thankful to have a father who did not try to dictate my life, or enforce dogmatic beliefs, but who merely instilled the virtues of a healthy body and mind. With all my complaints, I feel spoiled and unworthy to have gotten this life.

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Chapter 1
The Study of Religion

What is Religion?

To any astute observer of human behavior, “religion” appears ubiquitously within and between past and present cultures. Although definitions vary (see Bowen, 2017), it invariably constitutes a number of professed beliefs or intuitive assumptions about the configuration of reality, and the entities, forces, or substances that traverse its boundaries to interact with the visible world. These beliefs and assumptions precipitate behaviors that may appear to onlookers as nonsensical, or without an adaptive rationale, including impulsive superstitions, respectful prayers to distant deities, prolonged worship or meditation, wasteful sacrifice, and meticulous rituals. Indeed, the earliest evidence of religious behavior may be at a burial site in Qafzeh, Israel, dated to ~100,000 years ago (Stringer, Grun, Schwarcz, & Goldberg, 1989), at which skeletons were found stained with red ochre and surrounded by grave goods, taken to be evidence of supernatural belief1 (e.g., in an afterlife realm). Furthermore, the set of supernatural beliefs that constitute a religion might broadly be construed as concerning agents, whether these are tangible deities, or other concepts with agentic properties. The latter might include a substance that can act of its own accord (e.g., the Azande substance mangu), or a cosmic force that orders and manipulates reality according to particular principles (e.g., the East Asian notion of chi). With few exceptions, then, the definition of religion might be shortened to shared belief in supernatural agents (Jong, Bluemke, & Halberstadt, 2013).

Anthropological observations and cross-cultural comparisons such as these serve as a foundation for scientific research that asks why and how beliefs in supernatural agents are formed and maintained. As religious beliefs are products of the mind, this research typically provides psychological explanations, which tend to include either motivational biases (e.g., the beliefs provide comfort, mitigating anxiety), or cognitive biases (e.g., belief is dependent on how information is processed). Unfortunately, as the following sections of this chapter make clear, neither perspective has sufficiently explained religion as it pertains to belief. I argue that this is because cognitive and motivational perspectives (in isolation) only offer a

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1 This would be regardless of the extent to which particular peoples subjectively consider the contents of their beliefs to be ordinary features of reality (e.g., the Azande people; Bowen, 2017).
partial explanation of religious belief: the motivational perspective explains why we believe, but not how; the cognitive perspective explains how we believe, but not why.

Accordingly, in this thesis, I propose a cognitive-motivational model that integrates the two perspectives. Specifically, I focus on anxiety, which is often cited as a motivator for belief, and I describe how its cognitive effects relate to a cognitive bias for the recall of supernatural agents. I then describe a process of emotion regulation to complete a pathway from anxious states to religious belief. Essentially, the model draws on the cognitive perspective to explain how the motivational perspective generates religious beliefs.

The remainder of this chapter therefore examines the cognitive and motivational perspectives more closely, before reviewing the cognitive effects of anxiety and emotion regulation strategies. The final section elucidates the proposed cognitive-motivational model in more detail.

**The Cognitive Science of Religion**

In the past few decades, researchers in the cognitive science of religion (CSR) have applied objective scientific methods to the study of religion. Their cognitive perspective suggests that religion is the expression and collective operation of several cognitive mechanisms, including those devoted to agency detection, theory of mind, teleofunctional reasoning, kinship recognition, and ritualized behavior (McCauley, 2018; McKay & Whitehouse, 2015). Among CSR researchers, the dominant “byproduct” view (e.g., Boyer, 2001; Guthrie, 1995) recognizes that these mechanisms have other evolutionary functions (Sperber, 1996), leading many to describe religion as an aggregate or arbitrary construct with no singular biological foundation (Lawson, 2012; McCauley, 2018; McKay & Whitehouse, 2015). However, this aggregation perspective may be premature given that CSR lacks a well-supported explanation for why individuals commit to believing in the religious agents and concepts that these mechanisms promote. Belief is central to religion, which may be why neglect of belief within the aggregation perspective has culminated in a view that religion doesn’t exist as a definable construct (McCauley, 2018).

The difficulty CSR has with belief suggests a functionalist perspective that asks why this particular cluster of cognitive mechanisms has been mobilized in the manner we observe and how the process unraveled in our ancestral environment may be beneficial. In this thesis, I suggest that one function of religious belief is to reduce anxiety. It may therefore be the case that many of the cognitive mechanisms that have been identified as important to religious
cognition facilitate this process. In particular, a recall bias for supernatural or “minimally counterintuitive” agents may relate to cognitive biases observed in anxiety. In the next section, I therefore review CSR’s depiction of religious cognition, with a particular focus on minimally counterintuitive agents.

**Minimal Counterintuitiveness**

Throughout development, people attend to their surroundings, augment a set of expectations about the features of environmental stimuli, and develop and deploy inferences about how detected stimuli will behave (Boyer, 2001). Stimuli that violate expectations support fewer inferences, but also present a learning opportunity that attracts attention (Upal, 2010). The balance between informational and inferential potential leads to the prediction that stimuli are better recalled when they violate a small number of intuitive expectations (i.e., are minimally counterintuitive, or MCI) than when they violate none (i.e., are intuitive), or many (i.e., are highly counterintuitive). The prediction has been confirmed by researchers who also found the mnemonic advantage increases with greater retention intervals (Atran & Norenzayan, 2004; Banerjee, Haque, & Spelke, 2013; Barrett & Nyhof, 2001; Boyer & Ramble, 2001; Gonce, Upal, Slone, & Tweney, 2006; Norenzayan, Atran, Faulkner & Schaller, 2006; Tweney, Upal, Gonce, Slone, & Edwards, 2006; Upal, Gonce, Tweney, & Slone, 2007). Thus, MCI stimuli provide just enough novelty to attract cognitive resources, without being so unusual or unfamiliar as to seem irrelevant. In general, minimal counterintuitiveness may facilitate belief in religious agents by increasing the frequency with which they’re attended to, recalled, and transmitted to others (Barrett 2004; Boyer, 2003; Lawson, 2012). This may even apply to religious agents that are described as highly counterintuitive in some texts, given that online reasoning often portrays them in more intuitive ways, with human limitations (e.g., answering one prayer at a time; Barrett & Keil, 1996). It may also be that the schematic representation of MCI concepts gradually causes them to become mundane, requiring elaboration (Purzycki & Willard, 2016; Upal, 2010).

Drawing on work in developmental psychology, researchers argue that intuitive expectations arise from folk (or naïve) knowledge in the domains of physics, biology, and psychology (see Table 1 for examples) that emerges early in development and appears to be culturally invariable (Carey, 2009; Sperber & Hirschfield, 2004; Wellman & Gelman, 1992). Some describe this knowledge as represented within evolved modules that are innate, innately constrained, or maturationally natural given an ordinary developmental environment. They suggest that individuals determine the ontological category of stimuli and automatically
generate intuitive expectations associated with that category (Barrett, 2008a). For example, the category ‘object’ is expected to comply with folk physics and is categorized as MCI if it breaches a folk physics expectation (e.g., an invisible door) or if there is a transfer of an expectation from another folk knowledge domain (e.g., folk psychology – a talking door). Plants comply with folk physics and most folk biology expectations, while animals add several folk psychology expectations. The final ontological category, persons, can have no transfers (only breaches) because they are subject to expectations from all of the domains.

**Table 1.** Examples of intuitive expectations that arise from folk knowledge (Barrett, 2008a).

<table>
<thead>
<tr>
<th>Folk knowledge</th>
<th>Intuitive Expectations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physics</td>
<td>Objects have one location in space and time; cannot occupy the space of another object; are visible, tangible, and moved by contact; move as a connected whole; and fall when not supported.</td>
</tr>
<tr>
<td>Biology</td>
<td>Living things are composed of natural materials; are self-propelled; reproduce the same species; grow, develop, require sustenance, die, and seek to avoid death; and their parts serve the whole to sustain life.</td>
</tr>
<tr>
<td>Psychology</td>
<td>Mindful beings are self-aware; move in accordance with goals, desires, and beliefs; and possess limited knowledge that is private from the minds of other beings but can be communicated in limited ways.</td>
</tr>
</tbody>
</table>

Intuitive expectations that, once violated, describe something counterintuitive, are supposedly distinct from cultural expectations that, once violated, describe something counterschematic (i.e., bizarre), such as a purple dog or a salty banana (Barrett, 2008a; Porubanova, Shaw, McKay, & Xygalatas, 2014). However, intuitive expectations may simply be acquired earlier, and be more maturationally natural, without being cognitively distinct from other knowledge (i.e., not necessitating evolved modules), which may explain why cultural expectations are occasionally recalled better, and why some MCI concepts are recalled better than others (Banerjee et al., 2013; Purzycki & Willard, 2016; Upal, 2010).

Other aspects of religious cognition that are of less importance to this thesis will now be summarized.

**Theory of Mind**

People have the capacity to attribute beliefs, goals, and intentions to other agents and to recognize that these mental states differ from one’s own (Call & Tomasello, 2008). This
may facilitate belief and perceived interactions (e.g., prayer) with intentional religious agents (Kapogiannis et al., 2009; Riekki, Lindeman, & Raij, 2014; Schjoedt, Stødtkilde-Jørgensen, Geertz, & Roepstorff, 2009) and deceased ancestors (Bering, McLeod, & Shackelford, 2005).

**Teleofunctional Reasoning**

People have a tendency to find function, purpose, and design throughout their natural environment (e.g., “rocks are pointy to stop elephants sitting on them”), and this may occur more frequently once children have developed a theory of mind with which to infer goal-based design (Kelemen, 1999). Teleofunctional reasoning extends into adulthood, arising more often when there is limited time to compose one’s thoughts (Kelemen, Rottman, & Seston, 2013). This suggests people are intuitive theists, which may facilitate belief in religions that propose teleological explanations for natural phenomena (e.g., creationism).

**Agency Detection**

Studies suggest people have an agency detection device that commonly attributes agency to telic stimuli, such as animate objects, patterns, and spontaneous events that might show signs of design or control (Atran, 2002; Bloom, 2007). In our ancestral environment, it would have been adaptive for an agency detector to be hyperactive: falsely ascribing agency to such stimuli in order to reduce the number of errors that could lead to predation or other substantial fitness costs (Guthrie, 1995). This device may therefore facilitate belief in unseen agents, such as gods and spirits (Riekki et al., 2014).

**Intuitive Dualism**

People appear to intuitively consider minds as spatial entities that merely occupy and are separable from bodies (Bloom, 2004; Chudek, McNamara, Burch, Bloom, & Henrich, 2013). They also have difficulty simulating an absence of psychological function. For example, Bering (2006) found that we are more likely to believe psychological states survive death than biological or physical states, and that dispelling this intuitive belief requires learning. This may facilitate belief in religions that employ omnipresent gods, disembodied spirits, and souls that proceed into an afterlife. Indeed, religious priming has been shown to intensify belief in the survival of psychological states beyond death (Astuti & Harris, 2008).
**Moral Intuitions**

People have an intuitive sense of right and wrong regarding transgressions to do with harm, fairness, loyalty, authority, and purity (Haidt & Joseph, 2006). This may facilitate belief in religions that encourage divine interpretations of these intuitions, employing absolute moral codes, authoritative hierarchies, and purity rituals (Boyer, 2001). Indeed, people cheat less and exhibit more pro-social behavior when they are told a supernatural agent is observing them (i.e., the supernatural watcher hypothesis; McKay & Whitehouse, 2015, for a review).

**Coalitional Thinking**

People have a natural capacity to form cooperative groups and build coalitions (Boyd & Richerson, 2005). This may facilitate belief in religions that promote a convergence of opinion towards one normative belief structure, advertised by the display of common coalitional markers, including tattoos, attire, grooming habits, and synchronized or ritualized behavior (Cohen, Mundry, & Kirschner, 2014; McCauley & Lawson, 2002). These may also suffice as contextual cues for kinship detection (Whitehouse & Lanman, 2014).

**Ritual**

People commonly exhibit ritualized behavior, which may occur spontaneously in children, adults (when threats are salient) and in Obsessive Compulsive Disorder (OCD). The behavior appears to alleviate anxiety by swamping working memory with thoughts about the repetitive, meticulous, ordered structure of most rituals, and the lack of an intelligible relationship between the behavior and its intended effect (Boyer & Lienard, 2006; 2008). Schjoedt et al. (2013) built on this research and related it to emotional suppression in high-arousal rituals, and the deference of ritual understanding to elders. They proposed a theory of “cognitive resource depletion in religious interactions” in which cognitive resources are swamped or starved, leaving less time to contemplate ritual details and meanings. These effects may therefore facilitate belief in religions that employ demanding rituals in the context of anxiety-causing events.

While this collective of co-opted cognitive mechanisms might broaden the relevance of religious concepts and the frequency with which they are evaluated, they are arguably insufficient for a full account of belief. Indeed, all things being equal, we should be less inclined to believe an MCI concept than an intuitive concept (Gervais & Henrich, 2010). The
same limitation applies to adaptationist accounts (Atran & Norenzayan, 2004), which describe adaptive consequences of religion, such as greater well-being and cooperation through religious participation (Bulbulia, 2006; Shaver & Sosis, 2014; Xygalatas, Konvalinka, Roepstorff, & Bulbulia, 2011) and greater pro-sociality through religious thought (Bering, 2006), without establishing a motivation to commit to associated beliefs. The gap between the set of mechanisms that facilitate processing of certain religious concepts, and the belief in those concepts, has been called the Mickey Mouse problem (Atran, 2002), after the minimally counterintuitive cartoon superhero who has never been worshipped as a god.

This thesis will focus on what may be the most notable example of religious cognition described within CSR literature: the bias for remembering minimally counterintuitive concepts (the MCI effect). Although the claim that the MCI effect explains the pervasiveness of religion faces a number of objections, such as the general inadequacy of modular models and the mismatch between experimental MCI material and actual religious concepts (Purzycki & Willard, 2016; Upal, 2010), a more fundamental question is why the MCI effect exists at all. What evolutionary advantage does a bias for recalling intuitive violations afford? If this advantage could be determined, it might reveal ways by which the intensity of the MCI effect could fluctuate within a population, which might explain why some individuals may be more likely to form religious beliefs than others.

**Comfort Theories of Religion**

As mentioned in the opening section, shared belief in supernatural (or “counterintuitive”) agents may be the defining feature of religion, and several motivation-based theories have focused on this feature. Indeed, a growing collection of studies suggest religious beliefs follow motivational processes: people consciously or unconsciously want to believe in supernatural agents because the belief fulfills some psychological need (i.e., it’s comforting). A majority of these studies follow Hume (1757/1889) and Freud (1927/1961) by suggesting that “need” is to mitigate negative affective states or situations that are likely to generate such states.

Unfortunately, many of these studies lack explanatory detail and are based on data gathered from interviews or through exclusively correlational methods. For example, Levine and Salter (1976) interviewed 106 young-adult converts to 9 different religions, asking them to list reasons why they joined and subsequently stayed. Forty-six reported joining because they felt sad, lonely, rejected, or alienated; forty-three reported a lack of meaning in their
lives; thirty-six spoke of a personal crisis; and thirty-two cited the happiness of current members. Other reasons included seeking a religious experience, following a friend, overcoming personal problems, and wanting to help others. Following conversion, seventy-seven reported a feeling of security and self-confidence; sixty-four reported greater calmness, happiness, and self-growth; and fifty-one reported better interpersonal relationships and a sense of belonging. Spiritual growth, such as finding God, or truth, was only reported by forty-three. While there was no empirical investigation of the processes explaining these trends, the findings were not unusual. Converted individuals often refer to a past of sin and despair that is relieved by newfound religious beliefs (Frijda & Mesquita, 2000). For example, conversion may occur more readily among individuals suffering from drug addiction and withdrawal (Galanter & Buckley, 1978), and among prison inmates (Thomas & Zaitzow, 2006).

Supporting this research, correlational studies suggest religious belief is more common or intense among individuals who have experienced situations likely to produce negative affect, such as near-death experiences (McLaughlin & Newton, 1984), poverty (Barrett, 2004), and persistent threats to financial security (Gill & Lundsgaarde, 2004). Other studies suggest that religious belief provides comfort, such as increased life-satisfaction (Ellison, Gay, & Glass, 1989), greater self-esteem and psychological adjustment in cultures that value religiosity (Gebauer, Sedikides, & Neberich, 2012), less reported trait anxiety (Lavric & Flere, 2010), less depression among the recently bereaved (Maton, 1989), and greater acceptance of death and reduced death anxiety among older adults (Ardelt & Koenig, 2006; Krause, Pargament, & Ironson, 2018).

Although causal inferences are limited from such work, a number of experiments and pseudo-experiments also support the claim that negative affect motivates religious belief, and/or that religious belief is capable of relieving or buffering negative affect. For example, Legare and Souza (2014) found that priming randomness and a lack of control led to increased belief in the efficacy of rituals. Dechesne et al. (2003) found that bolstering afterlife beliefs reduced the likelihood that mortality awareness would generate defensive, motivational processes to reinforce values and self-esteem. Additionally, Whitson and Galinsky (2008) found that people manipulated to feel a lack of control were more likely to see illusory patterns and develop superstitions about random stimuli than a control group (e.g., that knocking on wood leads to a positive outcome). This was supported by a quasi-experimental study linking historically threatening events (e.g., the Great Depression) to the production of superstitious literature (e.g., about astrology; Sales, 1973).
In a quasi-experiment using longitudinal data, Sibley and Bulbulia (2012) found that religious faith increased in areas affected by the Christchurch earthquake, while faith in other areas of the country decreased. Atran (2002) reported similar findings after the 9/11 attacks. Another study found that lacking a sense of control led to increased belief in the existence of a controlling god (Kay, Gaucher, Napier, Callan, & Laurin, 2008), while McGregor, Nash, and Prentice (2010) used various “anxious uncertainty threats” to show that people react to anxiety by increasing theistic, afterlife, and supernatural justice beliefs (especially among people with dispositional anxiety and uncertainty aversion). The authors combined their findings, concluding that religious belief and conviction is a “compensatory control mechanism” that can alleviate anxiety associated with feelings of uncertainty, randomness, and lacking control (Kay, Gaucher, McGregor, & Nash, 2010). Their research was supported by neuroscientific evidence that found anterior cingulated cortex (ACC) activity decreased when religious beliefs were expressed (Inzlicht, Tullett, & Good, 2011). The ACC produces distress signals in response to error-detection, expectancy violation, and conflict. As MCI concepts violate expectations, it’s possible that they activate the ACC in a similar way, requiring the formation of comforting religious beliefs that can reduce this activation.

While the studies above have examined a variety of negative states and situations, much research has focused specifically on death anxiety. For example, Norenzayan and Hansen (2006) found that thoughts of death led to increased belief in supernatural agents and divine intervention, regardless of whether the agents were culturally familiar or alien. Willer (2009) largely replicated this effect for afterlife and theistic beliefs, interpreting the results in terms of motivated reasoning. However, the studies produced conflicting results regarding whether nonreligious individuals also increased their religious belief. Jong, Halberstadt, and Bluemke (2012) similarly painted a complex picture of the relation between death anxiety and prior religious beliefs: their results indicated that, when primed with mortality, religious and nonreligious individuals show “worldview defense” – increased confidence in their existing beliefs (religious and secular, respectively), but only when those beliefs are measured on a questionnaire. When belief was measured in terms of cognitive associations between supernatural concepts and “existence” (i.e., on an “implicit” measure), mortality priming increased belief for all participants regardless of religiosity. Conversely, Jackson et al. (2018) found that manipulated religious belief decreased and increased explicit death anxiety among religious and nonreligious participants, respectively, but all participants’ death anxiety was reduced on an implicit measure.

Although such studies are consistent with a motivation-based account of religious belief, the details of the motivational logic are often absent or lacking in detail. This has left
comfort theories open to criticism from many directions (Boyer, 2001, 2003; Lanman, 2012; Nichols, 2004; Platinga, 2000). For example, religious concepts are not exclusively, or even primarily comforting: they also include malevolent gods and spirits, terrifying narratives, and horrific notions of the afterlife (Boyer, 2003; Platinga, 2000). Other religious concepts may not be malevolent, but still lack any obvious means of providing comfort. For example, Nichols (2004) argues that the Christian “trinity” serves no motivational function at all, while Boyer (2001) notes that in many traditions the soul is not saved or liberated upon death; rather, the dead become ghosts or spirits, which may be of no particular comfort. Other criticisms focus on the mechanism itself. For example, Boyer (2001) argues that it is maladaptive to adopt comforting delusions to cope with anxiety, while Lanman (2012) contends that cultures more in need of comfort are the ones with the least comforting deities.

While some of these criticisms can be dismissed (e.g., not all concepts within a religious belief system have to be motivationally attractive, and not all emotion regulation is maladaptive)\(^2\), it is clear that a satisfactory motivation-based account of religious belief requires a more complex model than described at present. Anxiety may be at the core of such a model (the vast majority of reviewed studies concern anxiety or states that are likely to produce anxiety, such as lacking control), but there is still a paucity of detail. For example, what cognitive and motivational processes occur between feeling anxious and believing in the existence of a supernatural agent? What attracts anxious individuals to gods and religion rather than to more established forms of coping (e.g., Mattlin, Wethington, & Kessler, 1990)? Why are death anxious individuals attracted to gods and religion when an afterlife belief, in isolation, should suffice? Why do some religious beliefs appear discomforting? And, even if religious beliefs generally provide comfort, are these beliefs caused by that need?

Perhaps the most pressing question is: what comes after feeling anxious? To develop an answer to this question, I now review literature on the nature and consequences of anxiety.

**The Nature of Anxiety**

Emotions are affective states that motivate adaptive or goal-congruent thought and behavior following the appraisal of a stimulus that may be relevant to survival or well-being (Ellsworth & Scherer, 2003; Frijda & Mesquita, 2000; Lazarus, 1991). Relevance may be determined by naturally selected preferences (e.g., pleasure for sweet foods); acquired affinities/aversions (e.g., fear of wasps after being stung); or current goals (e.g., anger in a

\(^2\) For a more extensive theoretical argument against these criticisms, see Swan, 2012.
traffic jam). Following appraisal, physiological, behavioral, and cognitive changes ensure the body is prepared to execute adaptive behavior (Parkinson, 1995). For example, an increased heart rate prepares the body to flee a fear-inducing stimulus; smiling communicates a desire to persist with a happiness-inducing stimulus; and an alteration of rest-state attention and memory capacities ensures a focus on such stimuli. Thus, as opposed to moods, which are prolonged, unfocused affective states, emotions are transient, stimulus-focused states.

Discrete emotions, such as anxiety, are typically categorized by valence. Positive emotions feel pleasant, reinforcing goal-congruent or adaptive behavior (e.g., happiness, love, and pride), while negative emotions feel unpleasant, discouraging goal-conflicting or maladaptive behavior (e.g., fear, anxiety, and shame). Resultant behavior often involves approaching or avoiding, respectively, the stimuli that produce positive or negative emotions (Parkinson, 1995). Unfortunately, a more detailed definition of anxiety that considers a broader spectrum of characteristics, while also distinguishing it from other emotions and moods, is difficult to obtain. Anxiety is, of course, a negative affective state that (ultimately) motivates an avoidance of threat, but such threats may be internal (e.g., worries) or external (e.g., angry faces), and associated with social (Teale Sapach, Carleton, Mulvogue, Weeks, & Heimberg, 2015), physical (Pacheco-Unguetti, Acosta, Callejas, & Lupianez, 2010), or existential (Jong & Halberstadt, 2016) domains. The resultant state of anxiety could be described as a transient emotion or a prolonged mood depending on its time course, with physiological changes that are common to many other negative emotions (e.g., sweating, increased heart rate). Anxiety may therefore overlap or be confused with states such as fear, stress, and depression.

There are, however, some distinguishing features: anxiety is a response to a perceived, potential, or future threat, but not to a clear or present threat (i.e., fear; Eilam, Izhar, & Mort, 2011; Eysenck & Fajkowska, 2018). This feature can make it difficult to attribute anxiety to any particular source. For example, anxiety may manifest without conscious awareness of its cause, such as when encountering cues related to threats of evolutionary significance (e.g., contamination, social status loss, predation, intraspecific violence; Boyer & Bergstrom, 2011). Additionally, anxiety may be attributed to stimuli that are particularly relevant to an individual’s history (Saunders, 2013; Walsh, McNally, Skariah, Butt, & Eysenck, 2015), which likely relates to the finding that it can enhance episodic memory (Atance & O’Neill, 2001; Dere, Pause, & Pietrowsky, 2010): the unique human ability to mentally reconstruct the past and construct an imagined future (Suddendorf & Corballis, 1997). Indeed, while anxiety may be experienced as a persistent, unresolved, unfocused mood, leading to comparisons with depression, episodic memory effects can distinguish these states. Studies in which participants
were asked to generate future events found that anxious participants generated more negative events than controls, but the same number of positive events, while depressed individuals generated the same number of negative events as controls, but fewer positive events (summarized in Atance & O’Neill, 2001). These results suggest that anxiety is a threat-focused state, motivating the use of episodic memory to simulate the negative consequences of potential threats, while depression is an unfocused state, characterized by pessimism and a lack of motivation (Eysenck & Fajkowska, 2018; Mogg, Bradley, & Williams, 1995).

As we can’t see into the future with certainty, another key feature of stimuli that produce anxiety is the uncertainty of a potential threat and one’s ability to cope with it (Grupe & Nitschke, 2013; Lazarus, 1991). Uncertainty is likely to be appraised regarding whether the threat will manifest, how it will manifest, and whether it can be controlled or coped with. Indeed, anxiety is also related to ambiguous or signaled threats (Blanchard, Blanchard, Griebel, & Nutt, 2008), and a lack of control (Eilam et al., 2011). In this sense, anxiety can be distinguished from stress: the latter can be defined as a perceived inability to cope (Deasy, Coughlan, Pironom, Jourdan, & Mannix-McNamara, 2014; Lazarus & Folkman, 1984), whereas the former is characterized by an uncertain ability to cope.

Much like stress, anxiety produces physiological (e.g., sweating, chest tightness, breathing difficulty, increased heart rate and electrodermal activity), behavioral (e.g., trembling, restlessness, tension, general avoidance), and cognitive (e.g., difficulty concentrating, intrusive and obsessive thoughts) symptoms (Gale Encyclopedia of Medicine, 2015) that leave participants feeling unpleasant and motivated to undertake coping behaviors, such as vigilance and avoidance (Eilam et al., 2011; Parkinson, 1995). Such behaviors may be learned or innate and may include rituals that instill a sense of control (Boyer & Lienard, 2006; 2008; Legare & Souza, 2014; Malinowski, 1948). Furthermore, unpleasantness can motivate individuals to employ cognitive regulatory processes to avoid awareness of threat-related states and stimuli (e.g., thought suppression or repression; Derakshan, Eysenck, & Myers, 2007).

However, the initial cognitive symptoms of anxiety include biases that alter how an individual directs attention to, interprets, and recalls threatening stimuli (sometimes collectively called a “negativity bias”). These cognitive biases include:

- **General Hypervigilance.** A broadening of attention to scan the environment for threats.
- **Specific hypervigilance.** A narrowing of attention to focus on detected threats rather than on neutral stimuli (also called attentional bias to threat or ABT).
• **Interpretive bias.** A proclivity to interpret ambiguous stimuli as threatening.

• **Negative memory bias.** A proclivity to remember and recall more threat-related than non-threatening information.

Empirical support for these biases is summarized in Eysenck (1997) and in meta-analyses for ABT (Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg & van Ijzendoorn, 2007) and negative memory bias (Herrera, Montorio, Cabrera, & Botella, 2017; Mitte, 2008). The amygdala is thought to play a critical role in automatic threat detection, given activation of this neural structure in response to threats that have not yet been consciously perceived (Morris, Ohman, & Dolan, 1999; Pessoa, 2005). Besides external threats, biases may be directed towards internal physiological states, behaviors and cognitions that are appraised as threatening, leading to a feedback effect (Eysenck 1997). For example, negative memories may be the focus of ABT and interpretive bias, increasing anxiety further (East & Watts 1994). These biases further distinguish anxiety and fear. Indeed, while anxiety leads to increased vigilance for hidden danger cues in the environment (Barlow, 2002; Eilam et al., 2011), fear triggers a clear freeze, flee or fight response (Eilam, 2005).

Anxiety has other effects on cognition, summarized by Attentional Control Theory (Eysenck, Derakshan, Santos, & Calvo, 2007; Eysenck & Derakshan, 2011). For example, anxious participants perform worse than controls on tasks that require the central executive (involved in attentional control) but equally well to controls on tasks that require the visuospatial sketchpad, which processes visual and spatial information (Eysenck, Payne, & Derakshan, 2005). This is due to general and specific hypervigilance, which prevent anxious participants from inhibiting or shifting attention away from task-irrelevant stimuli that may contain potential threats; thereby reducing attentional control but maintaining the collection of visual and spatial information. Indeed, the deficit was greater when task irrelevant stimuli were threatening (Derakshan, Ansari, Shoker, Hansard, & Eysenck, 2009). Central executive tasks nevertheless appear to reduce anxiety by competing with it for limited working memory resources (Rapee, 1993), just as ritual behavior, involving meticulous order and repetition, can reduce anxiety by occupying working memory (Boyer & Lienard, 2006). Accordingly, the theory associates anxiety with use of stimulus-driven attentional systems, but not goal-directed attentional systems (Eysenck et al., 2007), although, when there is sufficient motivation to achieve task goals, anxious individuals can somewhat override stimulus-driven systems (Eysenck & Derakshan, 2011). For the most part, though, the cognitive effects of anxiety force us to learn about potential threats in our environment, whether we choose to or not.
While I have focused on state anxiety in this section, it is important to keep in mind that there are relatively stable individual differences in proneness to experiencing anxiety (trait anxiety). Around 30% of population variance in trait anxiety is described by genetic factors, with the remainder accounted for by environmental factors (Eysenck, 1997). Trait anxiety is therefore also associated with a greater propensity to use the aforementioned cognitive biases. However, trait anxious individuals appear to have danger schemas (functional structures of enduring representations; Beck & Clark, 1988), that direct biases toward only those threats that are congruent with them (e.g., social threats but not physical threats; Saunders, 2013; Walsh et al. 2015).

In summary, anxiety is a negative affective response to future, uncertain, potential threat, characterized by cognitive biases that facilitate the early detection of threat, psychological unpleasantness that motivates the avoidance of threat, and physiological and behavioral changes that facilitate successful avoidance. Thus, like most emotions, anxiety’s fundamental function is to direct thought, behavior and cognition in adaptive ways (Lang, Davis, & Öhman, 2000; Nesse, 1998).

### Anxiety Regulation

As many comfort theories suggest religious beliefs have the potential to regulate anxiety, it is important to review literature pertaining to how this regulation might occur. In the previous section, it was mentioned that regulation may come in behavioral (e.g., vigilance, avoidance, rituals) or cognitive forms (e.g., suppression, repression). This section focuses on cognitive forms that are motivated responses to negative affect (e.g., anxiety) or the sources of that affect (Gyurak, Gross, & Etkin, 2011; Koole, 2009; Tice, Bratslavsky, & Baumeister, 2001). Indeed, rather than just wanting to feel more pleasant, anxiety may produce a motivation to feel less uncertain (Raghunathan & Pham, 1999) or to achieve a sense of safety and control (Raghunathan, Pham, & Corfman, 2006).

Cognitive emotion regulation could be described as motivated reasoning: the tendency to reason towards beliefs that align with individual goals by employing biased strategies for accessing, constructing, and evaluating knowledge (Kunda, 1990). In the absence of affect, a typical goal might be to form an accurate belief. During anxiety, this would compete with a second goal: to form a belief that reduces unpleasantness. Motivated reasoning is therefore thought to influence the formation of numerous irrational beliefs that individuals want to

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3 However, the goal to form an accurate belief may still serve to prevent future negative affect related to looking foolish.
believe for various reasons (Epley & Gilovich, 2016; Kunda 1990). For example, the affective reward gotten from smoking cigarettes may motivate smokers to believe their behavior isn’t as unhealthy as research suggests (Aronson, 1968). Motivated reasoning may similarly lead to beliefs: that one performs unhealthy behaviors less frequently and healthy behaviors more frequently than is factually true; that health issues one is diagnosed with are less serious than issues one isn’t diagnosed with; that one possesses traits that are conducive to academic success (e.g., introversion), business success, or marital happiness; that failure is another’s fault while success is one’s own; that favorable events are likely to occur while unfavorable events are not; that tasks on which one performs poorly are unimportant or invalid; that potential interaction partners are especially likable; or that a crooked referee cost your team the game rather than their athletic ability (for a review of these studies see Kunda, 1990).

Thus, motivated reasoning subsumes several forms of motivated bias, including egoistic and moralistic biases (Paulhus & John, 1998) and other positive illusions (Taylor & Brown, 1988). Such illusions appear to include an automatic “optimism bias” that underestimates the likelihood of negative events (e.g., getting cancer) and overestimates positive events (Garrett & Sharot, 2017, Kappes & Sharot, 2018; Sharot, 2011), with supportive reasoning only coming later, if at all, as part of a reflective search for evidence that supports the desired conclusion. Indeed, we usually don’t just believe what we want to believe. In many of the above examples, the goal to reach a desired conclusion did not eliminate the goal to reach an accurate conclusion. The former was merely constrained by the latter, ensuring a biased search of existing knowledge structures for evidence that could support the desired conclusion and maintain an “illusion of objectivity”. This has been supported by data showing greater frequency and quicker response times for the retrieval of desirable information (Kunda, 1990).

Desire, which determines the direction of motivated beliefs, is therefore constrained by plausibility. However, accuracy goals may be more easily satisfied when particular content or contexts are present, such as when stimuli are ambiguous (Dunning, Meyerowitz, & Holzberg, 1989; Suls, Lemos, & Stewart, 2002), when hard evidence is lacking (Lord, Ross, & Lepper, 1979), when there is a rich quantity of information about which to form an interpretation (Ditto & Lopez, 1992; Omoto & Borgida, 1988), and when significant others hold the same belief (Golman, Loewenstein, Moene, & Zarri, 2016).

Motivated reasoning can presumably occur in anticipation of an affective state, to avoid or trigger it, if this is the goal. However, when regulating anxiety, the examples described above suggest motivated reasoning reduces unpleasantness by deploying an interpretive bias that is, essentially, a reversal of the interpretive bias produced by anxiety.
The extent of this reinterpretation would likely be constrained by accuracy goals that employ information gathered about the stimulus during the anxious state (e.g., via attentional and recall biases). Satisfying these accuracy goals may be relatively easy given the ease with which anxious feelings of unpleasantness can be misattributed (i.e., reinterpreted). A potential, future threat is, by definition, ambiguous and refutable relative to the kinds of stimuli that produce emotions such as fear and anger.

Furthermore, motivated reasoning most likely proceeds without conscious supervision (Kunda, 1990), with which beliefs would be rendered unjustifiable and unrewarding. Indeed, deliberate attempts to alter beliefs tend to falter (e.g., “I am just telling myself this to feel better”; Wegner, 1994), while unconscious processes should generate beliefs that are more likely to be perceived as a “true picture” of events (Koole & Rothermund, 2011). Given the importance and longevity of religious beliefs within individual worldviews, comfort theories should ideally incorporate methods of unconscious/implicit emotion regulation, such as motivated reasoning.

Nevertheless, emotion regulation strategies describe a broad category of empirically measurable phenomena, including several potential methods of anxiety regulation (Koole, 2009), some of which appear to involve motivated reasoning (e.g., positive reappraisal, and the interpretive bias in repression). The strategies include conscious and unconscious varieties (e.g., suppression and repression), various forms of coping (Mattlin et al., 1990), and they may include cognitive and expressive biases for the reinterpretation, and approach/avoidance of affective states as well as the stimuli that produce them (Koole, 2009). Furthermore, individuals appear to differ in the frequency and success with which they use these strategies (e.g., Szentagotai & Onea, 2007). As with the form of motivated reasoning described above, the defining feature of emotion regulation is the activation of a goal to influence the emotion trajectory (Gross, 2015). Much of the time, this goal is an automatic need to feel less unpleasant (Gyurak et al., 2011), and the following discussion focuses on strategies that may satisfy this goal.

As described above, conscious or “explicit” strategies, such as thought suppression (i.e., intentionally avoiding thinking about something; Wegner, 1989), positive reappraisal (attaching a positive meaning to a negative event; Garnefski, Kraaij, & Spinhoven, 2001), and positive refocusing (focusing on positive matters instead of a negative event; Garnefski et al., 2001), are unlikely to generate personally justifiable beliefs, although might be used to temporarily avoid aversive religious concepts.

Unconscious or “implicit” emotion regulation strategies, such as motivated reasoning, repression, and dissonance reduction (Koole, 2009), automatically regulate emotions in goal-
congruent ways without conscious supervision or an explicit intention to do so (Gyurak et al., 2011; Koole & Rothermund, 2011), and are therefore more likely to result in personally justifiable beliefs, such as religious beliefs. These strategies may overlap or be automatized versions of conscious strategies (Koole, 2009). For example, dissonance reduction is a form of motivated reasoning for which the particular goal is consonance of behaviors and beliefs, motivated by the negative affective consequences of exhibiting contradictory cognitions that are a reputational threat to the self (Harmon-Jones & Harmon-Jones, 2008; Kunda, 1990). Similarly, repression operates below conscious awareness and involves an interpretive bias for ambiguous stimuli, which could be called motivated reasoning, although it also involves avoidance biases to divert attention and memory capacities away from threat (Derakshan & Eysenck, 2007) that may be an automatic form of thought suppression (Szentagotai & Onea, 2007). Interestingly, these biases are therefore a complete reversal of the biases evident in anxious individuals (see previous section), making repression especially applicable to both anxiety regulation and religious belief.

The formation of religious beliefs via motivated reasoning and/or the repressive interpretive bias appears likely because the concepts that are committed to (e.g., an invisible god who behaves in “mysterious ways” and only communicates telepathically) often appear to be ambiguous, abstract, contradictory, and poorly evidenced, affording individuals latitude to interpret them in personally relevant and favorable ways (Dunning et al. 1989; Landau, Sullivan, & Greenberg, 2009; Maass, Salvi, Arcuri, & Semin, 1989; Suls et al. 2002; Thibodeau & Borodisky, 2011). Motivated reasoning is also facilitated when available information is rich and extensive enough to construct a justification for desired beliefs. Despite the ambiguity of their deities, religions typically employ large bodies of text or complex networks of fables to describe their conduct (Barrett, Burdett & Porter, 2009). Finally, the strength and longevity of religious beliefs suggests an affective influence (Frijda, Ortony, Sonnemans, & Clore, 1992; Sharot, 2004), and their common focus on non-trivial, goal-related issues, such as death, security, meaning, and purpose, implicates motivated reasoning via its tendency to produce personally justifiable, goal-congruent beliefs.

A number of studies support the idea that religious beliefs are products of motivated reasoning (see also the review of comfort theories earlier in this chapter). For example, Russell and Jones (1980) presented information that disconfirmed participant’s beliefs in extrasensory perception. This led to increased negative affect and a process by which less of the information could be recalled. However, this process (evidence of motivated reasoning) did not apply to non-believers, even though they were also subjected to upsetting, disconfirming information. In another study, religious participants exhibited negative affect
when presented with information that highlighted a discrepancy between their beliefs and the existence of worldwide suffering (Burris, Harmon-Jones, & Tarpley, 1997). Negative affect was reduced when they were given the opportunity to endorse transcendental arguments (e.g., God works in mysterious ways), suggesting these beliefs serve an emotion regulation function. Furthermore, Nichols (2004) provided a historical analysis that suggests motivationally attractive religious beliefs are more likely to survive in successive religions.

**Integrating the Study of Religion**

“In order to carry men’s attention beyond the present course of things, or lead them into any inference concerning invisible intelligent power, they must be actuated by some passion which prompts their thought and reflection; some motive which urges their first inquiry” (Hume, 1757/1889).

In this chapter, I reviewed two relatively independent approaches to the study of religion (cognitive and motivational), each of which leaves critical explanatory gaps, and I identified the cognitive and regulatory consequences of anxiety as potentially important for filling these gaps. In this final section, I propose a hot cognition model that situates cognitive biases on the motivation-based pathway from anxious states to religious belief. With this model, I therefore suggest that each independent approach can answer the others extant questions, if integrated appropriately. Indeed, while cognitive approaches lack an explanation for religious belief and a coherent model to explain their miscellaneous findings, motivational approaches have the basis for a model of belief but lack detailed findings about how the model works.

The independence of cognitive and motivational approaches might be expected. The cognitive sciences diverged from behavioral psychology in order to move beyond stimulus/response accounts of psychological phenomena, and to discover the unobservable mechanisms that produce those phenomena. Contrary to this position, comfort theorists submit explanations for religious beliefs that say little about the encoding, formulation, interpretation, and accessing of memories that are necessary for their generation. The neglect of these mechanisms by comfort theorists may explain the neglect of their work by cognitive scientists. The latter favor “cold cognitions” and relegate emotions, if they are mentioned at all, to products of cognition. Indeed, when emotions appear in CSR literature, they are often

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4 I use hot cognition simply to mean cognition colored by emotion.
confined to discussions of “religious experience” during rituals (McCauley, 2018), and invariably portrayed as distant products of cognitive processes. However, as the preceding sections have demonstrated, emotional states can be causal to cognitive biases, affecting the allocation of attention, the encoding and retrieval of memories, the type and quality of learning processes, the direction of behavior, and the formation of beliefs (Frijda & Mesquita, 2000). At the very least, then, emotions (and the motivations they generate) are perpetually and cyclically interacting with cognition. Thus, despite the insistence from CSR theorists that their field is laudably integrative (McCauley, 2018), this integration is selective at best, ignoring not just non-cognitive explanations for religion that may be worthwhile to interpret, but also evolutionary and non-modular accounts of counterintuitive memory effects (Purzycki & Willard, 2016). While some of these explanations may lack detail, such lacunae should represent an opportunity to implant a cognitive perspective.

The proposed hot cognition model considers the porous motivation-based pathway from anxious states to religious belief and implants a cognitive perspective. The model necessarily begins with the first missing step on this pathway: what happens after anxiety? The above review showed that, among other things, anxiety directs attention and memory resources towards threatening stimuli. This may therefore describe the memory bias for minimally counterintuitive concepts (the MCI effect) if MCI concepts can be characterized as threatening stimuli. If supported, anxious individuals would experience a more intense MCI effect than non-anxious individuals, biasing them towards MCI concepts, and potentially increasing the likelihood that the concepts will be believed. This would also provide the MCI effect with an adaptive rationale (i.e., threat detection), explain belief in malevolent gods, and partially explain how anxious individuals become religious.

Focusing on agents⁵, there are many theoretical reasons to suspect MCI agents are more threat-capable than intuitive agents. Often, MCI agents are ascribed counterintuitive abilities such as passing through walls (e.g., spirits) and reading minds (e.g., omniscient gods). An agent with the capacity to violate expectations in this way should be appraised as able to significantly help or hinder personal goals. During secondary appraisal (Lazarus, 1991), the paucity of inferences that can be generated about the agent likely creates uncertainty about how to cope, should it manifest and decide to hinder goals (although this also makes it less relevant). Thus, MCI agents should be appraised as especially threat-capable; perhaps more than highly counterintuitive agents, which should be less relevant to real-world concerns.

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⁵ Religions employ agents more than other ontological categories (e.g., objects; Barrett et al, 2009).
This threat likely produces anxiety, and this was supported by a study in which participants primed with God-concepts prior to a stressful anagram task reported greater anxiety than non-primed participants (Toburen & Meier, 2010). The authors concluded that the God prime may have increased anxiety by generating a sense of being watched, or as a reminder of authority. Indeed, other studies have found participants cheat less and exhibit more pro-social behavior when they think a supernatural agent is observing them (i.e., the supernatural watcher hypothesis; Bering et al., 2005; Johnson, 2016; McKay & Whitehouse, 2015; Shariff & Norenzayan, 2007), and participants who view their god(s) as more vengeful, harsh, fearsome, angry, punishing, jealous, and terrifying are less likely to cheat on tasks than participants who view their gods in more positive ways (Shariff & Norenzayan, 2011). Taken together, these studies suggest people reserve a peripheral and enduring anxiety about the punishments that threatening supernatural agents may exact. A tendency to attribute negative events to agents (negative agency bias; Morewedge, 2009) suggests this punishment could be perceived in many forms, including disastrous events that may employ an agent’s counterintuitive abilities.

Further evidence for the perceived threat of MCI agents can be found in religious narratives, which regularly portray deities as capricious, interfering, and wrathful. Indeed, an investigation of the content of urban legends and supernatural belief systems found that information concerning hazards was substantially more prevalent than information concerning benefits (Fessler, Pisor, & Navarrete, 2014). Attraction to hazards may explain why narratives depicting threatening deities, such as flood myths, are cross-culturally widespread (Witzel, 2010). Indeed, Fessler et al. suggested that eliciting negative emotions, such as disgust, should therefore facilitate social transmission (not too dissimilar to the current proposal about anxiety). Physical representations of MCI agents similarly depict intimidating beings with exaggerated features that may elicit awe, obedience, or represent a threat to neighbors (Wilson, 2012). For example, deities often appear as tall, muscular, attractive beings that wear the garb of kings and queens or the armaments of soldiers.

In the Abrahamic faiths, at least, scripture appears to encourage followers to fear their gods in a manner that could be described as fostering persistent anxiety about them. Examples appear in the Qur’an: "O you who have believed, fear Allah as He should be feared and do not die except as Muslims in submission to Him" (3:102), and the Bible: "What doth the Lord thy God require of thee, but to fear the Lord thy God, to walk in all his ways, and to love him, and to serve the Lord thy God with all thy heart and with all thy soul" (Deuteronomy 10:12).

At least in religious contexts, then, MCI agents are regularly portrayed as threatening, which, I propose, accounts for the attention they receive. Why, however, are threatening
agents worshipped? And why do many people regard their gods as caring, benevolent beings (Kirkpatrick, 2005), capable of providing comfort? This, I suggest, requires another step on the pathway from anxious states to religious belief. I propose that later impressions of MCI agents are formed by interpretive biases during anxiety regulation that transform captivating but threatening MCI agents into comforting, motivationally attractive, and believable beings, or, at the very least, beings that can be appeased into behaving in a non-malevolent way (e.g., via offerings or worship that allow believers some perceived control over aversive events). As described in the previous section, for this motivated reasoning to occur, there must be sufficient information about which to form a favorable interpretation. In other words, a god must be more than threat-capable; it must be benefit-capable (affording opportunities). As Feuerbach put it: “The true reason why fear does not offer a complete explanation of religion is that, once the danger is past, fear gives way to an opposite emotion [that] attaches to the same object as the fear. [...] The god who destroys trees, animals, and men with his thunderbolt is the selfsame god who fructifies the fields and meadows with his rain” (Feuerbach, 1851).

In summary, I propose a hot cognition model that integrates cognitive biases for threat detection and motivational biases for emotion regulation on a causal pathway from anxious states to religious belief. I suggest that the MCI effect is a form of threat detection that can be intensified when feeling anxious, facilitating the detection of, and therefore increasing the likelihood of belief in, religious agents. Furthermore, I suggest that cognitive forms of implicit emotion regulation can facilitate the formation of religious beliefs by constructing positive interpretations of these threatening gods (an “expressive” form may be religious rituals; Boyer & Lienard, 2008; Koole, 2009). Although this formulation involves beliefs about gods that reduce anxiety, many other comforting phenomena could be attributed to counterintuitive agents that are perceived in a positive way. Finally, as described in the previous section, religious agents may possess content, such as ambiguous and beneficial features, that can facilitate the construction of these positive interpretations and beliefs. Thus, the hot cognition model of religious belief generates a number of hypotheses:

1) MCI agents are more potentially threatening and more potentially beneficent (perceived to afford greater opportunities) than intuitive agents.
2) A bias for recalling the threat potential of MCI agents can explain the MCI effect.
3) Anxious individuals exhibit a stronger MCI effect due to increased threat processing (in turn biasing them towards religious belief).

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6 This is also intimated by the Bible passage above that speaks of “love” and “fear” in the same sentence.
4) Religious agents are counterintuitive agents with content that facilitates implicit, interpretive emotion regulation strategies.

5) Individuals prone to implicit, interpretive emotion regulation strategies are more likely to identify as religious.

6) Individuals prone to implicit, interpretive emotion regulation strategies habitually reinterpret threatening impressions of religious agents to produce more comforting impressions.

The remainder of this thesis reports ten studies to test these hypotheses. In Chapter 2 (a submitted paper), three studies are reported that examine the threat and benefit that MCI agents afford, and the role these inferences play in generating the MCI effect. Chapter 3 presents four studies that investigate the extent to which anxiety, in its various forms, can intensify the MCI effect. Chapter 4 (a submitted paper) examines the motivationally attractive properties of religious agents, as opposed to secular agents, in a study that addresses the Mickey Mouse problem. Chapter 5 presents two studies that examine tendencies for religious individuals to regulate their emotions, and the extent to which regulatory strategies are used to maintain and generate theistic beliefs.

The number and scope of these studies necessitated substantial data collection over a short time, and thus most of the studies only included US participants who volunteered on the internet (via Amazon’s Mechanical Turk or “MTurk”). This methodology meant that only US-centric views of MCI concepts and religious/secular agents were obtained. Nevertheless, the prior review suggests that threat detection and motivated reasoning biases are universal aspects of human cognition. I would therefore expect these studies to be cross-culturally replicable, but with minor variations related to local motivations, conditions, and taxonomy. The methodology places greater restrictions on the generalizability of Chapter 5’s examination of religious identity (most religious US participants are Christian). However, given that Christianity is the most popular religion globally, I consider this acceptable as an initial test of the Chapter’s hypotheses. The use of MTurk participants also has some drawbacks, most notably the likelihood that some participants won’t pay enough attention to the materials. Thus, each study utilizes an attention check and several time-based criteria with which to exclude inattentive participants. MTurkers are also more likely to be unemployed or

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7 The studies included in this thesis received ethics approval from the University of Otago’s Department of Psychology and the Human Ethics Committee (Category B application, ref. D16/055), and the research was conducted in accordance with the University’s Responsible Practice in Research – Code of Conduct and all necessary laboratory compliance permits.
in need of additional income, although the population demographics are broader in terms of age, background, and education-level than university undergraduate pools.

These limitations are revisited in the final chapter, where I consider the entirety of the results as a model for how the cognitive and motivational approaches to religious belief might be integrated in future work. I show how interactions between cognitive and motivational processes may be crucial for providing a complete understanding of religious belief, and perhaps religious thought and behavior in general. Indeed, although this thesis focuses on one aspect of religious cognition (the MCI effect), the model represents a preliminary step towards explaining why CSR’s repertoire includes the mechanisms that it does.
Chapter 2

The Fitness Relevance of Counterintuitive Agents

(A paper submitted for publication in July 2018)

Abstract

Cognitive scientists have attributed the ubiquity of religious narratives partly to the favored recall of counterintuitive concepts within those narratives. Yet, this recall bias is inconsistent, sometimes absent, and without a functional rationale. Here, we asked if counterintuitive concepts are more fitness relevant than intuitive concepts, and if fitness relevance can explain the existence and variability of the observed memory bias. In three studies, participants rated the potential threat and potential opportunity afforded by agents with abilities that violated folk psychology, physics, or biology. As in previous work, agents with counterintuitive abilities were recalled better than those with intuitive abilities. Additionally, counterintuitive agents were perceived as greater threats, and as providing greater opportunities, than agents with intuitive abilities, and fitness relevance mediated the memory bias under some conditions. Counterintuitive abilities that violated folk psychology were rated more intuitive and more of an opportunity than violations of folk physics or biology, while folk physics violations were recalled best. Explanations for these effects and their relevance to the cognitive science of religion are discussed.

Introduction

Concepts that minimally violate intuitive expectations attract attention and are remembered better than concepts that are either entirely expected, dramatically violate intuitive expectations, or only violate culturally-acquired expectations (Banerjee et al., 2013; Barrett, 2008a; Barrett & Nyhof, 2001; Boyer & Ramble, 2001; Boyer, 2003; Gonc et al., 2006; Tweney et al., 2006; Upal et al., 2007). For example, “a person who was at two places at the same time” is recalled better than “a person who was at one place at a time”, and

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8 This paper was written with my co-author and supervisor, Jamin Halberstadt. I devised the experimental design, analyzed the data, and wrote the first draft. Professor Halberstadt provided a supervisory role during the experiment with regards to framing questions appropriately and advising on analytical methods, and he contributed to later drafts of the paper, mainly with regards to structure of the paper and clarity of the arguments.
concepts with one or two such counterintuitive features are recalled better than those with many (Boyer & Ramble, 2001).

Since its discovery, the cognitive advantage for minimally counterintuitive (MCI) concepts has become a critical element in the repertoire of cognitive mechanisms that are thought to predispose humans to religious thought and behavior (Atran & Norenzayan, 2004; Boyer, 2003; Lawson, 2012). Our attraction to gods may rely on this ‘MCI effect’ if gods violate at least one intuitive expectation about agents. These expectations are thought to arise from folk (or “naïve”) knowledge about physics, biology, and psychology that emerges early in development and appears culturally invariable (Carey, 2009; Sperber & Hirschfield, 2004; Wellman & Gelman, 1992). Folk physics, biology, and psychology might respectively lead to expectations, for example, that objects can’t be in two places at once, that all living things die, and that people can’t read minds.

Despite the explanatory promise of MCI concepts, the nature of the “folk knowledge” that they violate, and the cognitive architecture that represents such violations, have been difficult to clarify. Some authors favor a modular account that characterizes folk knowledge as innate, implicit, inaccessible, consciously unalterable, and stored within distinct, domain-specific cognitive structures or “modules” (Atran, 2002; Boyer, 2001). Others favor a domain-general, connectionist model that describes folk knowledge as “deeper” (i.e., acquired earlier and applied implicitly) than cultural or “schematic” knowledge, but otherwise structurally equivalent (Purzycki & Willard, 2016; Upal, 2010). In this latter account, MCI concepts that violate folk knowledge may simply be exaggerated forms of “shallower,” counterschematic concepts (e.g., a purple dog or a salty banana). Such a deep-shallow continuum may help to explain inconsistencies in the MCI effect, such as when MCI concepts are occasionally less “catchy” than counterschematic concepts, (Atran & Norenzayan, 2004; Johnson, Kellya, & Bishop, 2010; Norenzayan et al., 2006; Porubanova et al., 2014), and why some MCI concepts might be catchier than others – why folk physics violations like an invisible mango, for example, are recalled better than folk biological violations like an immortal lizard, or folk psychological violations like a singing icicle (Banerjee et al., 2013).

Accordingly, there is also no consensus – or even a coherent account – for why some MCI concepts, such as gods, are worshiped (if gods can even be classed as MCI; see Purzycki & Willard, 2016), while others, such as Mickey Mouse, are not (i.e., the “Mickey Mouse problem”; Atran, 2002). Thus, the suggestion that the MCI effect explains the nature and popularity of religious beliefs may be premature. A talking donkey in a well-accepted Bible story does not obviously differ, in terms of its counterintuitiveness, from a talking donkey in a fictional Dreamworks cartoon. Indeed, some authors have suggested they don’t differ at all,
and that belief is rather a function of the context in which they are presented (Gervais & Henrich, 2010; but see Barrett, 2008b, and Fondevila et al., 2012).

Here, we propose that both the MCI effect, as well as the bestowment of belief to particular MCI concepts, may be understood better by investigating the functional value of these phenomena, a topic all but ignored by cognitive scientists of religion. One exception is Purzycki et al.’s (2012) “strategic knowledge hypothesis” (see also Barrett 2008b; Boyer, 2000), which suggests MCI agents that are knowledgeable about important social matters are more likely to attract attention and belief than unknowing agents. We find this view compelling but argue that socially strategic knowledge and other proposed features of attractive MCI concepts (e.g., Barrett, 2008b) describe a more generally memorable feature: their fitness relevance.

Memory systems have likely been shaped by natural selection to prioritize certain kinds of information (Boyd & Richerson, 1985), such as information relevant to survival and reproduction (Gervais, Willard, Norenzayan, & Henrich, 2011; Nairne, 2016; Nairne, Thompson, & Pandeirada, 2007; Sandry, Trafimow, Marks, & Rice, 2013). Indeed, “as products of natural selection, these systems likely bear the specific imprint of nature’s criterion—the enhancement of fitness (survival en route to differential reproduction). As a result, the ability to learn and remember will likely be influenced by the fitness-relevance of the information and tasks involved” (Nairne, 2012, p. 1-2). Accordingly, we propose that MCI concepts are perceived to be more fitness relevant than intuitive concepts, and that fitness relevance at least partially explains the magnitude and variability of the MCI effect, with implications for the believability of particular MCI concepts and agents. Our argument is consistent with the claim that the cultural evolutionary success of popular religions somewhat depends on their utilization of MCI concepts (Boyer, 2001) – with religious thought and behavior as byproducts of the MCI memory bias. However, we propose that the fitness relevance of these concepts at least partially drives this bias.

Specifically, an MCI concept is fitness relevant to the extent it is perceived to increase or decrease survival and/or reproductive prospects. Such concepts, in theory, should relate to potential threats of relative importance during human evolution, such as predation, intraspecific violence, contamination, and social status loss (Boyer & Bergstrom, 2011). For example, children preferentially recall information about the danger posed by an animal relative to its name or its diet, and mistakes made by children and adults typically label safe animals dangerous rather than the reverse (Barrett & Broesch, 2012). Other studies have found a recall bias for potentially contaminated over uncontaminated items (Nairne, 2014), animate over inanimate items (VanArsdall, Nairne, Pandeirada, & Cogdill, 2015), ancestral
threats over modern threats (Wilson, Darling, & Sykes, 2011), and socially important information over socially trivial information (Stubbersfield, Tehrani, & Flynn, 2015). Attention and transmission biases similarly favor fitness relevant content (see Nairne, 2016, for a review). Moreover, a recent study attributed a memory bias for agents over objects, independent of their counterintuitiveness, to fitness relevance, arguing that agents, and especially intentional agents, carry more risk of harm (Porubanova et al., 2014), though we note that the same argument could be made for agents’ potential beneficence (albeit to a lesser extent; Rozin & Royzman, 2001). Indeed, many of the above biases could lead to fitness increments as much as to the avoidance of decrements, and several studies have found that stimuli rated as useful or relevant to fitness scenarios (e.g., hunting and gathering) are recalled better than stimuli rated irrelevant (Klein, Robertson, & Delton, 2010; Nairne et al., 2007; Nairne, 2016). Accordingly, we propose that MCI concepts, such as agents with MCI abilities, are perceived to have a broader capacity to threaten or assist with naturally-constrained goals related to survival and reproduction than intuitive concepts.

The current study provides the first direct test of the role of perceived fitness relevance on memory for intuitive and MCI abilities in different content domains (psychological, physical, and biological), with “fitness relevance” operationalized as the perceived potential threat and potential opportunity afforded by agents with those abilities. We predicted that MCI abilities would be remembered better than intuitive abilities, replicating previous research; more importantly, we predicted that MCI abilities would be rated more fitness relevant (for both threat and opportunity) than intuitive abilities, and that fitness relevance would statistically explain their recall advantage. We had no a priori hypotheses regarding differences across MCI content domains on any of the measures, other than to replicate a prior recall advantage for violations of folk physics (Banerjee et al., 2013).

**Study 1**

**Method**

**Participants**

Consistent with a previous study that measured ratings for MCI concepts (Pyysiäinen, Lindeman, & Honkela, 2003), we aimed to recruit at least 250 participants from Amazon’s Mechanical Turk, an online community of “workers” who perform simple tasks online in exchange for token payment (US$.50 in this case). Two hundred and eighty-one participants
(150 female, 129 male, 2 identifying as “other”) were recruited and randomly assigned to five ratings conditions. All were native English-speaking U.S. nationals currently living in the U.S. Their average age was 37.2 years (SD = 12.3); 175 (62%) identified with a religion (of which 88% were Christian); the remaining identified as “agnostic,” “atheist,” or “none.”

**Materials**

Stimuli included forty abilities, twenty intuitive and twenty counterintuitive, presented in dialogue form (“I can [ability]”). Each counterintuitive ability was minimally counterintuitive, depicting a single breach of either folk physics, folk biology, or folk psychology (see Table 2), based on content domains described by Barrett (2008a) and Boyer (2001). The total numbers of words and letters were equivalent between the MCI and intuitive categories.

Memory was measured with a surprise free recall task, in which participants were asked to think about and try to list, on separate lines of a response box, the 40 abilities they were shown. They were given 4 minutes (after which the survey would proceed automatically) and told they didn’t have to remember the exact wording. A filler task was administered between encoding and recall, in which participants were asked to find missing objects in pairs of nearly-identical pictures (Harvard Visual Attention Lab, 2016).

**Design and Procedure**

The study was administered in the Qualtrics survey environment and completed online. Participants were presented with “a list of abilities that people might have” and told some might be unusual. All were told to “Imagine there are 40 people who each possess a different ability that they’d like to tell you about”. Participants then rated all abilities, in random order, in response to one of five questions:

- **Intuitiveness.** Do you think a human being could possess this ability?
- **Threat.** Would you consider a person with this ability to be a potential threat to you?
- **Opportunity.** Do you think a person with this ability could significantly improve your life if they wanted to?
- **Visualization.** Can you form a vivid mental image of a person with this ability?
- **Desirability.** Would you like to have this ability?
All ratings were made on a scale anchored at 1 (not at all) and 7 (definitely). Desirability and ease of visualization were included as control variables because they could potentially produce significant recall differences between the MCI and intuitive stimuli (Purzycki & Willard, 2016; Upal et al., 2007).

**Table 2.** MCI and intuitive abilities used in Study 1.

<table>
<thead>
<tr>
<th>MCI abilities (I can…)</th>
<th>Intuitive abilities (I can…)</th>
</tr>
</thead>
<tbody>
<tr>
<td>directly control other people’s minds. (psy)</td>
<td>lie so well that most people believe me.</td>
</tr>
<tr>
<td>hurl objects just by using my mind. (psy)</td>
<td>converse in several different languages.</td>
</tr>
<tr>
<td>send thunderstorms to villages that offend me. (psy)</td>
<td>rule more harshly than the worst dictator.</td>
</tr>
<tr>
<td>see the future and know what will happen. (psy)</td>
<td>draw realistic pictures of animals.</td>
</tr>
<tr>
<td>answer any question because I know everything. (psy)</td>
<td>make enemies more easily than friends.</td>
</tr>
<tr>
<td>converse with billions of people simultaneously. (psy)</td>
<td>set fire to most things with suitable fuel.</td>
</tr>
<tr>
<td>remove my head and reattach it. (bio)</td>
<td>dance with the grace of a professional ballerina.</td>
</tr>
<tr>
<td>never die and will live forever. (bio)</td>
<td>barely contain my violent sexual urges.</td>
</tr>
<tr>
<td>give birth to different species of animal. (bio)</td>
<td>excavate artifacts to put in my museum.</td>
</tr>
<tr>
<td>transform myself into a monster. (bio)</td>
<td>fight skillfully with any weapon.</td>
</tr>
<tr>
<td>create living, breathing people out of sand. (bio)</td>
<td>read dozens of newspapers in a month.</td>
</tr>
<tr>
<td>raise the dead and command them. (bio)</td>
<td>sentence people to death in my court.</td>
</tr>
<tr>
<td>quickly grow to many times my size. (bio)</td>
<td>cook food from many different cultures.</td>
</tr>
<tr>
<td>evaporate when I feel heavy. (phys)</td>
<td>shout racist abuse better than anyone.</td>
</tr>
<tr>
<td>be in two places at the same time. (phys)</td>
<td>teach young children science at my school.</td>
</tr>
<tr>
<td>reverse the direction of time. (phys)</td>
<td>steal almost anything from anyone.</td>
</tr>
<tr>
<td>split into an army of duplicate beings. (phys)</td>
<td>steer a boat better than anyone.</td>
</tr>
<tr>
<td>levitate and fly unaided through the air. (phys)</td>
<td>make many kinds of poison.</td>
</tr>
<tr>
<td>disintegrate any object I touch. (phys)</td>
<td>juggle with my eyes closed.</td>
</tr>
<tr>
<td>walk right through walls and people. (phys)</td>
<td>make shoes in dozens of sizes.</td>
</tr>
</tbody>
</table>

Note: The labels psy, bio, and phys denote violations of folk psychology, biology, and physics, respectively, and are not part of the stimuli.

After rating all the abilities, participants were given four minutes to complete as much of the distraction task as they could. Memory was tested immediately afterwards. Finally, prior to being debriefed, participants were administered an attention check, requiring that they read to the end of the question to know which answer to give, and were asked if they used
“any visual aids, such as a copy of the 40 abilities, which were used to help you during the memory test”.9

Results

Two participants were not included in the final analysis after failing the attention check. Thirty participants were excluded from analyses involving their ability ratings after giving insufficient attention to the rated items (i.e., responded in less than 2 s on average). Twenty participants were excluded from analyses involving their recall data either because they admitted to using visual aids, or because they did not understand or attempt the recall task.

MCI vs Intuitive Abilities

Table 3 displays means and reliabilities of the abilities as a function of rating question and a priori counterintuitiveness. Paired samples t-tests revealed that, unsurprisingly, MCI abilities were judged less intuitive and more difficult to visualize than intuitive abilities. Importantly, MCI abilities were rated significantly higher than intuitive abilities on both measures of fitness relevance (potential threat and potential opportunity).

<table>
<thead>
<tr>
<th></th>
<th>Intuitiveness</th>
<th>Potential Threat</th>
<th>Potential Opportunity</th>
<th>Visualization</th>
<th>Desirability</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>(MCI)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>1.34</td>
<td>4.08</td>
<td>3.24</td>
<td>2.94</td>
<td>3.27</td>
</tr>
<tr>
<td>St. Dev.</td>
<td>.58</td>
<td>1.43</td>
<td>1.69</td>
<td>1.61</td>
<td>1.52</td>
</tr>
<tr>
<td>α</td>
<td>.8910</td>
<td>.94</td>
<td>.96</td>
<td>.96</td>
<td>.95</td>
</tr>
<tr>
<td><strong>(Intuitive)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>5.84</td>
<td>2.95</td>
<td>2.52</td>
<td>5.17</td>
<td>2.97</td>
</tr>
<tr>
<td>St. Dev.</td>
<td>1.52</td>
<td>.86</td>
<td>1.15</td>
<td>1.41</td>
<td>.90</td>
</tr>
<tr>
<td>α</td>
<td>.97</td>
<td>.84</td>
<td>.91</td>
<td>.96</td>
<td>.83</td>
</tr>
<tr>
<td>t(df)</td>
<td>-20.69(45)</td>
<td>8.36(53)</td>
<td>5.33(47)</td>
<td>-8.18(45)</td>
<td>1.84(54)</td>
</tr>
<tr>
<td>r</td>
<td>.95</td>
<td>.75</td>
<td>.61</td>
<td>.77</td>
<td>.24</td>
</tr>
<tr>
<td>P</td>
<td>&lt; .001</td>
<td>&lt; .001</td>
<td>&lt; .001</td>
<td>&lt; .001</td>
<td>.071</td>
</tr>
</tbody>
</table>

Table 3. MCI and intuitive abilities on the five target ratings.

9 They were assured payment regardless of their answer.
10 Two items had zero variance and were removed from this reliability analysis.
The first author, blind to condition, scored the free recall data as follows: 1 point was given if the essential property of an ability was recalled verbatim or in synonymous terms (e.g., “pass through solid objects” was an acceptable alternative to “walk through walls”). Half a point was given if the ability was partially recalled, or if a similar, related ability was described (e.g., “see through walls”). A hypothesis-blind research assistant independently coded 20% of the recall data, with an interrater reliability of 90%. The mean recall score was 8.5 points out of a possible 40, or 21.2% (M = .212; SD = .098).

Recall scores were submitted to a 5 (rating condition) x 2 (ability counterintuitiveness) mixed model ANOVA, with the second factor treated as a repeated measure. MCI abilities (M = .250; SD = .124) were recalled better than intuitive abilities (M = .174; SD = .109), confirming the MCI effect for these materials, F(1,254) = 90.747, p < .001, r = .51. There was also a main effect of rating condition, F(4,254) = 2.846, p = .025. Bonferroni-adjusted pairwise comparisons revealed one, theoretically irrelevant, significant effect: rating the abilities for desirability resulted in better recall than rating for visualization (p = .021).

Separate multilevel mediation models, using the MLmed macro for SPSS (Rockwood & Hayes, 2017), were used to test whether the MCI effect (the effect of a priori counterintuitiveness on recall) was mediated by threat or opportunity ratings. The models nested rating and recall for each ability within participants, and a random intercept was specified, as there was significant variance in intercepts across participants when threat ratings, Var(u0j) = .005, p = .006, or opportunity ratings, Var(u0j) = .008, p = .002, were included. As seen in Figure 1, both models revealed significant indirect effects, indicating the MCI effect was mediated by threat ratings and opportunity ratings.

Figure 1. Models of a priori counterintuitiveness as a predictor of recall mediated by (a) threat rating, and (b) opportunity rating. Indirect effects apply Monte Carlo confidence intervals based on 10,000 samples.
**MCI Content Domains**

Perceptions of the MCI abilities differed significantly across content domains. As seen in Figure 2, Bonferroni-adjusted pairwise comparisons revealed that psychology violations were rated more intuitive than biology (p < .001), and physics violations (p < .001), which did not differ (p = .295). Psychology violations were also rated more of an opportunity than biology violations (p < .001), and physics violations (p = .015), while physics violations were more of an opportunity than biology violations (p < .001). Threat ratings did not differ significantly across content domains. Comparisons with intuitive abilities (Table 3) revealed that biology violations did not significantly differ from intuitive abilities on opportunity rating (p = 1), while physics and psychology violations were both rated more of an opportunity (both p < .001).

![Figure 2](image_url)

**Figure 2.** Mean ratings for MCI abilities that violate different types of folk knowledge.

Recall for MCI abilities differed significantly across content domains but did not interact with rating condition. Bonferroni-adjusted pairwise comparisons revealed physics violations (M = .278; SD = .180) were recalled better than biology violations (M = .217, SD = .161, p < .001), and psychology violations (M = .254, SD = .187, p = .199). Psychology violations were recalled better than biology violations (p = .027).
Discussion

As predicted, participants showed better memory for MCI abilities – defined specifically as violations of intuitive expectations and confirmed empirically as abilities that humans do not normally possess – than for intuitive abilities. Visualization and desirability ratings suggested this “MCI effect” was not due to either liking for the abilities or to the ease with which they could be visualized.

Of more importance, these data support the hypothesis that MCI abilities are more fitness relevant – operationalized as the subjective potential for threat and opportunity – than intuitive abilities, and perceptions of fitness relevance can partially explain the MCI effect (the effect of a-priori counterintuitiveness on recall) for these abilities and, presumably, the agents that possess them. Indeed, among MCI abilities, folk psychology violations were rated the least counterintuitive, but weren’t recalled least well, which might be explained by them having the highest ratings for potential opportunity. Nevertheless, the direct MCI effect remained significant when either aspect of fitness relevance was controlled (Figure 1), although the effect might be fully explained if both were considered in the same model. The next study will measure ratings as repeated measures to determine if this is the case.

This study leaves other questions unanswered, as well; the most pressing of which is whether the MCI and intuitive abilities were appropriately matched for context. Although we attempted to balance threatening and beneficial contexts between MCI and intuitive abilities, it is possible that the MCI abilities were more likely to feature contexts with fitness relevant outcomes. For example, several, such as giving birth to other species, or living forever, have outcomes related to death or reproduction. This may have biased, and perhaps accounted for, perceptions of fitness relevance that we’ve attributed to the counterintuitiveness of the MCI abilities. Study 2 attempts to match the context of the abilities more closely by holding their outcomes constant and varying only their intuitiveness, i.e., whether or not they violate intuitive expectations.

Study 2

Method

Participants

One hundred and eighty-two participants (109 female, 71 male, 2 identifying as “other”) were recruited online via Amazon’s Mechanical Turk, as described in Study 1, and
paid US$ 1.00 to complete the study. Their average age was 37.0 years (SD = 11.3); 95 (52%) identified with a religion (of which 89% were Christian); the remaining identified as “agnostic,” “atheist,” or “none.”

**Materials**

Eighteen MCI abilities – six violations each of folk psychology, physics, and biology – were adapted from Study 1 to permit the creation of credible, outcome-matched, intuitive abilities. For example, “I can hurl objects just by using my mind” was amended to “I can use my mind to throw objects over long distances” and paired with the new intuitive ability “I can use my arms to throw objects over long distances”. As seen in Table 4, the final stimulus set thus included 18 pairs of abilities that differed in whether an MCI or intuitive method was used to produce an identical outcome. Each participant rated 9 intuitive and 9 MCI abilities (3 from each content domain). They never rated both abilities from the same pair, which was achieved by creating 2 stimulus lists.

**Design and Procedure**

The procedure was identical to that of Study 1, except that participants rated all 18 abilities three times over, on intuitiveness, threat and opportunity (visualization and desirability ratings were not included), with order of ratings and order of stimulus presentation randomized.

**Results**

Using the same criteria as in Study 1, one participant was not included in any analyses after failing the attention check; 28 participants were excluded from intuitiveness rating analyses, 39 from threat rating analyses, 40 from opportunity rating analyses, and 7 from recall data analyses.
Table 4. MCI and intuitive abilities used in Study 2. Each row contains a matched pair.

<table>
<thead>
<tr>
<th>MCI abilities (I can…)</th>
<th>Intuitive abilities (I can…)</th>
</tr>
</thead>
<tbody>
<tr>
<td>use my mind to throw objects over long distances. <em>(psy)</em></td>
<td>use my arms to throw objects over long distances.</td>
</tr>
<tr>
<td>answer any question because I know everything. <em>(psy)</em></td>
<td>answer any question because I think I know everything.</td>
</tr>
<tr>
<td>get people to do what I want by controlling their mind. <em>(psy)</em></td>
<td>get people to do what I want by persuading them.</td>
</tr>
<tr>
<td>use telepathy to tell what people are thinking. <em>(psy)</em></td>
<td>read body language to tell what people are thinking.</td>
</tr>
<tr>
<td>use the psychic visions I experience to make predictions about the future. <em>(psy)</em></td>
<td>use the mathematical model I derived to make predictions about the future.</td>
</tr>
<tr>
<td>hold simultaneous conversations with thousands of people. <em>(psy)</em></td>
<td>hold conversations with thousands of people in a year.</td>
</tr>
<tr>
<td>survive any fight because I am indestructible. <em>(bio)</em></td>
<td>survive any fight because my armor can withstand all weapons.</td>
</tr>
<tr>
<td>birth different species of animal from my womb. <em>(bio)</em></td>
<td>deliver different species of animal at my veterinary practice.</td>
</tr>
<tr>
<td>split into a swarm of bees. <em>(bio)</em></td>
<td>use a fragrance to attract a swarm of bees.</td>
</tr>
<tr>
<td>shapeshift to look like someone or something else. <em>(bio)</em></td>
<td>use prosthetic makeup to look like someone or something else.</td>
</tr>
<tr>
<td>create living, breathing animals out of sand. <em>(bio)</em></td>
<td>create living, breathing animals in my cloning laboratory.</td>
</tr>
<tr>
<td>sometimes bring people back to life if I look at them and smile. <em>(bio)</em></td>
<td>sometimes bring people back to life if I perform CPR.</td>
</tr>
<tr>
<td>walk through any wall. <em>(phys)</em></td>
<td>climb over any wall.</td>
</tr>
<tr>
<td>appear in two places at the same time. <em>(phys)</em></td>
<td>use a hologram to appear in two places at the same time.</td>
</tr>
<tr>
<td>disintegrate things if I touch them with my hand. <em>(phys)</em></td>
<td>disintegrate things with acid in my laboratory.</td>
</tr>
<tr>
<td>levitate and fly unaided through the air. <em>(phys)</em></td>
<td>levitate and fly through the air using my jetpack.</td>
</tr>
<tr>
<td>escape a locked room by turning into a vapor. <em>(phys)</em></td>
<td>escape a locked room by picking the lock.</td>
</tr>
<tr>
<td>instantaneously double my current size. <em>(phys)</em></td>
<td>double my current size by weightlifting.</td>
</tr>
</tbody>
</table>

Note: The labels *psy*, *bio*, and *phys* denote violations of folk psychology, biology, and physics respectively, and are not part of the stimuli.
**MCI vs Intuitive Abilities**

Figure 3 displays means of the abilities on the three target ratings as a function of their *a priori* counterintuitiveness. Intuitiveness, threat, and opportunity ratings were submitted to separate 2 (ability counterintuitiveness) x 2 (stimulus list) mixed model ANOVA, with the first factor treated as a repeated measure. Unsurprisingly, the analysis of intuitiveness ratings revealed a main effect of ability, such that participants found MCI abilities less intuitive than intuitive abilities, $F(1,151) = 1031.246, p < .001, r = .93$. There was no interaction with stimulus list.

The analysis of fitness relevance revealed analogous main effects. MCI abilities were perceived as more potentially threatening, $F(1,140) = 218.386, p < .001, r = .78$, and more of a potential opportunity, $F(1,139) = 8.639, p = .004, r = .24$, than intuitive abilities. Ability counterintuitiveness interacted with stimulus list to predict threat ratings, $F(1,140) = 23.278, p < .001, r = .38$, and opportunity ratings, $F(1,139) = 28.107, p < .001, r = .41$. In both lists, MCI abilities remained significantly more threatening than intuitive abilities ($p < .001$), but, were only more of an opportunity in one list ($p < .001$), being slightly less of an opportunity in the other ($p = .016$).

![Figure 3. Mean ratings for MCI and intuitive abilities.](image)
Recall scores were determined in the same manner as Study 1, with an interrater reliability of 88%, and a mean recall score of 8.8 points out of 18, or 48.7% (M = .487; SD = .213).11 Recall scores were submitted to a 2 (ability counterintuiveness) x 2 (stimulus list) mixed model ANOVA, with the first factor treated as a repeated measure. There was a main effect of ability, with MCI abilities (M = .523; SD = .244) recalled significantly better than intuitive abilities (M = .450; SD = .237), confirming the MCI effect for these materials, F(1,172) = 16.541, p < .001, r = .30. The effect interacted with stimulus list, F(1,172) = 14.812, p < .001, r = .28. The MCI effect was stronger in one of the lists (MCI: M = .560; SD = .267; intuitive: M = .431; SD = .231; p < .001) than in the other (MCI: M = .477; SD = .204; intuitive: M = .474; SD = .244; p = .886).

In the same manner as Study 1, multilevel mediation models with random intercepts (Threat: Var(u0j) = .022, p < .001; Opportunity: Var(u0j) = .027, p < .001) established if the MCI effect was mediated by threat or opportunity ratings. Threat did not mediate the MCI effect, b = .0004, 95% CI [-.0110, .0120], p = .949, nor did opportunity, b = -.0005, 95% CI [-.0031, .0017], p = .655.

**MCI Content Domains**

Perceptions of the MCI abilities differed significantly across content domains but did not interact with stimulus list. As seen in Figure 4, they followed a similar pattern to Study 1 (Figure 2). Bonferroni-adjusted pairwise comparisons showed psychology violations were rated more intuitive than biology and physics violations (both p < .001), which did not differ (p = .989). Of 18 MCI abilities, the top five were psychology violations. Psychology violations were also rated more of an opportunity than biology and physics violations (both p < .001), which did not differ (p = .537). The top four most highly rated violations were psychological. Threat ratings did not differ significantly across content domains. Comparisons with intuitive abilities (Figure 3) revealed that only psychology violations were rated significantly more of an opportunity than intuitive abilities (p < .001).

Recall of the MCI abilities differed significantly across content domains but did not interact with stimulus list. Bonferroni-adjusted pairwise comparisons revealed physics violations (M = .565; SD = .308) were recalled better than psychology violations (M = .495, SD = .313, p = .024), and biology violations (M = .509, SD = .323, p = .085), which did not differ (p = 1).

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11 This is higher than in Study 1 because participants saw the materials three times and had fewer items to remember.
Figure 4. Mean ratings for MCI abilities that violate different types of folk knowledge.

Discussion

This study matched MCI and intuitive abilities to control for contextual differences between them. Despite some unexpected interactions with stimulus lists (evidence that certain abilities are more memorable for reasons other than their intuitiveness), the essential findings from Study 1 were replicated, independent of those effects: MCI abilities were judged less intuitive, more threatening, and more beneficial than intuitive abilities (the latter only for folk psychology violations); they were also remembered better than intuitive abilities, although, unlike in Study 1, the MCI effect was not mediated by threat or opportunity ratings.

Since the only conceptual difference in this study was the control of outcomes, the findings suggest that variance in outcomes in Study 1 at least partially accounts for why threat and opportunity mediate the MCI effect in that study, but not in Study 2. Our findings suggest that controlling for differences in outcomes between MCI and intuitive abilities eliminates the mediating effects of threat and opportunity on the MCI effect. Without this mediation, the MCI effect observed in this study ($r = .30$) replicates the direct effect of *a priori*
counterintuitiveness on recall observed in Study 1 (Figure 1) and allows us to attribute the larger overall MCI effect in that study ($r = .51$) to the additional effect of fitness relevance. We conclude that the inherent fitness relevance of agents with MCI abilities only augments the MCI effect when applied to produce particular outcomes (that are not present for intuitive stimuli), such as outcomes related to survival or reproduction, e.g., a being who gives birth to different species.

Differences between violation types followed similar patterns to Study 1. Violations of folk psychology were rated more intuitive and more of an opportunity than other violation types, although, unlike in Study 1, biology violations were not rated less of an opportunity. The high opportunity rating for psychology violations accounted for all of the advantage observed for MCI over intuitive abilities on this variable. Physics violations were again recalled best. These effects are discussed in the General Discussion.

Although we have interpreted these studies in terms of the fitness relevance of counterintuitive abilities, they leave open the possibility that ability judgments were in fact judged indirectly, through assumptions about the nature of the agents possessing them. That is, participants may implicitly assume that agents with MCI abilities are supernatural beings, such as gods, and estimate threat and opportunity accordingly. This account can be tested by pairing MCI and intuitive abilities with explicitly intuitive agents, such as scientists, who can also do counterintuitive things. For example, would a scientist with a mindreading machine afford the same threat and opportunity as an agent with supernatural mindreading abilities? Study 3 answers this question.

**Study 3**

As well as replicating the main findings from Studies 1 and 2, this study tested the hypothesis that the fitness relevance of counterintuitive abilities is attributable to the implicit counterintuitiveness of the agents who possess them. We did so by manipulating participants’ assumptions with supposedly authoritative information about whether (or not) it is possible for scientists to reproduce MCI abilities. If fitness-relevance is attributable to the assumed status of agents, then MCI abilities should be rated more fitness relevant when thought to be scientifically impossible (since in this case the agents who possess them must themselves be counterintuitive). If fitness relevance is attributable to the abilities themselves, threat and opportunity ratings should be independent of information about the agent’s status.
Method

Participants

One hundred and seventy-one participants (91 female, 79 male, 1 identifying as “other”) were recruited online via Amazon’s Mechanical Turk, as described in Study 1, and paid US$ 0.50 to complete the study. Their average age was 37.5 years (SD = 13.3); 100 (58%) identified with a religion (of which 96% were Christian); the remaining identified as “agnostic,” “atheist,” or “none.”

Materials

As a manipulation of agent counterintuitiveness, participants read one of two “important press releases” that argues for or against the scientific reproduction of MCI abilities, providing examples from each MCI content domain (Appendix A). For example, in the “intuitive” condition the text describes how “currently available technologies could be used to construct devices that allow people to enhance their physiology, manipulate reality, and even exhibit extrasensory abilities,” noting that astral projection, for example, “can be achieved with the construction of a headset that detects, transmits, and amplifies the wearer’s brainwaves in targeted ways.” In the “counterintuitive” condition, these same abilities are described as “scientifically impossible,” noting that astral projection “could never occur because of the dependent relationship between one’s thoughts and the neurons that are unique to each individual brain.”

Design and Procedure

The study was completed online in Qualtrics. Two questions followed the manipulation of agent counterintuitiveness: “Are you excited by the content of this press release?” and “Do you think that science will be able to provide people with many abilities that are thought of as supernatural?”, the second of which acted as a manipulation check. They next rated the 20 MCI and 20 intuitive abilities used in Study 1 (see Table 2), on intuitiveness, threat, and opportunity, as in Study 2, before completing an attention check and being debriefed. Intuitiveness ratings served as an additional manipulation check, as the question covers both agents and abilities.
Results

Four participants were not included in any analyses after failing the attention check. Based on the same criteria as Study 1, 32 participants were excluded from analyses involving their intuitiveness ratings, 32 from threat rating analyses, and 43 from opportunity rating analyses.

Manipulation Check

Participants were more likely to believe science could provide MCI abilities after reading that they are possible (M = 4.12; SD = 1.82) than after reading that they are impossible (M = 3.07; SD = 1.79), t(165) = -3.767, p < .001, r = .28. They were also more excited after reading that MCI abilities are possible (M = 4.52; SD = 1.82) than after reading they are impossible (M = 3.21; SD = 1.64), t(165) = -4.898, p < .001, r = .35.

MCI vs Intuitive Abilities

Intuitiveness, threat, and opportunity ratings were submitted to separate 2 (agent counterintuitiveness) x 2 (ability counterintuitiveness) mixed model ANOVAs, with the second factor treated as a repeated measure. Unsurprisingly, the analysis of intuitiveness ratings revealed a main effect of ability, such that MCI abilities were rated less intuitive than intuitive abilities, F(1,133) = 1274.636, p < .001, r = .95. The effect interacted with agent counterintuitiveness, F(1,133) = 6.071, p = .015, r = .21, serving as a further confirmation of the manipulation. As Figure 5 shows, MCI abilities were rated more intuitive in the “intuitive” condition than in the “counterintuitive” condition, t(133) = -2.591, p = .011, r = .22. Intuitive abilities did not differ between these conditions (p = .267).

The analyses of threat and opportunity revealed analogous main effects. MCI abilities were perceived as more potentially threatening, F(1,133) = 95.937, p < .001, r = .65, and more of a potential opportunity, F(1,133) = 35.715, p < .001, r = .46, than intuitive abilities. However, neither threat (p = .577) nor opportunity (p = .448) interacted with agent counterintuitiveness.
Perceptions of MCI abilities differed significantly across content domains. As seen in Figure 6, Bonferroni-adjusted pairwise comparisons showed psychology violations were rated more intuitive than biology violations and physics violations (both $p < .001$), which did not differ ($p = 1$). This effect was significant across, but nevertheless interacted with, agent counterintuitiveness ($p = .013$). The manipulation produced a greater change in the rated intuitiveness of psychology violations ($\Delta M = .661$) than biology ($\Delta M = .237$) or physics ($\Delta M = .332$) violations. Comparisons also showed that psychology violations were rated more of an opportunity than biology violations and physics violations (both $p < .001$), while physics violations were more of an opportunity than biology violations ($p < .001$). Threat ratings did not differ significantly across content domains, and neither threat nor opportunity ratings across content domains interacted with agent counterintuitiveness. As in Study 1, comparisons with intuitive abilities (Figure 5) revealed that biology violations did not significantly differ from intuitive abilities on opportunity rating ($p = 1$), while physics and psychology violations were both rated more of an opportunity (both $p < .001$).
Figure 6. Mean ratings for MCI abilities that violate different types of folk knowledge.

Discussion

This study replicated Studies 1 and 2 in demonstrating that the perceived fitness relevance of MCI abilities exceeds that of intuitive abilities. However, perceptions of fitness relevance were equivalent regardless of whether participants were inclined to think intuitive agents, or only counterintuitive agents, could possess them. This suggests that the fitness relevance that participants attribute to agents demonstrating MCI abilities is associated with the abilities in question, and is not mediated by assumptions about the agent. This study also replicated Studies 1 and 2 in finding that folk psychology violations are especially intuitive and represent a greater opportunity than other violation types.

General Discussion

Cognitive scientists of religion attribute the ubiquity of religious narratives partly to the favored recall of MCI concepts within those narratives, but this recall bias is inconsistent, sometimes absent, and without an obvious adaptive rationale. We argued that MCI concepts are typically more fitness relevant than intuitive concepts – that is, perceived as a greater potential threat and/or opportunity to survival or reproduction – and are therefore prioritized by naturally selected memory systems. Across three studies, we asked if MCI agents are
indeed perceived this way, whether this perception relates to the abilities themselves or the agents who possess them, and whether perceived fitness relevance can explain the existence and variability of the MCI effect. We also asked if variance across physical, biological, and psychological counterintuitive content domains might similarly explain some of the inconsistency in the MCI effect.

In all three studies, the perceived fitness relevance of counterintuitive abilities – abilities that violate intuitive expectations about human capacities – was shown to exceed that of intuitive abilities, even when the abilities resulted in the same outcomes (Study 2) and, indeed, even when humans were granted access to them (Study 3). The latter effect suggests it is the abilities themselves, rather than the agents possessing them, that are perceived as fitness relevant.

In Studies 1 and 2, counterintuitive abilities were recalled better than intuitive abilities (replicating the MCI effect). Mediation analyses were inconsistent, however. Study 1 found that fitness relevance partially explained the MCI effect, but Study 2 did not. The primary difference between the studies is the latter’s control of outcomes; that is, when two different means were used to achieve the same result, it was only the counterintuitiveness of the means, and not their fitness relevance, that predicted memory. This suggests perceptions of fitness relevance, when cued by agents with counterintuitive abilities, do not mediate the MCI effect unless those abilities are employed to produce particular, fitness relevant outcomes. For example, in Study 1, five counterintuitive abilities (immortality, resurrection, self-duplication, birthing other species, creating people from sand) were related to survival or reproduction, compared to only one intuitive ability (“sentence people to death in my court”). Similarly, seven MCI abilities had outcomes that implied greater access to socially important information (seeing the future, punishing offensive villages, omniscience, bilocation, superior communication, mind control, walking through walls) with only one comparable intuitive ability (being multilingual). Our studies therefore support the conclusion that for fitness relevance to explain the MCI effect, counterintuitive abilities must be employed to produce fitness relevant outcomes, such as those related to death, reproduction, or social goals, in ways that intuitive abilities are not. This speculation must be confirmed in future replications and extensions of this work, however.

Our findings therefore only provide a partially adaptive rationale for the MCI effect. All studies demonstrated the perceived fitness relevance of MCI abilities, suggesting we perceive agents with these abilities as broadly able to facilitate or hinder naturally-constrained goals. For example, an agent that can “tell what people are thinking” may threaten a goal to keep our thoughts private or benefit us by revealing the thoughts of others. We suggest this
broad, perceived capacity to facilitate or hinder goals relates to the paucity of mundane inferences that can be generated about MCI concepts (Boyer, 2001), resulting in uncertainty and caution. Nevertheless, in terms of an evolutionary explanation, the extent to which these goals are “naturally-constrained” is unclear and dependent on theoretical formulations (e.g., Boyer & Bergstrom, 2011). Furthermore, despite this perceived fitness relevance, mediation of recall depended on what the abilities were used to accomplish. This condition may be important for explaining the cultural evolutionary success of religions that employ gods with these abilities. Indeed, it could be argued that the most popular religious narratives adhere to a recall optimum, employing MCI agents’ enhanced potential for beneficence to accomplish fitness relevant outcomes that cannot be easily attributed to intuitive agents, such as resurrection, afterlife immortality, miraculous births, healing, and spontaneous food production. Similarly, MCI agents’ enhanced potential for threat has been employed to police and punish society with floods, famine, disease, and infertility, and to dispense ultimate justice with a hellish hereafter. Returning to our example from the introduction, both Balaam’s and Shrek’s donkeys can speak (the latter all too much), but only Balaam’s appears exclusively in a fitness-enhancing context (i.e., saving Balaam from certain death at the hands of an angel). It follows that agents with counterintuitive abilities that do not intervene in human affairs to affect fitness relevant outcomes should be less memorable, and perhaps less believable, than those that do. These considerations could help explain the differences between Studies 1 and 2: Study 2, with its strict context matching, may have paired (counter)intuitive abilities with uncommon outcomes, while Study 1 may have employed outcomes that regularly accompany the (counter)intuitive abilities presented.

Our results also represent the first demonstration of an MCI effect for the abilities an agent is purported to possess. This perhaps makes our study less directly comparable to existing research that focuses on agents alongside other ontological categories (e.g., objects), and on the nature of agents rather than their abilities. However, since agents feature heavily in religious narratives (Barrett et al. 2009) we consider our focus suited to comparisons with real religious beliefs (Purzycki & Willard, 2016). Indeed, we posit that gods and spirits are typically described in terms of the counterintuitive abilities they demonstrate when enacting narrative-worthy events. For example, most supernatural belief systems include a creation myth in which a counterintuitive agent does the creating (Sproul, 1979). Similarly, claims of divine intervention are claims about godly acts rather than gods per se. Furthermore, the distinction between agents and their abilities made in Study 3 suggests that the recall of MCI agents in earlier research may have been partially mediated by assumptions about the abilities those agents are assumed to possess.
Another novel contribution of the current work is the finding of systematic differences in the extent to which different types of violations were recalled, although we can currently only speculate about their explanation. For example, MCI abilities that violated folk physics were consistently recalled better than abilities in other content domains (replicating Banerjee et al., 2013), but were not consistently less intuitive or more fitness relevant. Modular models of counterintuitiveness appear insensitive to this manner of variation, leading Purzycki and Willard (2016) to suggest intuitive and cultural expectations should be thought of as deep and shallow inferences, categories that may permit greater overlap and variation between and within them. Using this framework, physics violations might be recalled better because they violate deeper inferences than other violation types. Indeed, folk physics expectations, such as about the solidity and continuity of objects, are thought to emerge in the first few months of life (Baillargeon, 2002), with folk psychology expectations, such as attributions of mental states to others, emerging later (Poulin-Dubois, Brooker, & Chow, 2009).

Folk psychology also emerged as a distinctive domain, with violations consistently rated less counterintuitive than violations in other domains. This could be attributed to innate or emergent capacities. For example, Willard, Henrich, and Norenzayan (2016) found that people vary in their tendency to anthropomorphize objects – a folk psychology violation that transfers human mental states to non-human forms – implying that the counterintuitiveness of such violations may change over time. However, the intuitiveness data are also consistent with Bloom’s notion of intuitive dualism. Bloom suggests minds are intuitively represented as non-physical entities that are distinct and separable from bodies (Bloom, 2004; Chudek et al. 2013). People might, to some extent, represent minds as unbounded by space, time, and the boundaries of other minds, causing some violations of folk psychology to appear less counterintuitive. For example, it may be easier to intuit a mind ‘reaching’ into other minds if it’s physically unbounded than if it resides within material barriers (i.e., a skull).

In all three studies, agents with abilities violating folk psychology were also rated more of a potential opportunity. These abilities included reading or controlling minds, telekinesis, telling the future, and extraordinary knowledge and communication skills. Perceived opportunities may therefore concern gaining access to socially important information that could aid in overcoming social threats, such as deception, status loss, ostracism, and intraspecies conflict, all of which have become primary concerns in recent human evolution (Alexander, 1989). Other evolutionarily significant threats, such as predation and contamination (Boyer & Bergstrom, 2011) and the stimuli that can remedy them, may have become concurrently less salient, and less relevant. In short, an ‘MCI mind’ that violates
folk psychology represents an opportunity to overcome what may be the most salient threats in our recent evolutionary history.

Accommodating differences between MCI abilities on these variables may require a more flexible model of counterintuitiveness than modular models allow (Boyer, 2001). For example, connectionism, which models incoming information in terms of incremental changes to the weights of connections between existing units of information, may provide a better fitting model of how MCI abilities are encoded and recalled (Purzycki & Willard, 2016; Upal, 2010). In such models, perceiving a stimulus leaves a memory trace proportional to the total incremental change in weights to the existing memory architecture (Bechtel & Abrahamsen, 1991; McClelland & Rumelhart, 1985; Rumelhart, Smolensky, McClelland, & Hinton, 1986). Counterintuitive information likely weakens strong, oft-reinforced connections (i.e., intuitions), resulting in a relatively large change to existing weights, and in turn a stronger memory trace (the MCI effect). However, the size of its memory trace should depend on how an individual’s developmental and cultural history have shaped both the strength and number of connections between intuitive and other units of information, factors that may vary systematically between content domains. For example, because folk physics expectations govern every solid object in our environment, while folk biology and psychology only concern living entities, folk physics knowledge should be more widely connected to other units of information. We also expect these connections to be stronger, given their regular environmental reinforcement and aforementioned early developmental emergence (Wellman & Gelman, 1998). The relative strength and penetration of folk physics expectations could thus explain the recall advantage for violations of them.

Furthermore, by differentiating the “catchiness” of isolated violations, connectionist models may be able to capture other phenomena, such as the fact that cultural violations (e.g., “illiterate teacher”) are sometimes recalled better than counterintuitive violations (e.g., “melting teacher”) (Atran & Norenzayan, 2004, Johnson et al., 2010; Norenzayan et al., 2006; Porubanova et al., 2014). Cultural information might be reinforced by experience to produce stronger connections than exist for some intuitive information, but, without applicability to entire ontological categories, have fewer connections overall. Recall of violations would depend on the total incremental change to connection weights, favoring cultural violations in a minority of cases. Such models also imply a process through which regular encounters with counterintuitive material might increase its perceived intuitiveness by repeatedly weakening connections that represent intuitive expectations. This could explain the occasional presence of maximally counterintuitive gods in some religions and the emergence of seemingly bizarre...
cults (Cofnas, 2018; Willard et al., 2016; Upal, 2010), as well as the aforementioned process through which folk psychology violations might become more intuitive over time.

This work has largely focused on how the fitness relevance of MCI agents might be reflected in religious cognition. However, fitness relevance may have a greater impact on religious behavior, and on what separates believable from unbelievable MCI agents. For example, the common supplicatory function of prayer, sacrifice, and other religious rituals may be encouraged by the special opportunities afforded by gods. Conversely, the threat posed by gods may explain behavior such as deference, a strict adherence to ritual procedures, and other precautionary measures (Lienard & Boyer, 2006). Rituals and various religious behaviors may be a means of interacting with the fitness relevance of gods in order to extract fitness relevant outcomes, while MCI concepts may be a common way to bolster this relevance further, such that gods can plausibly exert control over events that have no earthly explanation or solution. God-sized problems, such as death and natural disasters, require god-sized solutions, and achieving these impossible fitness relevant outcomes may be the utility of MCI concepts that feature in religious narratives.
Chapter 3
The Effect of Anxiety on Memory for Counterintuitive Agents

Introduction

In the previous chapter, counterintuitive agents (defined by the counterintuitive abilities they possess) were judged as more potentially threatening and beneficial than intuitive agents, but, for this “fitness relevance” to explain their favored recall (the “MCI effect”), the agents needed to have employed their counterintuitive abilities to produce fitness relevant outcomes, such as those related to death, reproduction, or social goals. In this chapter, I argue that the cognitive biases associated with anxiety intensify the MCI effect by directing attention and memory towards the threatening features of counterintuitive agents (hypothesis 3; Chapter 1).

The previous chapter suggested that while the MCI effect can result from a large memory trace left behind by the modification of deep knowledge structures by counterintuitive concepts (i.e., the potential to learn from novel events; Upal, 2010), this effect can be partially mediated by the threat that is inherent to those concepts, presumably because threatening information and its relation to personal fitness are also necessary to learn about. Anxiety, as defined in Chapter 1, produces cognitive biases specifically to learn about threats: biases that locate and focus on threats, evaluate their negative outcomes, and encode them to memory. Thus, while threat detection can partially mediate an MCI effect even in non-anxious individuals, supporting the claim that memory systems have been tuned by natural selection to preferentially detect threat (Dijksterhuis & Aarts, 2003; Nairne, 2016; Rozin & Royzman, 2001), I propose that anxious individuals will exhibit a larger bias for the recall of MCI agents, which, as established in the previous chapter, are threatening stimuli.

A number of studies support the claim that anxiety biases cognitive resources toward threat, although the body of work is admittedly more limited than it first appears. Utilizing data from dozens of studies, meta-analyses have found that anxiety biases attention (Bar-Haim et al., 2007) and memory (Herrera et al., 2017; Mitte, 2008) toward the detection of threat-related stimuli. However, many of these studies relied on self-report measures (e.g., scales). Unfortunately, for attentional bias to threat (ABT), the most recent meta-analysis

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12 The term “opportunity” that was used in the previous chapter (a submitted paper) is now replaced by the more apposite term “benefit”.

excluded induced anxiety because of substantial differences in procedures (Bar-Haim et al., 2007). However, more recent work employing mood induction procedures suggests induced (state) anxiety has a large effect on ABT by alerting and orienting attention toward threat (Nelson, Purdon, Quigley, Carriere, & Smilek, 2015; Pacheco-Unguetti et al. 2010; Robinson, Letkiewicz, Overstreet, Ernst, & Grillon, 2011), while trait anxiety is more related to a deficit in controlling attention (i.e., in shifting attention away) and may only apply to threats that are self-relevant (e.g., Bar-Haim et al., 2007; Saunders, 2013; Walsh, et al. 2015).

Regarding the recall bias, meta-analyses also omitted induced anxiety (Mitte, 2008) or produced non-significant results from a limited number of such studies (k = 4; Herrera et al., 2017). However, both reviews found a larger bias when stimuli were encoded at a low/moderate depth of processing (perceptual or read-only rather than conceptual tasks) suggesting the recall bias is facilitated by ABT. Despite the lack of studies, there is substantial literature concerning mood congruent recall, particularly regarding the preferential recall of negative or threatening information (e.g., stories or word lists) when in a depressed mood (Gaddy & Ingram, 2014; Matt, Vazquez, & Campbell, 1992), which may be somewhat related to anxious mood (Maser & Cloninger, 1991), and a few studies have revealed mood congruent recall for what appear to be anxious moods. For example, Rusting (1999) found that when participants listened to unpleasant music and imagined themselves experiencing negative events, they recalled negative words better and positive words worse than participants who underwent a positive mood induction. However, using a similar dependent measure, Foa, McNally, and Murdock (1989) found no mood congruent recall for speech-anxious students who were informed they would be making a speech, suggesting some forms of anxiety may direct the bias in different ways (such as to internal cognitions instead of external stimuli; Eysenck, 1997). Additionally, Breck and Smith (1983) found that when socially anxious individuals were made to think a social interaction would follow their study, they recalled more negative self-descriptive traits than individuals not told about the interaction, and other researchers have reported similar results using different methodologies (Bradley, Mogg, Galbraith, & Perrett, 1993; Charpentier, Hindocha, Roiser, & Robinson, 2016; Eden et al., 2014; Norton, Schaefer, Cox, Dorward, & Wozney, 1988). In all cases, induced anxiety appeared to have a role in facilitating the encoding of threatening information, presumably by alerting and orienting attention towards threats.

In the first study in this chapter, I asked if the MCI effect – the bias to recall minimally counterintuitive (i.e., threatening) agents – is stronger in anxious individuals than in non-anxious individuals. Participants were presented with a story containing both intuitive and MCI agents, and their memory for those agents was tested via free recall and recognition
tasks, both immediately and after three weeks. Generally, studies have shown that the recall advantage for MCI concepts increases over time, which may account for the cultural success of religious materials (Atran & Norenzayan, 2004; Banerjee et al., 2013; Barrett & Nyhof, 2001; Johnson et al., 2010; Norenzayan et al., 2006). Anxiety was induced in half of the participants, either just prior to encoding or just prior to retrieval. There is reason to think that these induction procedures will differ. Studies suggest anxiety induced at encoding facilitates recall, while anxiety induced at retrieval is detrimental (reviewed in Robinson, Vytal, Cornwell, & Grillon, 2013). This might be understood through the hypervigilance bias and ABT, in which anxious individuals scan the environment for potential danger before selectively attending to threat (Eysenck, 1997). This would facilitate the encoding of threatening information but distract from the retrieval of information that has already been encoded.

Thus, the study conformed to a 2 (anxiety condition) x 2 (induction: encoding versus retrieval) x 2 (counterintuitiveness of abilities) design, with the third factor treated as a repeated measure, and the dependent variable (memory) measured at two different times.\(^\text{13}\) I predicted a main effect of counterintuitiveness (an MCI effect) and, more importantly, an interaction with anxiety at encoding (but not at retrieval). I also predicted that the fraction of counterintuitive abilities forgotten between the two times would be smaller than the fraction of intuitive abilities forgotten.

**Study 1**

**Method**

**Participants**

An a-priori power analysis\(^\text{14}\) based on an effect size observed between anxious and non-anxious groups for the recall of threatening information (\(d_b = .321\), Herrera et al., 2017), indicated that 388 participants would be required to obtain power of .80 when \(p\) is set to .05. Four hundred and eleven volunteers were ultimately recruited (239 female, 169 male, and 3 identifying as “other”) from Amazon’s Mechanical Turk and paid US$.50 for their participation. All were native English-speaking U.S. nationals currently living in the U.S. Their average age was 36.8 years (SD = 12.5); 225 identified with a religion (of which 94%)

\(^{13}\) Time was not treated as an experimental factor because of the likelihood of participant loss between the two times.

\(^{14}\) All power analyses in this thesis were made using GPower v.3 (Faul, Erdfelder, Lang, & Buchner, 2007).
were Christian); 175 identified as “agnostic”, “atheist”, or “none”; and 12 identified as “other” (e.g., spiritual).

**Materials**

Anxiety was manipulated using the stimuli and procedure developed by Pacheco-Unguetti et al., (2010), which previously produced significant differences in state anxiety (p < .0001; \( \eta^2 = .63 \)) and ABT (alerting: p = .011, \( \eta^2 = .10 \); orienting: p = .031, \( \eta^2 = .07 \)). In the anxiety condition, participants were presented with ten distressing images from the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 1999), each accompanied with text about a related potential threat (see Figure 7). The images were chosen for their negative valence, and text emphasized the uncontrollability of the threat depicted in the image. For example, an image of a person with a life-threatening injury was accompanied by the text, “Car journeys can lead to tragic accidents. On the road, danger is around every corner.” In the control (non-anxious) condition, ten non-distressing images from the IAPS with positive valence\(^{15}\) were accompanied by related, non-threatening text about goal-achievement and contentment. For example, an image of children playing with pet animals was accompanied by the text, “Life offers great possibilities for enjoyment and fulfillment”.

![Figure 7. Screen shots from the anxiety (left) and control conditions (right).](image)

Prior to presentation of the anxiety [control] stimuli, participants were told they would see an unpleasant [pleasant] set of photographs. They were asked to involve themselves personally and to see the photos as relevant and related to their life. They were reminded that

\(^{15}\) Although these stimuli were positively valenced, they did not appreciably reduce anxiety (Pacheco-Unguetti et al., 2010) and can be considered a control condition.
events are sometimes beyond their control [that life can be fulfilling]. Participants were then presented with the ten image/text pairs appropriate to their experimental condition. For each pair, the text appeared first, for six seconds, followed by the accompanying image for a further eight seconds. After presentation of the stimuli, a manipulation check asked participants to rate “how do you feel right now?” on a scale anchored at 1 (unpleasant) to 9 (pleasant).

Following previous research (see Chapter 1), the to-be-recalled materials were arranged within a short story (i.e., a narrative) with a main character, a beginning, and an ending. It was preceded with the instructions: “On the following pages, you will be presented with a short story. On each page, there will be a delay before the next button appears. This is only to ensure a minimum amount of time is spent reading the text. Please read all of the story carefully and take as long as you like to proceed through the pages.” The following story was then presented to participants:

“Mr. Klorp was carrying his flute home one night when he noticed the temple door was open. He stepped inside and heard voices coming from a back room. When he approached the room and looked through the keyhole, he saw some villagers having a secret meeting with some strange beings. There were sixteen at the meeting, and Mr. Klorp listened as each of them introduced themselves.

(Continue to the next page to see what they said.)

“I am Tristan. I can steer a boat better than anyone.”
“I am Katrina. I can directly control other people's minds.”
“I am Beatrix. I can steal almost anything from anyone.”
“I am Oliver. I can walk right through walls and people.”
“I am Marissa. I can juggle with my eyes closed.”
“I am Jared. I can transform myself into a monster.”
“I am Hector. I can sentence people to death in my court.”
“I am Benedict. I can be in two places at the same time.”
“I am Quentin. I can make shoes in dozens of sizes.”
“I am Philippa. I can hurl objects just by using my mind.”
“I am Cordelia. I can make many kinds of poison.”
“I am Eleanor. I can give birth to different species of animal.”
“I am Camilla. I can draw realistic pictures of animals.”
“I am Tobias. I can never die and will live forever.”
“I am Sebastian. I can fight skillfully with any weapon.”
“I am Theresa. I can see the future and know what will happen.”
Mr. Klorp was so surprised by what he heard that he dropped his flute onto the floor. Without checking to see if anyone had heard, he picked it up and ran home as quickly as he could.”

To ensure sufficient attention was given to the stimuli, the story beginning (discovery of the meeting) was displayed for a minimum of twelve seconds before participants could click to proceed. The sixteen “I am <name>. I can <ability>” agents were displayed in random order on separate screens for a minimum of five seconds. The story ending (running home) was displayed for a minimum of six seconds.

The to-be-recalled materials were the names and abilities of the sixteen agents. Half of the agents had a counterintuitive ability and half had an intuitive ability. Specifically, half breached a single folk-knowledge expectation in the ontological category of ‘persons’ (Barrett, 2008a), giving them a counterintuitiveness score of 1 in Johnson et al.’s (2010) classification system (i.e., they were MCI). The eight counterintuitive abilities and eight intuitive abilities were drawn from Chapter 2 (Table 2) and differed in terms of intuitiveness (M = 1.41, SD = .33; M = 5.58, SD = .32; t = 25.77, p < .001). Having the agents interact within a social context was intended to reinforce intuitive expectations about the psychological functioning of the agents, allowing further inferences to be drawn that may contribute to the MCI effect (Atran & Norenzayan, 2004; Boyer & Ramble, 2001).

A filler task, used as a distraction prior to memory testing, required participants to find missing objects in twenty pairs of nearly identical pictures (Harvard Visual Attention Lab, 2016). The choice of a pictorial distraction was intended to prevent any priming of the semantic recall materials. Participants were given four minutes to complete as much of the filler task as they could.

Memory was tested in two ways: free recall of agent’s abilities (and the agents associated with them), and a recognition task to match names with abilities. Participants were not told beforehand that their memory would be tested. In the free recall task, participants were presented with the instructions:

“We would now like you to think about the short story you read earlier about Mr. Klorp's visit to the temple.

In the space below, try to list the abilities of the characters who were meeting secretly in the back room of the temple. List all the abilities you can remember. For each ability, if you can remember the name of the character associated with that ability, write that character's name next to it. If you cannot remember the character's name, just list the ability. Use a separate line for each ability-character pair.
You have four minutes. The survey will advance automatically after four minutes has gone by. It's important to us that you spend all of this time thinking about the story and listing what you can remember.”

Participants typed their answers into a text box. After four minutes, the survey automatically directed them to the recognition task. This had no time restriction and included the following instructions (abilities and character names were listed in the same order for all participants):

“Below is a list of abilities for characters from the short story about Mr Klorp’s visit to the temple. Based on what you can recall from the story, please select characters from the drop down menus that you think match those abilities. Each ability should be matched with a different character. When you’ve finished, please click the next button to proceed.”

**Design and Procedure**

The study, described as a survey about “perceptions of people and objects,” was administered in the Qualtrics survey environment and completed online. After providing written informed consent, participants were randomly allocated to the anxious or non-anxious condition and, independently, to the encoding or retrieval condition. The ordering of tasks within these conditions is shown in Figure 8. Thus, the retrieval conditions were identical to the encoding conditions, except that the anxiety manipulation immediately preceded the memory tasks.

**Figure 8.** Procedure in the encoding and retrieval conditions.

After the initial recall and recognition tasks (completed after the filler), participants were administered an attention check, requiring that they read to the end of the question to
know which answer to give. Prior to being partially debriefed\textsuperscript{16}, participants were asked if they used “any visual aids, such as a copy of the 40 abilities, which were used to help you during the memory test”.\textsuperscript{17} After three weeks, all participants were contacted about performing a follow-up survey, for which they were paid US$1. They were given one week to complete the survey, in which their memory was tested in the same way, before being fully debriefed.

Results

Twenty-seven participants were excluded from the analysis: 4 failed the attention check, 11 admitted to using visual aids, 10 did not understand or attempt to complete the free recall task, and 2 failed more than one of these criteria. As mood effects are time-dependent, a further 41 participants were excluded for spending more than 2 SD above the mean time to progress between any two consecutive blocks (manipulation, story, and memory). Given differences between the induction procedures, the encoding and retrieval conditions were considered separately in the following analyses of memory.\textsuperscript{18}

Participants rated their mood as more unpleasant\textsuperscript{19} in the anxiety conditions (M = 8.16; SD = 1.16) than in the control conditions (M = 2.33; SD = 1.46), F(1,339) = 1675.37, p < .001, confirming the success of the manipulation. There was no main effect of induction (encoding versus retrieval; p = .863) and no interaction between anxiety and induction (p = .865).

Short-Term Memory

The free recall data were scored as in Chapter 2, except that both raters scored all of the data, with an Interrater reliability of 91%; average scores were used in the following analyses. On the free recall task, the mean score for abilities was 5.68 points (SD = 2.72) out of a possible 16 (36%) and for pairs (names correctly paired with an ability) it was 1.36 points (SD = 2.35) out of 16 (9%). On the recognition task, the mean score was 4.42 (SD = 3.97) out of 16 (28%).

\textsuperscript{16}The hypotheses were not revealed at this point.
\textsuperscript{17}They were assured payment regardless of their answer.
\textsuperscript{18}For the retrieval procedure, the time between seeing the recall materials and recalling them was longer due to the inclusion of the anxiety manipulation. As the MCI effect is expected to intensify with time, this would likely lead to a more intense effect following the retrieval procedure, which may obscure the predicted effect – that anxiety during the encoding procedure will intensify the MCI effect relative to the other conditions.
\textsuperscript{19}Unpleasantness (i.e., negative affect) is a product of anxiety (and motivator for later regulation strategies). More extensive manipulation checks were not used as the procedure is time dependent, and Pacheco et al. (2010) had confirmed the manipulation produces anxiety.
Free recall scores in the encoding condition were submitted to a 2 (anxiety) x 2 (counterintuitiveness) mixed model ANOVA, with the second factor treated as a repeated measure. There was a main effect of counterintuitiveness on memory, with counterintuitive abilities (M = 3.37; SD = 1.60) recalled better than intuitive abilities (M = 2.37; SD = 1.50), confirming an MCI effect for these materials, F(1,166) = 57.76, p < .001, r = .51. There was no main effect of anxiety on memory (p = .479). There was a significant interaction between counterintuitiveness and anxiety, F(1,166) = 3.89, p = .050, r = .15, with the MCI effect being more intense for anxious participants (see Figure 9), although the MCI effect remained significant in both conditions (both p < .001).

![Figure 9](image_url)

**Figure 9.** Recalled counterintuitive and intuitive abilities in anxiety and control conditions.

This analysis was repeated with pair scores (i.e. agents correctly paired with their abilities) as the dependent measure. As participants could only score on this task if they had recalled the agent’s ability (making counterintuitive pairs more likely), pair scores were normalized by using the percentage of counterintuitive (or intuitive) abilities paired with a correct name. There was a significant main effect of counterintuitiveness on memory, F(1,151) = 6.25, p = .013, r = .20. Intuitive abilities were paired with a correct name 24% of the time (M = .24, SD = .36). Counterintuitive abilities were paired with a correct name 18% of the time (M = 0.18, SD = .28). There was no main effect of anxiety (p = .234) and no interaction (p = .700).
Repeating this analysis with recognition task scores as the dependent measure also revealed that intuitive agents (M = 2.24; SD = 2.14) were remembered better than counterintuitive agents (M = 2.04; SD = 1.97), but this effect was only marginally significant (p = .082). There was no main effect of anxiety (p = .590) and no interaction (p = .427).

The same analytic strategy was used in the retrieval condition. Once again, there was a main effect of counterintuitiveness on memory, with counterintuitive abilities (M = 3.38; SD = 1.68) recalled better than intuitive abilities (M = 2.25; SD = 1.64), confirming an MCI effect, F(1,173) = 75.28, p < .001, r = .55. There was no main effect of anxiety on memory (p = .261) and no interaction between counterintuitiveness and anxiety (p = .944). The analysis of pair scores revealed a significant main effect of counterintuitiveness on memory, F(1,155) = 10.48, p = .001, r = .25. Intuitive abilities were paired with a correct name 28% of the time (M = .28; SD = .41). Counterintuitive abilities were paired with the correct name 19% of the time (M = .19; SD = .30). There was no main effect of anxiety on memory (p = .487) and no interaction (p = .586). The analysis of the recognition task revealed no significant effects.

**Long-Term Memory**

After between 3 and 4 weeks, 249 (73%) participants completed the memory tests again in a follow-up survey. This return rate did not differ as a function of anxiety condition (p = .842), induction procedure (p = .816), or their interaction (p = .128). On the free recall task, the mean score for abilities was 2.45 (SD = 1.90) points out of 16 (15%). Pairs were not analyzed as the mean score was 1%, with 95% of participants failing to recall any pair accurately. On the recognition task, the mean score was 1.65 (SD = 2.19) out of 16 (10%).

Data were analyzed as described above. For the encoding condition, there was a main effect of counterintuitiveness on free-recall of abilities, with counterintuitive abilities (M = 1.59; SD = 1.33) recalled better than intuitive abilities (M = .81; SD = 1.13), F(1,121) = 35.70, p < .001, r = .48. There was no main effect of anxiety on memory (p = .639) and no interaction (p = .735). Repeating this analysis with recognition task scores as the dependent measure revealed no significant effects.

For the retrieval condition, there was a main effect of counterintuitiveness on free recall of abilities, with counterintuitive abilities (M = 1.73; SD = 1.22) recalled better than intuitive abilities (M = .77; SD = 1.06), F(1,124) = 60.46, p < .001, r = .57. There was no main effect of anxiety on memory (p = .590) and no interaction (p = .412). Repeating this analysis with recognition task scores as the dependent measure revealed a main effect of counterintuitiveness on memory, with intuitive agents (M = .90; SD = 1.30) remembered...
better than counterintuitive agents (M = .73; SD = 1.17), F(1,124) = 4.12, p = .044, r = .18. There was no main effect of anxiety on memory (p = .542) and no interaction (p = .898).

**Rate of Forgetting**

The fraction of counterintuitive and intuitive abilities forgotten between the two time periods (rate of forgetting) was calculated for each participant and submitted to a 2 (anxiety) x 2 (counterintuitiveness) mixed model ANOVA, with the second factor treated as a repeated measure. In the encoding condition, there was a main effect of counterintuitiveness on rate of forgetting, with counterintuitive abilities forgotten slower (M = .45; SD = .66) than intuitive abilities (M = .69; SD = .39), F(1,115) = 11.40, p = .001, r = .30. There was no main effect of anxiety (p = .922), and no interaction (p = .503). Similarly, in the retrieval condition, there was a main effect of counterintuitiveness on rate of forgetting, with counterintuitive abilities forgotten slower (M = .44; SD = .48) than intuitive abilities (M = .62; SD = .67), F(1,110) = 4.85, p = .030, r = .21. There was no main effect of anxiety (p = .445), and no interaction (p = .914). Repeating these analyses with rate of forgetting on the recognition task revealed no significant effects.

**Discussion**

In this study, I asked if an expected recall bias for counterintuitive abilities over intuitive abilities (an MCI effect) would be more pronounced for anxious individuals than for non-anxious individuals. Consistent with previous research (for a review: Purzycki & Willard, 2016), counterintuitive abilities were free-recalled better than intuitive abilities overall, and were retained better over a three week period. As predicted, the recall advantage for counterintuitive abilities was stronger when participants were anxious at the time they encoded them. In contrast, the effect did not depend on participants’ mood at retrieval. This difference is consistent with existing research on the cognitive effects of anxiety at encoding and retrieval (reviewed in Robinson et al., 2013). The findings thus support a model in which anxious individuals exhibit hypervigilance and ABT (Eysenck, 1997), facilitating the encoding of threatening information, but distracting from the retrieval of information that has already been encoded.

Interestingly, the MCI effect was not evident in a recognition task that asked participants to match these abilities with the name of the agent. However, the free recall of names paired with abilities also failed to produce an MCI effect. Instead, intuitive agents
(name + ability) were recalled better for short term free recall (encoding and retrieval procedures), long-term recognition (retrieval procedure), and marginally for short term recognition (encoding procedure). This was unexpected as Banerjee et al. (2013) had found an MCI effect for nouns paired with counterintuitive descriptions. The present results may be due to a ‘narrowing of attention’ effect (e.g., Erdelyi & Applebaum, 1973), in which attentional capture by an emotionally salient item (e.g., an MCI ability) resulted in diminished processing of less salient surrounding items (e.g., a name). Thus, these findings cannot confirm that recognition tasks are unable to produce MCI effects. Confirmation would have indicated greater agreement with the anxious recall bias, which is reliably observed for free recall tasks, but not for other tasks such as recognition, word-completion, and lexical-decision (Herrera et al., 2017; Mitte, 2008). A more compatible and fruitful recognition task might have involved asking participants to select the abilities they observed from a longer list, containing a number of abilities not in the story, without any consideration of names.

Despite no differences in rate of forgetting between conditions, no significant intensification of the MCI effect by anxiety remained after three weeks. This might be expected, as retention over longer periods may be more related to trait anxiety, which should permit greater representation of experienced threats within threat schemas (Eysenck, 1997). However, retention may depend on consistency with threats already in those schemas (i.e. self-relevance; Saunders, 2013). Alternatively, emotion regulation strategies may favor distortions of the stimuli, resulting in false recall. Although the MCI effect may not seem applicable to religion unless it persists over time, other factors, such as interpretive biases produced during emotion regulation, may guide a progressive distortion of encoded stimuli. Anxious individuals may be particularly likely to deploy these strategies to mitigate anxiety, gradually eliminating MCI effect intensification for the original recall materials. As described in Chapter 1, these distortions may be important precursors to belief, and this possibility is explored in more detail in Chapter 5.

While this study supported the main hypothesis – that anxiety intensifies the MCI effect – it requires replication, extension, and the consideration of several problems with the manipulation. For example, some of the anxiety statements and pictures depicted threats caused by other people (e.g., physical assault); others did not (accidents, diseases). Some were self-relevant threats (personal injury); others were other-relevant threats (pictures of sick children). Some concerned death; others concerned only physical harm. Furthermore, some images may have evoked emotions other than anxiety, such as disgust, which does not necessarily produce anxiety (Marzillier & Davey, 2005).
In sum, some of these factors may have contributed more to the MCI effect than others. For example, self-relevant threats should be more likely to produce consistently high levels of experienced anxiety, while other-relevant threats (e.g., a suffering child) may be less relevant for some participants (i.e., if they don’t have children). Additionally, the threat of death might be perceived as more serious than the threat of physical harm, both in the level of experienced anxiety, and the perceived need for divine intervention to facilitate its avoidance (i.e., via a counterintuitive agent). Indeed, many of the “comfort theories” reviewed in Study 1 concerned the threat of death, implicating MCI agents. Similarly, impersonal threats (not caused by other people) may be perceived as more likely than interpersonal threats to have been caused by MCI agents. Many such agents are represented as bodiless entities that interact with the world through unknown means (Bering, 2006; Norenzayan, 2013). These predictions will be tested in Study 4.

Despite the broadness of the manipulation, it nevertheless excluded another type of anxiety: social anxiety, which may also intensify the MCI effect. Thus, before disentangling the conflated variables in the present manipulation (Studies 3 and 4), the potential limits of this intensification effect should be determined. The next study therefore investigated the effect of social anxiety on recall for counterintuitive and intuitive agents.

**Study 2**

The goal of this study was to determine if the effect of anxiety on the MCI effect would replicate when social anxiety, rather than physical anxiety, was manipulated. As social anxiety principally concerns a fear of evaluation that is inherently self-relevant, interpersonal, and separable from disgust (Teale Sapach et al., 2015), it could be investigated without conflating the variables discussed in the previous discussion.

**Method**

**Participants**

From the University of Otago psychology department, 119 undergraduate students (93 female, 26 male) participated in exchange for course credit. Their average age was 20.3 years (SD = 4.1); 46 identified with a religion (of which 74% were Christian) and 73 identified as “agnostic”, “atheist”, or “none”.

**Materials and Procedure**

The procedure was identical to that of Study 1, except that a different manipulation was used; eliciting social anxiety and a different (overlapping) set of abilities were used. In addition, given the observed effects in Study 1, anxiety was manipulated only at encoding, and the memory tests were not repeated after three weeks. Participants completed the study, described as about “Understanding texts and images”, in groups of 1-10 in a university computer lab.

The experimental manipulation involved an uncertain social threat that has produced anxiety and negative affect characteristic of goal conflict in previous studies (for a summary see: McGregor et al., 2010). The threat took the form of seven difficult-to-understand paragraphs about statistics that were designed to make participants’ academic goals appear less achievable. Conversely, the control condition provided easy to understand paragraphs about how statistics can be useful in the social sciences. Examples of these paragraphs are shown in Figure 10.

![Figure 10](screenshots.png)

*Figure 10. Screenshots of paragraphs from the anxiety (top) and control condition (bottom).*

Before reading the paragraphs, participants in the anxiety condition were asked to “write a few sentences about your long term academic plans. What do you hope to achieve with your studies? What do you expect this achievement will lead to?” by typing their answer into a text box. They were then given the following instructions:
“The next few screens contain a passage from a popular psychology textbook for undergraduates. The passage outlines a statistical procedure called Linear Structural Relations, or LISREL. LISREL is a very useful tool for analyzing causal relations among psychological variables.

We are interested in assessing how understandable it is to you, and how this relates to your personality and demographics. Please take your time to read and understand each passage. On each screen you will answer how well you understand it. Please try your best.”

Participants rated how understandable they found each of the paragraphs on a five-point scale from “not at all understandable” to “extremely understandable”. After rating each of the seven paragraphs, they were shown the whole text and given the following instructions:

“Thank you for submitting your responses. The passage you read is shown below. We'd now like you to take 4 minutes to demonstrate your understanding of the passage. Please use the box below to summarize the passage in your own words as best you can. The survey will advance automatically after 4 minutes has gone by.”

Participants in the control condition followed the same procedure, except they were asked to “write a few sentences about what you plan to do with your free time in the coming weeks and months. What experiences do you hope or expect to have?” and they were introduced to the control condition paragraphs with the following instructions:

“The next few screens contain a passage from an introductory statistics text. The passage outlines reasons why statistics can be useful in the social sciences.

We are interested in how understandable it is to you. Please take your time to read and understand each passage. On each screen you will answer how well you understand it. Please try your best.”

After rating the paragraphs for understandability, they were given the following instructions about summarizing the text:

“Thank you for submitting your responses. The passage you read is shown below. We'd now like you to take 4 minutes to summarize the passage. Please use the box below to summarize it as best you can. The survey will advance automatically after 4 minutes has gone by.”

The same story and instructions from Study 1 were used, but with a different set of eight counterintuitive abilities and eight intuitive abilities, drawn from Chapter 2 (Table 2), that differed in terms of intuitiveness (M = 1.36, SD = .38; M = 5.80, SD = .42; t = 22.39, p < .001). The following abilities were used:
“I am Tristan. I can remove my head and reattach it.”
“I am Katrina. I can make many kinds of poison.”
“I am Beatrix. I can raise the dead and command them.”
“I am Oliver. I can steer a boat better than anyone.”
“I am Marissa. I can give birth to different species of animal.”
“I am Jared. I can barely contain my violent sexual urges.”
“I am Hector. I can transform myself into a monster.”
“I am Benedict. I can read dozens of newspapers in a month.”
“I am Quentin. I can evaporate when I feel heavy.”
“I am Philippa. I can steal almost anything from anyone.”
“I am Cordelia. I can disintegrate any object I touch.”
“I am Eleanor. I can draw realistic pictures of animals.”
“I am Camilla. I can answer any question because I know everything.”
“I am Tobias. I can rule more harshly than the worst dictator.”
“I am Sebastian. I can directly control other people's minds.”
“I am Theresa. I can teach young children science at my school.”

Results

Three participants were excluded from the following analyses: 2 failed the attention check and 1 admitted to using visual aids. The anxiety condition was rated less understandable (M = 18.14; SD = 4.53) than the control condition (M = 27.28; SD = 4.62), t(114) = -10.764, p < .001, r = .71, partially validating the manipulation.

The free recall data were scored as in Study 1. There was no second coder. On the free recall task, the mean score for abilities was 6.69 points (SD = 2.16) out of 16 (42%) and for pairs (names correctly paired with an ability) it was 1.85 points (SD = 2.35) out of 16 (12%). On the recognition task, the mean score was 5.70 (SD = 4.07) out of 16 (36%).

Free recall scores were submitted to a 2 (anxiety) x 2 (counterintuitiveness) mixed model ANOVA, with the second factor treated as a repeated measure. There was a main effect of counterintuitiveness on memory, with counterintuitive abilities (M = 3.54; SD = 1.39) recalled better than intuitive abilities (M = 3.15; SD = 1.44), confirming an MCI effect for these materials, F(1,114) = 5.28, p = .023, r = .21. There was no main effect of anxiety on memory (p = .949) and no interaction between counterintuitiveness and anxiety (p = .435; Figure 11).

This analysis was repeated with pair scores as the dependent measure (normalized by converting to percentages as described in Study 1). There was a significant main effect of
counterintuitiveness on memory, $F(1,108) = 11.55, p = .001, r = .31$. Intuitive abilities were paired with a correct name 32% of the time ($M = .32; SD = .38$). Counterintuitive abilities were paired with a correct name 21% of the time ($M = .21; SD = .30$). There was a main effect of anxiety on memory, $F(1,108) = 5.83, p = .017, r = .23$, with memory significantly better in the anxiety condition ($M = .33; SD = .32$) than in the control condition ($M = .20; SD = .26$). There was no interaction between counterintuitiveness and anxiety ($p = .960$).

The analysis was repeated again with recognition scores as the dependent measure. There was a significant main effect of counterintuitiveness on memory, $F(1,114) = 12.53, p = .001, r = .31$, with intuitive agents ($M = 3.14; SD = 2.30$) remembered better than counterintuitive agents ($M = 2.56; SD = 2.13$). There was no main effect of anxiety on memory ($p = .151$) and no interaction ($p = .874$).

### Figure 11. Recalled counterintuitive and intuitive abilities in anxiety and control conditions.

### Discussion

This study sought to replicate and extend the key finding from Study 1: that anxiety intensifies the MCI effect. As is evident from Figure 11 (and its comparison to Figure 9), the study failed as a replication – the MCI effect did not differ by experimental condition ($p = .435$). At first glance, these results indicate that either Study 1 is not replicable or social anxiety does not produce the predicted effects.
However, there are other explanations. For example, it’s possible that the manipulation made participants feel like they were being tested, such that, when instructed to read a story “carefully”, they expected to have their memory for the story tested. Being in a test environment (i.e., completing the study in silence with a group of other students) may have contributed to this feeling. A previous study in which participants expected a memory test showed no memory bias for counterintuitive items (Porubanova et al., 2014). As we don’t usually encounter information with a conscious motivation to memorize it, such studies have little external validity. Test-expectant participants may be more likely to apply their attention uniformly to all items, encode the items as a word list, assess syntactic rather than semantic content, and recall sequences of items that favor no particular class of item. Indeed, the motivation to be “accurate” can reduce other cognitive biases (for a review: Kunda, 1990). In support of this explanation, the MCI effect (.21) was smaller than in Study 1 (.51 and .55), although it did not completely disappear. It’s unclear how test-expectancy might have interacted with condition, although greater difficulty in the anxiety condition may have intensified test-expectation, resulting in the (non-significant) reduction of the MCI effect observed (Figure 11). This may have led to increased effort, which is supported by anxious participants recalling more items than control participants in all three memory tasks, although significantly only for the pairing data.

Another possibly is that anxiety triggered by a goal-conflict directs cognitive resources towards stimuli that were not in the recall materials. Anxiety typically precipitates a ‘bottom up’ search of the environment, with selective attention for whatever potentially threatening stimuli are found (Eysenck, 1997; Eysenck et al., 2007), but anxiety triggered by goal-conflict may precipitate a more introspective, internal search of memory, with selective attention for potentially threatening social consequences concerning the discrepancy between future goals and current status (Saunders, 2013; Segerstrom, Tsao, Alden, & Craske, 2000).

Similarly, it may be that social anxiety only directs attention to external stimuli when those stimuli are socially threatening, and the recall materials may not have contained threats of this kind. Previous studies have found that physical anxiety sensitivity predicted attention to physically threatening words, but not socially threatening words (Hunt, Keogh, & French, 2006; Keogh, Dillon, Georgiou, & Hunt, 2001), and that the opposite is true for social anxiety sensitivity (Asmundson & Stein, 1994), although some studies have found social anxiety predicts no external biases for attention (Mansell, Ehlers, Clark, & Chen, 2010) or recall (Foa et al., 1989).

It’s therefore possible that participants in this study exhibited no biases toward external threatening stimuli, or a bias for socially threatening stimuli other than those in the
recall materials. As a test of this possibility, Studies 3 and 4 developed a new manipulation designed to induce different types of anxiety and used it to re-examine the hypotheses tested in Studies 1 and 2.

**Study 3**

This study tested the effectiveness of a new manipulation, based on the method in Study 1, but designed to induce different types of anxiety (social, physical, and death), for use in Study 4. As noted in the discussion of Study 1, the anxiety manipulation in that study, while effective according to the manipulation check, involved several types and sources of anxiety (e.g., physical and death), only some of which may have intensified the MCI effect. Indeed, Study 2 found that a form of social anxiety, while not part of Study 1, did not intensify the MCI effect.

Thus, to better control the source and nature of induced anxiety, a new manipulation was developed that targeted social, physical, and death anxiety specifically. Physical and death conditions were further distinguished by whether they involved interpersonal or impersonal threat (in the social domain, fear of evaluation is central and inherently interpersonal; Teale Sapach et al., 2015). This design leverages the fact that the discreteness of emotional states depends largely on the situations for which they are responses (Clore & Huntsinger, 2009), with neurocircuitry that differs between, for example, social and physical domains (Wilson-Mendenhall, Barrett, Simmons, & Barsalou, 2011). Human agents appeared in every image in every condition (to avoid disproportionate agentic priming), all described threats were potentially self-relevant, and all conditions avoided disgust-inducing stimuli. A summary of the conditions appears in Table 5.

It was hypothesized that each of the manipulation’s anxiety conditions would produce a significant increase in reported state anxiety (compared to a control condition), and that the anxiety conditions would not differ from one another in the degree of anxiety they produce.

**Method**

**Participants**

A power analysis, using the effect size reported by Pacheco-Unguetti et al. (2010) for the manipulation conditions used in Study 1, indicated that 180 participants would be required to obtain 80% power with p set to .05. Two hundred and twenty-one volunteers were
ultimately recruited from Mechanical Turk (97 female, 122 male, and 2 identifying as “other”) and paid US$.70. All were native English-speaking U.S. nationals currently living in the U.S. Their average age was 36.3 years (SD = 12.3); 128 identified with a religion (of which 94% were Christian); 89 identified as “agnostic”, “atheist”, or “none”; and 4 identified as “other” (e.g., spiritual).

**Materials**

The manipulation contained five anxiety conditions and one control condition. Each anxiety condition presented ten statements, on separate screens, designed to elicit anxiety by describing an uncertain future threat to the self in the form of an authoritative fact or statistic about the likelihood of a situation involving the threat occurring. The control condition had authoritative statements designed to minimize uncertain future threats. As shown in Table 5, between the six conditions, statements were distinguished by the type (social, physical, death) and cause (interpersonal/impersonal) of threat they described.

**Table 5.** Summary of statements used in the six manipulation conditions.

<table>
<thead>
<tr>
<th>Anxiety domain</th>
<th>Interpersonal?</th>
<th>Threat type</th>
<th>Situations described</th>
<th>Word count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social</td>
<td>Yes</td>
<td>Negative evaluation</td>
<td>Social interaction, performance, or visible symptoms of anxiety.</td>
<td>274</td>
</tr>
<tr>
<td>Physical</td>
<td>No</td>
<td>Personal injury</td>
<td>Chance accidents and fires, natural diseases, and environmental disasters.</td>
<td>268</td>
</tr>
<tr>
<td>Physical</td>
<td>Yes</td>
<td>Personal injury</td>
<td>Assault, rape, arson, medical malpractice, and human-caused accidents, diseases and climate change.</td>
<td>274</td>
</tr>
<tr>
<td>Death</td>
<td>No</td>
<td>Death (dying)</td>
<td>Chance accidents and fires, natural diseases, and environmental disasters.</td>
<td>269</td>
</tr>
<tr>
<td>Death</td>
<td>Yes</td>
<td>Death (dying)</td>
<td>Murder, terrorism, war, arson, medical malpractice, and human-caused accidents and diseases.</td>
<td>272</td>
</tr>
<tr>
<td>Control</td>
<td>n/a</td>
<td>None</td>
<td>Safety, contentment, goal achievement.</td>
<td>273</td>
</tr>
</tbody>
</table>

Similar to Study 1, after a statement had remained on screen for eight seconds, a negatively-valenced image appeared below to provide a visual depiction. It remained on screen, with the statement, for a further eight seconds before the next statement appeared.
Most of the sixty images (ten in each condition) were selected from the Nencki Affective Picture System (NAPS; Marchewka, Żurawski, Jednoróg, & Grabowska, 2014) with others from the Set of Fear Inducing Pictures (SFIP; Michalowski et al., 2017), the Warsaw Set of Emotional Facial Expression Pictures (WSEFEP; Olszanowski et al., 2015), and the IAPS (Lang et al., 1999). The image file names within each database are shown in Appendix B. Each image was displayed at a width of 770 pixels and contained at least one human agent.

Example statements [and images] based on these criteria are shown below for the six conditions. All of the statement-image pairings can be found in Appendix C.

- **Social.** The most commonly cited reason for the breakdown of relationships is “saying the wrong thing” and offending friends or family. [old man sitting alone]
- **Physical impersonal.** Scientists and geologists have never predicted a major earthquake. Multiple studies confirm it’s impossible to know when and where they will strike. [rescue workers digging through rubble]
- **Physical interpersonal.** Alcohol and drug-impaired drivers cause nearly half of all traffic accidents. It’s impossible to know when one will put you in harm’s way. [car accident]
- **Death impersonal.** The likelihood of developing cancer at some point in your life is 50%. There is no way to know who will die from it and who won’t. [sick man]
- **Death interpersonal.** The murder rate has been rising quicker than at any time in the last 25 years. Researchers say this is related to rising social and political tensions. [murder scene]
- **Control.** Relationship studies have shown that the affection we receive from those we love makes us feel safe, confident, and secure in our environment. [loving family]

State anxiety was measured with the 20-item state version of the State-Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983), which asks participants to rate from 1 (not at all) to 4 (very much so) the extent to which items such as “I feel secure” indicate how they “feel right now”.

**Procedure**

The study was administered in Qualtrics and completed online. Participants were presented with a survey about “perceptions of scientific studies in the media”. After providing written informed consent, participants completed the STAI, were randomly allocated to one of the six manipulation conditions, read the manipulation instructions (described in full in
Appendix C, and based on the Study 1 instructions), and completed the manipulation. Afterwards, they completed the STAI again and were debriefed.

**Results and Discussion**

Thirty-nine participants were excluded for inattention to one of the STAI scales (responded in less than 1 s per item; a criterion set a-priori). Seven further participants were excluded for inattention to the manipulation instructions (i.e., completed in less than 5 seconds).

To examine the effect of the anxiety conditions, average STAI scores were submitted to a 5 (anxiety condition) x 2 (pre/post manipulation) mixed model ANOVA, with the second factor treated as a repeated measure. Post-manipulation scores (M = 27.06; SD = 14.87) were significantly higher than pre-manipulation scores (M = 16.58; SD = 12.94), F(1,139) = 117.46, p < .001. There was no interaction with condition, F(4,139) = 1.25, p = .292. The change in anxiety was calculated for each condition (post minus pre score), and Dunnett’s post-hoc tests were used to compare each anxiety condition to control. All of the anxiety conditions significantly differed from control for (p < .01). Results are summarized in Figure 12.

![Figure 12](image)

**Figure 12.** Change in anxiety as a function of experimental condition. More positive values indicate a greater increase in anxiety post-manipulation.

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20 This was based on a qualitative analysis of completion times, which exhibited a bimodal distribution with a local minimum at 5 seconds, indicating behavioral differences (inattention) below 5 seconds.
In summary, the anxiety conditions all significantly increased anxiety, did not differ significantly from each other, and all differed significantly from control. The manipulation therefore appeared suitable for exploring the effects in Study 1 across social, physical, and death anxiety domains. Nevertheless, it should be stated that these domains were distinguished a-priori and may not be perceived entirely as intended by participants. This was necessitated by a lack of state anxiety scales for the various domains.

**Study 4**

In this study, I sought to replicate the effect of anxiety on the MCI effect, reported in Study 1, using the anxiety manipulations developed in Study 3. As in Study 1, an overall MCI effect was hypothesized, with anxiety manipulations (at encoding) intensifying the effect. In line with predictions made in Study 1 (Discussion), I also expected greater intensification when anxiety was produced by impersonal versus interpersonal threats, as the former more easily afford counterintuitive attributions (e.g., divine intervention). Finally, I expected the greatest intensification for anxiety involving threat of death, which is the threat most likely to require a counterintuitive solution. The results will paint a more nuanced picture of how anxiety relates to the MCI effect, as well as speak to potential confounds in Studies 1 and 2.

**Method**

**Participants**

A power analysis using the effect size found in Study 1 indicated that 492 participants would be required to obtain 80% power with \( p \) set to .05. Five hundred and sixty one volunteers were ultimately recruited from Mechanical Turk (325 female, 235 male, and 1 identifying as “other”), and paid US$1. All were native English-speaking U.S. nationals currently living in the U.S. Their average age was 38.6 years (SD = 12.6); 291 identified with a religion (of which 93% were Christian); 262 identified as “agnostic”, “atheist”, or “none”; and 8 identified as “other” (e.g., spiritual).

**Materials and Procedure**

The method was identical to that used in the encoding conditions of Study 1, except that participants were randomly assigned to one of the six conditions developed in Study 3.
(see also Appendix C). Additionally, only the free recall task was used to assess memory, and there was no three-week follow-up. Finally, Study 1’s attention check was removed due to relatively few failures in recent studies in our lab.21

**Results**

Sixty-nine participants were excluded from the analysis: 33 spent more than 2 SD above the mean time to progress between two of the manipulation, story, and memory blocks, 2 did not understand or attempt to complete the free recall task, 21 admitted to using visual aids, and 13 failed more than one of these criteria.

A planned contrast confirmed that participants in the five anxiety conditions (M = 6.50; SD = 1.93), rated their mood as more unpleasant than in the control condition (M = 2.28; SD = 1.28), t(146.57) = 25.75, p < .001, confirming the success of the manipulation.

The free recall data were scored as in Study 1, with an interrater reliability of 93%. The mean recall score for abilities was 5.61 points (SD = 2.64) out of a possible 16 (35%). A repeated measures ANOVA confirmed an MCI effect, with counterintuitive abilities (M = 3.26; SD = 1.67) recalled better than intuitive abilities (M = 2.35; SD = 1.49), F(1,491) = 134.21, p < .001, r = .46.

To determine if anxiety intensified the MCI effect, the difference between recalled counterintuitive and intuitive abilities was calculated for each participant and used as a measure of the MCI effect (plotted in Figure 13). A planned contrast confirmed that the five anxiety conditions (M = .99; SD = 1.71) produced a significantly more intense MCI effect than the control condition (M = .52; SD = 1.83), t(486) = 2.26, p = .024, r = .10.

Omitting the control condition, a one way ANOVA found no difference in MCI effect intensity among the anxiety conditions (p = .820). A planned contrast comparing the three interpersonal conditions to the two impersonal conditions found no difference in MCI effect intensity (p = .533). A planned contrast comparing the death anxiety conditions to the other anxiety conditions also found no difference in MCI effect intensity (p = .586).

Finally, negative affect was used to predict the MCI effect, independent of the experimental manipulation. The correlation was weak but positive, r = .11, p = .015, such that the bias to recall counterintuitive information was greater for participants who felt more unpleasant.

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21 This may be due to participant familiarity with the check. It has been used in dozens of Mechanical Turk studies since Study 1 was completed.
Discussion

This study replicated the main finding from Study 1, such that anxiety experienced at encoding intensifies the bias to remember counterintuitive concepts, both when anxiety was manipulated and when it was measured (as negative affect). The intensification was robust across a range of factors, such as anxiety type (social, physical, death), and anxiety cause (impersonal, interpersonal), supporting an argument that the conflation of these variables in Study 1 did not matter to the result, and that Study 2 may not have been a reliable measurement of the effects of social anxiety. However, these results did not support the prediction that greater MCI effect intensification occurs when MCI agents can be more easily associated with the causes of and/or solutions to the threats presented in the anxiety conditions. Rather, the robustness across domains and the general correlation with negative affect (i.e. unpleasantness) suggests the results can be interpreted in terms of general, bottom-up, cognitive biases for threat detection, rather than through more evaluative processes, although this is discussed in more depth in the General Discussion.
**General Discussion**

Cognitive scientists have failed to establish an adaptive rationale for the favored recall of concepts that minimally violate our intuitions (the “MCI effect”), or to isolate the importance of the MCI effect to religious belief, while social scientists have failed to delineate processes through which anxiety can lead to belief in these concepts. Across four studies, I asked if anxiety-related cognitive biases for threat detection can intensify the MCI effect, potentially increasing the likelihood of subsequent belief among anxious individuals. In Study 1, anxiety elicited prior to encoding (but not prior to retrieval) intensified the MCI effect relative to a control condition, although this relative intensification did not remain after three weeks, and the anxiety condition conflated several kinds of anxiety. Study 2 determined that a form of social anxiety did not intensify the MCI effect, although the Study 2 manipulation may have been confounded by minimized or inwardly directed cognitive biases. Study 3 developed a new anxiety manipulation for use in Study 4, distinguishing social, physical, and death anxiety caused by impersonal or interpersonal threats, and found that the conditions produced similar levels of state anxiety (beyond that of a control condition). Study 4 applied the new manipulation in a replication of Study 1, finding consistent intensification of the MCI effect across anxiety domains, correlated with experienced negative affect. This suggested that the Study 1 results were not affected by a conflation of anxieties, that Study 2 did not fail because it manipulated social anxiety, and that anxiety-related biases do not depend on situational context.

Taken together, these findings support a mood congruent encoding effect, in which anxious individuals selectively encode MCI agents because the potential threat they afford is congruent with their anxious mood. Conversely, a mood congruent retrieval explanation, in which access to memories about potentially threatening MCI agents is enhanced in an anxious mood, was not supported (Study 1). This is in line with theories that relate experienced ‘state’ anxiety to increased use of stimulus-driven, ‘bottom-up’, attentional systems (e.g., Attentional Control Theory; Eysenck et al. 2007) that aid in the encoding of new stimuli, but may distract from the retrieval of already encoded stimuli (Robinson et al., 2013). The implication of these systems in the findings is supported by MCI effect intensification appearing consistently across anxiety domains and being correlated with reported negative affect (Study 4). Indeed, this suggests participants did not evaluate MCI agents in terms of whether they might cause or be a solution to the threats presented during the prior manipulation. However, it may be that participants evaluated MCI agents as equally relevant to all anxiety conditions, or the anxiety manipulation did not adequately distinguish the domains (the a priori distinction could not be
empirically validated). Nevertheless, these findings from Studies 1 and 4 suggest the observed MCI effect intensification occurred independently of context (or outcome), via simple attentional biases, rather than via an interpretive bias that associated the agent’s threatening features with particular fitness relevant outcomes. This remains consistent with the findings from Chapter 2 and suggests that anxiety directs cognitive resources towards the threatening features of MCI agents, but probably does not implicitly generate fitness relevant outcomes beyond what is explicitly stated in the recall materials.

To better support a claim of mood congruent MCI effects, as well as the assumption that these counterintuitive agents were comparable to religious gods, one might expect well-known gods to actually elicit anxiety as a result of being threatening. This is supported by a number of studies described in Chapter 1 (Bering et al., 2005; Shariff & Norenzayan, 2007; Toburen & Meier, 2010). In the next chapter, the threat potential of well-known gods is also explored.

One contradictory finding in the current set of studies was the potential for social threats to enhance the MCI effect. Although socially threatening information produced such an effect (albeit weakly) in Study 4, a different manipulation failed to differ from a control condition in Study 2. As noted in the Discussion of Study 2, the failure could be explained by participants’ anticipation of the memory test, although another possibility is that the manipulation, in generating a goal conflict, biased attention and recall towards internal states, such as persistent worries about whether goals could be achieved, rather than to external stimuli. In general, rumination (repetitive negative thoughts) linked to anxiety is thought to arise from goal interruption (Segerstrom et al., 2000), and Eysenck (1997) has detailed several examples of how cognitive biases may be turned inward – to one’s own behavior, physiological states, and cognitions. For example, Eysenck and Derakshan (1997) found that high trait-anxious individuals were more pessimistic than low-anxious individuals about future examination performance. Butler and Mathews (1987) obtained the same result, but also revealed that pessimism was greater one day before the exam than one month before, suggesting greater state anxiety led to greater focus on negative outcomes. In these scenarios, the exam represented an anxious goal-conflict – threatening the achievement of future academic goals – that, rather than focusing attention on external stimuli, focused attention on internally-generated negative outcomes to do with failing the exam. The manipulation in Study 2, in making academic goals appear less achievable, bore many similarities to this example, and may therefore have inhibited cognitive biases for the external recall materials.

In Study 1, the persistence of MCI effect intensification was investigated over a longer time period. Although there was no difference in rate of forgetting between conditions, no
significant intensification related to state anxiety at encoding persisted after three weeks. It may be that retention over longer periods is related more to trait anxiety, but this might only be the case if the counterintuitive material is consistent with existing threat schemas (Saunders, 2013; Walsh et al., 2015). Regardless, in real world scenarios, anxiety may persist or reoccur for longer time periods than what was produced by our manipulations, ensuring persistent MCI effect intensification. Another possibility is that emotional control mechanisms favor distortions or transformations of the material. This could answer a question that has thus far been ignored in these studies: if counterintuitive agents are initially perceived as threatening, scary beings, then how and why do individuals end up believing in them, and why do many believers consider their gods kind, loving, benevolent entities (Kirkpatrick, 2005)? Perhaps what they end up believing is not what initially attracted their attention. These questions are explored in the next two chapters.

In summary, anxiety experienced prior to encountering information about counterintuitive agents was shown to temporarily improve memory for those agents. This process may therefore bias anxious individuals towards religious belief via an initial attraction to potentially threatening gods. This constitutes an early component in the proposed pathway from anxiety to religious belief (Chapter 1), addresses persistent questions in the cognitive and social studies of religion (such as how anxiety leads to religious belief, and why the MCI effect is important to that process), and highlights the benefits of pursuing an integrative approach to the study of religion. In the next chapters, the pathway from anxiety to religious belief is elucidated further, turning to the features of believable, counterintuitive agents, and to the individual differences that regulate threatening information about these agents.
Chapter 4

The Mickey Mouse Problem:
Distinguishing Religious and Fictional Counterintuitive Agents

Quantifying the Gods

Towards the end of the previous chapter, I asked why people would choose to believe in the existence of counterintuitive agents that afford considerable potential threat. There are many possible answers – perhaps religious believers are gluttons for punishment and self-sacrifice (Routledge & Arndt, 2008) – but this speculation isn’t particularly useful without knowing exactly what it is people believe. Many people clearly believe a lot more than the existence of a potential threat (Kirkpatrick, 2005).

Only after obtaining such a definition can I speculate about an appropriate mechanism for hypotheses 5 and 6 and the wider process of religious belief formation (see Chapter 1). Thus, in this chapter, I distinguish religious supernatural agents from their fictional counterparts, providing a solution to the “Mickey Mouse problem” (i.e., why are only some counterintuitive agents worshiped). In so doing, I test hypothesis 4 (Chapter 1): that religious agents are counterintuitive agents with content that facilitates implicit, interpretive, anxiety regulation strategies (such as motivated reasoning and repression).

The methods I employ deviate from theoretical approaches (e.g., Barrett, 2008b; Gervais & Henrich, 2010); instead asking how a god’s defining features can be empirically measured. I draw on variables established in Chapter 2, such as threat, beneficence, and tendencies to violate folk knowledge, to answer this and the larger questions of what defines a religious agent and what this definition tells us about the processes involved in religious belief.

(The following is a paper, of the same title as this chapter, submitted for publication in February 2019)\textsuperscript{22}

\footnote{\textsuperscript{22} This paper was written with my co-author and supervisor, Jamin Halberstadt. I devised the experimental design, analyzed the data, and wrote the first draft. Professor Halberstadt provided a supervisory role during the experiment with regards to framing questions appropriately and advising on analytical methods, and he contributed to later drafts of the paper, mainly with regards to structure of the paper and clarity of the arguments.}
Abstract

The Mickey Mouse problem refers to the difficulty in predicting which supernatural agents are capable of eliciting belief and religious devotion. We approached the problem directly by asking participants to invent a “religious” or a “fictional” agent with five supernatural abilities. Compared to fictional agents, religious agents were ascribed a higher proportion of abilities that violated folk psychology or that were ambiguous – violating nonspecific or multiple domains of folk knowledge – and fewer abilities that violated folk physics and biology. Similarly, participants rated folk psychology violations provided by the experimenter as more characteristic of religious agents than were violations of folk physics or folk biology, while fictional agents showed no clear pattern. Religious agents were also judged as more potentially beneficial, and more ambivalent (i.e., similar ratings of benefit and harm), than fictional agents, regardless of whether the agents were invented or well-known to participants. Together, the results support a motivational account of religious belief formation that is facilitated by these biases.

Introduction

The domain of counterintuitive agents includes all manner of gods, goddesses, superheroes, and cartoon characters with abilities and features that violate our intuitive or ‘folk’ expectations about the world (Barrett, 2008a). An omnipresent god would, for example, violate the ‘folk physics’ expectation that objects cannot be in several places at once. An immortal superhero violates the ‘folk biology’ expectation that all living things die. A talking mouse violates the ‘folk psychology’ expectation that animals cannot use language. These intuitive expectations about the features and behaviors of stimuli from various ontological categories (i.e., objects, living things, animals) are described as maturationally natural because they appear early in development and across cultural contexts (Carey, 2009; Sperber & Hirschfield, 2004; Wellman & Gelman, 1992). We implicitly apply them to our environment, such that any counterintuitive agent that violates them is likely to attract attention.

Prior research has shown that agents violating a minimal number of intuitive expectations (“minimally counterintuitive,” or MCI, agents) are typically remembered better than agents that either adhere to expectations, dramatically violate intuitive expectations, or only violate culturally-acquired expectations (Banerjee et al. 2013; Barrett, 2008a; Barrett &
As it could be argued that gods and goddesses are MCI agents, some authors have implicated the MCI effect in the development and pervasiveness of religion (Barrett 2004; Boyer, 2003; Lawson, 2012). Indeed, counterintuitive statements are rated more ‘religious’ than intuitive statements (Pyysärinen et al., 2003) and a minimal amount of such content may be an ideal condition for belief (Fondevila et al., 2012; Harmon-Vukic, 2016; Willard et al., 2016). Others, however, have asked why fictional agents such as Mickey Mouse and Santa Claus aren’t believed and worshiped to the same extent as gods, even though they are comparably counterintuitive (Atran, 2002). The “Mickey Mouse problem” thus came to describe the difficulty of current cognitive theories of religion to predict which MCI agents are more likely to be believed, and in turn become candidates for religious devotion.

Responses to the Mickey Mouse Problem have been limited in number and scope. Some authors suggest there is no way to distinguish the content of believable and unbelievable MCI agents, attributing religious belief instead to contextual conditions, such as conformity with cultural norms, mimicry of prestigious and authoritative individuals, and observation of costly displays of commitment that enhance the credibility of the performer’s beliefs (Cofnas, 2018; Gervais & Henrich, 2010; Gervais et al., 2011; Henrich, 2009; Lanman, 2012; McCauley & Cohen, 2010). This approach is unsatisfying, however, both because religious and nonreligious agents have not been systematically compared on dimensions other than their counterintuitiveness, and also because distinctions in terms of “context” only push back explanation one step. While context may be important for explaining which agent from a set of established religious agents is worshiped at a particular time and place (known as the “Zeus Problem”; Gervais & Henrich, 2010), it does not explain how contexts become established or favorable toward particular agents in the first place (Kirkpatrick, 2015; Sterelny, 2018; Swan, 2012).

Solving the Mickey Mouse Problem may therefore require a more thorough examination of the features of believable/worshiped and secular/fictional counterintuitive agents. Previous work has alluded to differences that might be important in this regard. For example, people tend to ascribe the Christian god analogical and abstract features (e.g., “God is love”; “God is the beginning and end”) that potentially violate multiple domains of folk expectations, but ascribe non-divine entities more concrete abilities that violate specific folk domains (e.g., “reads minds” only violates folk psychology; “teleports” only violates folk physics) (Harmon-Vukic, 2016). Indeed, an “all-seeing” god might achieve this feat through biological mutation, physical omnipresence, or psychological telepathy; a god that “is love” or “the beginning and end” might imply a physical transformation, or perhaps an absence of
other intuitive mental or biological processes. We call these nonspecific features and abilities that, nevertheless, appear to require a degree of counterintuitiveness, “ambiguous violations”. If common to gods, their role in religious belief may be to afford gods influence over a wider range of events than is possible for non-divine agents, and to allow individuals greater scope for interpretation and motivated reasoning about the causes and purposes of those events, including apparently disconfirming events (e.g., via appeals to God’s “mysterious ways”; Dunning et al., 1989; Kunda, 1990).

Harmon-Vukic (2016) also uncovered a second feature of religious agents: an interest in human affairs. Participants tended to assign God abilities, roles, and relationships that indicated a direct interest in people’s lives, such as inspiring emotions and playing a beneficent role as teacher, friend, or healer. Similarly, Pyysiäinen et al. (2003) found that counterintuitive statements were rated more “religious” than intuitive statements, especially when those statements involved agents interested in human affairs. Such an interest might suggest the importance of religious agents’ psychological abilities: agents that, for example, exist as disembodied minds (Bering, 2006), who have the ability to impose their will on individuals’ behavior (Bering, 2011), or are omniscient (Shariff & Norenzayan, 2007), may be better placed to influence human affairs than those who violate only physical (e.g., omnipresence) or biological (e.g., immortality) intuitions. Indeed, a number of studies have documented religious agents’ violations of folk psychological beliefs in particular (e.g., Barrett, Richert & Driesenga, 2001; Knight, Sousa, Barrett, & Atran, 2004).

Religious agents’ interest in human affairs may be seen in light of a more general principle: their relevance to human fitness. Religious agents may be encoded and, ultimately, worshiped, because they serve intelligible purposes (Cofnas, 2018), and perhaps represent a potential threat or benefit to human survival and/or reproductive prospects. In Chapter 2, we found that counterintuitive agents both pose a greater threat, and also offer greater opportunity (i.e., hold greater potential benefits) than intuitive agents, and it may be that fitness relevance further distinguishes religious and fictional agents.

In particular, the idea that potential benefits afforded by gods make them attractive targets for belief is reminiscent of the popular claim that emotional or motivational processes are key ingredients in religious belief (e.g., Nichols, 2004). Though largely ignored or criticized in cognitive theories of religion (Boyer, 2003), the claim is supported by a number of studies in which negative affective states seemingly motivate people to seek out comforting religious beliefs about beneficent, overseeing gods (Ellison et al., 1989; Gebauer et al., 2012; Gill & Lundsgaarde, 2004; Inzlicht et al., 2011; Jong et al., 2012; Kay et al., 2008; Legare & Souza, 2014; McGregor et al., 2010; Norenzayan & Hansen, 2006). If such “comfort theories”
are to be believed, religious agents should be perceived as more of a potential benefit than fictional agents.

Operationalizing fitness relevance in terms of an entity’s potential threat and potential benefit to human well-being, as opposed to a list of apparently fitness relevant criteria (e.g., “possesses socially strategic information” and “interacts with the human world”; Barrett, 2008b; Boyer, 2000; Sorenson, 2005), permits further predictions. For example, monotheistic gods are commonly described as ambivalent, warranting both love and fear (e.g., “What doth the Lord thy God require of thee, but to fear the Lord thy God, to walk in all his ways, and to love him”; Deuteronomy 10:12)), which might partially explain their cultural evolutionary success over polytheistic deities (Norenzayan, 2013), as well as fictional agents not worshiped by anyone, who appear to be more valenced. Thus, it may be that the most believable counterintuitive agents are those that are capable of both threatening and rewarding adherents.

In sum, there are both theoretical and empirical reasons to expect that the content of religious versus secular counterintuitive agents will differ systematically in ways that illuminate the process of religious belief formation. Specifically, we hypothesize that participants will more likely ascribe psychological violations and ambiguous violations to religious than to nonreligious agents. We also predict that religious agents will be judged more potentially harmful, more potentially beneficial, and more ambivalent (i.e., similar ratings of harm and benefit), compared to fictional (nonreligious) agents. In the following studies, we test these hypotheses and attempt to construct a template that describes the pantheon of religious counterintuitive agents.

Method

Participants

Consistent with an a-priori power analysis of previous studies that measured ratings and recall for counterintuitive abilities (Chapter 2; Pyysiäinen et al., 2003), we aimed to recruit at least 276 participants from Amazon’s Mechanical Turk, an online community of “workers” who perform simple tasks online in exchange for token payment (US$.80 in this case). Three hundred and nine participants were ultimately recruited (139 female, 168 male, and 2 identifying as “other”). All were native English-speaking U.S. nationals currently living in the U.S. Their average age was 33.6 years (SD = 9.7); 160 identified with a religion (of which 89% were Christian); the remaining identified as “agnostic”, “atheist”, or “none”.
**Materials**

Stimuli included twenty minimally counterintuitive abilities that described a single breach of either folk physics, folk biology, or folk psychology (Table 2), based on content domains defined by Barrett (2008a) and Boyer (2001). In Chapter 2 (Study 1), these abilities were rated significantly less intuitive (M = 1.34, SD = .58) than a set of twenty normal (intuitive) abilities (M = 5.84, SD = 1.52; r = .95, p < .001).

**Design and Procedure**

The study was administered in the Qualtrics survey environment and completed online. Participants completed one of two surveys, described to participants as “investigating the features of religious [fictional] beings and entities”. Unless otherwise noted, the surveys differed only in whether the word “religious” or “fictional” was used in the instructions and dependent measures.

After providing written informed consent, participants completed three tasks, always in the same order. First, they were asked to “invent a new religious [fictional] being or entity with supernatural abilities,” and to list five supernatural abilities they thought it would possess. Afterwards, they were re-presented with the abilities they generated and asked to rate each one in terms of its counterintuitiveness (“do you think a human being could possess this ability?”). Participants were then asked to imagine a real encounter with the entity they invented, and to rate the potential threat (“do you think it could cause you significant harm if it wanted to?”) and benefit (“do you think it could significantly improve your life if it wanted to?”) it posed.

Second, participants were presented with the twenty MCI abilities from Table 2, in a single, randomly-ordered “list of supernatural abilities that might apply to religious [fictional] beings and entities”. For each ability, participants provided an attribution rating by answering “is this ability likely to be attributed to a religious [fictional] being or entity?”

Third, participants were asked to “name 5 well-known religious [fictional] beings or entities with supernatural abilities, from the past or present.” We defined a religious agent as an entity “that many people believe exists, and that is part of a religion”, and a fictional agent as an entity “that people generally do not believe exists”. Participants then rated each entity in terms of its potential harm and benefits, answering the questions specified above. They were told to assume, for the purposes of making their ratings, that their five agents do exist.

All ratings in this study were made on scales anchored at 1 (not at all) and 7 (definitely). Prior to being debriefed, participants were administered an attention check,
requiring that they recall the type of agent (religious or fictional) they invented earlier in the survey. Fifteen participants failed to answer this question correctly and were not included in any of the following analyses.

Results

Participant-Invented Agents

Eight participants were excluded from analyses involving the five abilities they chose for their new entity because none of their abilities could be coded as counterintuitive. In all, 141 participants chose 702 abilities for religious agents, and 145 participants chose 725 abilities for fictional agents. The abilities participants chose were coded by the first author and a hypothesis-blind research assistant in terms of whether they (1) exclusively violated folk psychology, (2) exclusively violated folk biology, (3) exclusively violated folk physics, (4) violated nonspecific or multiple folk domains (i.e., ambiguous), or (5) violated none of the domains (i.e., was not a counterintuitive ability). Coders agreed 92% of the time, with disagreements resolved through discussion.

As abilities more strongly associated with religious [fictional] agents are likely to be generated first, each ability was weighted by $(6-k)/5$, where $k$ is its position within the participant’s list of five abilities. This transformation assigns a “salience score” (i.e., 1.0, 0.8, 0.6, 0.4, and 0.2 to items 1 to 5 respectively; Smith & Borgatti, 1997) that effectively captures the ease with which a violation type comes to mind when thinking of a religious [fictional] agent. For example, if the participant first listed three abilities that were folk biology violations followed by two that were folk physics violations, salience scores would be 2.4 and 0.6 for these violation types respectively, and zero for the three unlisted types. This procedure, which is a standard technique for dealing with free-list data in the anthropological study of religion (e.g., Purzycki et al., 2018), has the additional advantage of controlling for the number of abilities listed. Below, salience scores are reported as percentages of total salience scores for the categories included in a given analysis.

As expected (since their task was to list supernatural abilities), participants listed relatively few intuitive abilities, and their mean salience did not differ between religious ($M = .13; SD = .21$) and fictional agents ($M = .10; SD = .17; p = .231$). Participants also listed relatively few ambiguous violations, but such abilities were far more salient for religious ($M = .23$).}

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23 Two participants provided fewer than five abilities but were retained in the analysis.
Salience scores for distinctive domain violations were submitted to a 2 (agent type) x 3 (violation type) mixed model ANOVA, with the second factor treated as a repeated measure; results appear in Figure 14. There was a main effect of violation type, $F(2, 564) = 32.72, p < .001$, with physics violations ($M = .46; SD = .29$) more salient than psychology violations ($M = .31; SD = .28; p < .001$) or biology violations ($M = .24; SD = .26; p < .001$); psychology violations also differed from biology violations ($p = .013$). Of more interest, there was an interaction between agent type and violation type, $F(2,564) = 8.17, p < .001$. Looking at each violation type independently, t-tests indicated that psychology violations were more salient for religious agents than for fictional agents, $t(282) = -4.03, p < .001 r = .23$, while biology and physics violations were more salient for fictional agents, $t(282) = 1.98, p = .049, r = .12$, and $t(282) = 2.07, p = .039, r = .12$.

**Figure 14.** Mean salience (weighted frequency) of folk psychology, folk biology, and folk physics violations for fictional and religious agents, treated as percentages of total salience.

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24 Although not of interest in the current study, this replicates other studies that have found better recall for folk physics violations over other violation types (Chapter 2; Banerjee et al., 2013).
Thirteen participants were excluded from analyses involving their intuitiveness, threat, and benefit ratings for the agent they invented after giving insufficient attention to the questions (i.e., responding faster than 1s per item, a criterion set a priori). Mean intuitiveness, threat, and benefit ratings for participant-invented agents are shown in Figure 15. Fictional and religious agents did not differ significantly on intuitiveness (p = .583), or potential threat (p = .602), but potential benefit ratings were higher for religious agents, t(255.14) = -2.84, p = .005, r = .18.

We defined the “ambivalence” of each agent in terms of the absolute difference between its threat and benefit rating, such that larger values reflect relatively polarized ratings of threat and benefit. On average, religious agents (M = 1.02; SD = 1.77) were rated more ambivalent than fictional agents (M = 1.56; SD = 1.99), t(268.08) = 2.35, p = .020, r = .14.

![Figure 15. Mean ratings for invented fictional and religious agents.](image)

**Ability Attribution Ratings**

Attribution ratings (i.e., whether the supernatural abilities in Table 2 apply to religious and fictional beings) were submitted to a 2 (agent type) x 3 (violation type) mixed model ANOVA, with the second factor treated as a repeated measure. (Twenty-four participants

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25 For fictional agents, mean threat and mean benefit ratings were only comparable (see Figure 15) because participants invented similar numbers of beneficent heroes and threatening villains.
were excluded from this analysis for inattention to the task.) There were theoretically uninteresting main effects of agent type, $F(1,268) = 3.99, p = .047$, and violation type, $F(2,536) = 34.58, p < .001$, with Bonferroni-corrected pairwise comparisons indicating that the abilities were more strongly associated overall with fictional agents ($M = 5.45; SD = 1.40$) than with religious agents ($M = 5.09; SD = 1.44; p = .047$), and that psychology violations ($M = 5.50; SD = 1.38$) were more strongly associated with agents generally than physics violations ($M = 5.28; SD = 1.54; p < .001$) and biology violations ($M = 5.04; SD = 1.62; p < .001$), which also differed from one another ($p < .001$). Of more interest, there was an interaction between agent type and violation type, $F(2,536) = 25.14, p < .001$ (see Figure 16).

For religious agents, Bonferroni-corrected pairwise comparisons indicated that psychology violations ($M = 5.55; SD = 1.44$) were more strongly associated than biology ($M = 4.80; SD = 1.57; p < .001$) or physics violations ($M = 4.98; SD = 1.56; p < .001$), which did not differ ($p = .056$). For fictional agents, psychology violations ($M = 5.45; SD = 1.30$) did not differ significantly from biology ($M = 5.30; SD = 1.65; p = .245$) or physics violations ($M = 5.61; SD = 1.46; p = .160$), while physics violations were more strongly associated than biology violations ($p < .001$)

![Figure 16](image_url)

**Figure 16.** Attribution ratings for 20 counterintuitive abilities (see Table 2) to religious and fictional agents. Abilities towards the upper-left portion of the graph are more attributable to religious agents.
**Well-Known Agents**

Fourteen participants were excluded from analyses involving their 5 well-known agents because they didn’t specify any agents that matched the requested criteria; twenty-three were excluded due to inattention to the rating questions. Of the remaining participants, 128 provided a total of 518 fictional agents (108 distinct agents), and 129 provided a total of 591 religious agents (64 distinct agents). A list of these agents and their mean ratings can be found in the Appendix D. These mean ratings (across agents) suggest the prevalence of “God” and “Jesus” in participants’ responses did not significantly affect the results (across participants) detailed below.

As seen in Figure 17, religious agents were rated less threatening, \( t(255) = 2.69, p = .008, r = .17 \), and more of a benefit, \( t(255) = -3.12, p = .002, r = .19 \), than fictional agents. Ambivalence was calculated as described above; religious agents (\( M = 1.30; SD = 1.38 \)) were again rated more ambivalent than fictional agents (\( M = 2.07; SD = 1.74 \)), \( t(255) = 3.90, p < .001, r = .24 \).

![Figure 17](image.png)

**Figure 17.** Mean ratings for well-known fictional and religious agents.
General Discussion

Cognitive scientists of religion still don’t know why only some counterintuitive agents are believable and worthy of devotion. We examined the characteristics of religious and nonreligious supernatural agents directly and found four ways in which they differ. First, counterintuitive abilities that violate folk psychology were more salient for participant-invented religious agents than for fictional agents and were more closely associated with religious agents than other types of violations. Second, counterintuitive abilities that were ambiguous – violating nonspecific or multiple domains of folk knowledge – were more salient for invented religious agents than for nonreligious agents. Third, invented and well-known religious agents were rated more of a potential benefit than their non-religious counterparts. Fourth, invented and well-known religious agents were more ambivalent (i.e., the difference between a religious agent’s threat and benefit rating was relatively small), while fictional agents were more valenced towards extremes of heroism (high benefit, low threat) or villainy (low benefit, high threat).

We suggest that these biases collectively provide a template for predicting which counterintuitive agents can become objects of religious devotion. In particular, the bias for folk psychological violations, and the biases for beneficial and (for well-known agents) less threatening abilities, suggest that “successful” agents must also be motivationally compelling: minimally counterintuitive traits make agents memorable, but memorable agents must satisfy psychobiological needs to become gods.

Religious agents’ tendency to violate folk psychology over other folk beliefs is consistent with a motivational interpretation. In Chapter 2, we found that agents with abilities that violate folk psychology were rated more of a potential opportunity (i.e., had more potential to benefit people) than agents violating folk physics or biology. We surmised that agents violating folk psychology represent an opportunity to gain access to socially strategic knowledge— an opportunity that is particularly salient given our recent evolutionary history in which social threats have become increasingly costly and ubiquitous (Alexander, 1989). Indeed, the fact that agents have greater scope to violate folk psychology expectations may account for why agents feature prolifically in religious narratives (Barrett et al., 2009), and appear more than other ontological categories (e.g., objects) in statements rated religious (Pyysiäinen et al., 2003).

The ambiguous traits used to describe religious agents, while not necessarily motivationally compelling in and of themselves, may interact with other motivational states to facilitate belief. When traits are defined ambiguously, abstractly (Maass et al., 1989), or
metaphorically (Landau et al., 2009; Thibodeau & Borodisky, 2011) it becomes easier to attribute them in motivationally attractive ways. For example, the “better than average effect,” in which people rate themselves above average on positive traits and below average on negative traits (Brown, 2012; Kunda, 1990), is smaller when traits are precisely defined (e.g., neat, athletic, sarcastic, clumsy) than when they are ambiguous (e.g., idealistic, sophisticated, impractical, insecure; Dunning et al. 1989; Suls et al. 2002), suggesting that ambiguity allows people to reason their way toward favored conclusions more easily. Similarly, the ambiguous content attributed to religious agents may facilitate motivated reasoning, making it easier to reason toward a belief in these agents. Counterintuitive abilities that can be demonstrated in a variety of ways (violating nonspecific or multiple folk domains), might permit gods to influence manifold situations of motivational significance (Cofnas, 2018), without precluding or disconfirming their involvement in any (Kirkpatrick, 2015). A god’s omnipotence, control of nature, magical powers, or “mysterious ways”, for example, can be applied in whatever manner a believer deems necessary.

A common argument against motivation-based theories of religion is that some gods are not comforting – they’re scary – and why would anyone want to believe in a scary god? We suggest that, like ambiguity, ambivalence facilitates the motivated reasoning process. We think anxiety and uncertainty attributed to threat-capable gods (Toburen & Meier, 2010) can motivate belief-reinforcing behaviors, such as rituals and other deferential practices (Barrett, 2008b; Durkheim 1912/1995; Legare & Souza, 2014; Shariff, Norenzayan, & Henrich, 2010), and that these behaviors become more intuitively compelling if the agent to whom they are directed is ambivalent. For example, rituals and prayers often depict a transaction in which a god is requested to perform a counterintuitive act in return for worship, good behavior, or a tangible offering. An entirely malevolent god would have little interest in accepting requests, just as an entirely benevolent god would have little interest in refusing them. Thus, an ambivalent god is the only god for whom transactional prayers and rituals make sense. Furthermore, an ambivalent god with whom we can communicate and occasionally extract positive outcomes may be more appealing, and more plausible, than a valenced god, or a god that acts capriciously or randomly. Thus, ambivalence should help make rituals and prayers an intuitively compelling avenue through which gods can deliver benefits (see Lienard & Boyer, 2006, for other intuitively compelling ritual content), facilitating motivated reasoning towards a belief in these gods.

One anomalous finding is that well-known fictional agents were rated more threatening than their religious counterparts, but this wasn’t the case for invented agents. Negative information, such as about threatening agents, is more cognitively attractive than
positive information, hence the phrase “fear sells” (Rozin & Royzman, 2001). A cultural unfolding of this negativity bias, constrained by the motivation to disbelieve overly threatening agents, may explain why it was restricted to well-known fictional agents. Such agents might share or even surpass the cognitive attractiveness of religious agents, in being counterintuitive and threatening, but may lack motivational attractiveness, resulting in popular but unbelievable beings. In other cases, threat may be lacking while benefit is not, which might result in motivationally attractive beings that don’t demand our attention for long enough to become religiously established (e.g., Santa or the Easter Bunny). The cognitive attractiveness of threat may therefore be an alternative or additional reason why ambivalence appears to be a key feature of religious beings.

Nevertheless, it is adaptive to pay attention to threats, and possibly also to believe the reality of those threats in some contexts. In evolutionary terms, the cost of falsely believing a threatening agent is absent should be greater than falsely believing it is present, and this negative credulity bias (Fessler et al., 2014) may explain why (an apparent minority of) religious agents deviate from ambivalence into malevolence (Atran & Norenzayan, 2004). Some cultural environments may require and activate our agency detection device more than others (Eilam et al., 2011), making malevolent deities more likely.

Although American participants, mostly Christian, provided our data, we would expect similar results in other cultural contexts to the extent that they afford and foster similar motivations (e.g., to avoid negative affective states) that are natural to the human mind. Conversely, cultural differences in the characteristics of religious agents may reflect motivations that arise or are more salient as a consequence of particular environments. Similarly, individual differences within cultures may reflect idiosyncratic motivations (e.g., for more social contact) associated with particular traits (e.g., death anxiety; emotion regulation). This essentially motivational account of the characteristics of religious agents has the advantage of catering to the existence of atheists: despite observing the same content and contexts as everyone else, they lack belief, presumably because they lack a motivation for which this content is relevant.

Although the current study contributes to the development of a “belief template” that could, eventually, predict which agents are most likely to inspire religious devotion, it is just a start, with several acknowledged limitations. For example, we did not measure levels of belief in the well-known agents cited by participants, which could provide a better understanding of the role of individual differences. In addition, our distinction between religious and fictional entities neglects some counterintuitive agents, such as ghosts and spirits, that many people believe exist, but that are not necessarily objects of religious devotion. Future work might
present participants with specific beings, entities, and other paranormal phenomena with a diverse range of a-priori plausibility before measuring belief and their perceived features. Similarly, our request for supernatural abilities restricted the number of intuitive features that participants attributed to their invented agents. Although we found no difference in rated intuitiveness or the number of intuitive abilities listed, the trend was towards religious agents being more intuitive, as found in other work (Fondevila et al, 2012; Harmon-Vukic, 2016). Finally, our proposed template neglects some religious agents, such as Satan and Loki, that are apparently neither beneficent nor ambivalent. It could be argued that belief in such agents (and polytheism in general) is declining, in line with the template’s proposed optimum, however, in less optimal settings, the ambivalence criterion might also be applied to groupings or entire pantheons of agents. Thus, we acknowledge that cultural and environmental factors may affect the reliability of the template, which is more a measure of cultural evolutionary success than a strict set of exclusionary criteria.

In summary, we think a religious agent template, comprising beneficent yet ambivalent agents with ambiguous and folk-psychology-violating abilities, goes some way to solving the Mickey Mouse problem. Mickey Mouse lacks the necessary beneficence, ambivalence, and ambiguity, and we therefore lack the motivation and latitude to believe he is real.
Chapter 5
Managing Beliefs about Counterintuitive Agents

Introduction

Armed with an appropriate definition of a religious agent, this chapter returns to the question of why anxious and threat-sensitive individuals would choose to believe in the threatening counterintuitive agents that routinely demand their cognitive resources. The finding that religious agents possess content (ambiguity, beneficence, ambivalence, and folk psychology violations) that is likely to facilitate motivated reasoning (i.e. implicit interpretive biases) suggests that the answer involves emotion regulation.

As described in Chapter 3, threatening and upsetting stimuli, such as MCI agents, are more salient and memorable than positive stimuli (Dijksterhuis & Aarts, 2003; Rozin & Royzman, 2001), and the extent of these biases depends on individual differences, such as state and trait anxiety (Eysenck, 1997). Yet, as described in Chapter 1, there is widespread evidence that individuals also differ in the frequency and success with which they use strategies to regulate or avoid conscious awareness of these stimuli (for a review: Koole, 2009). Unfortunately, classification of these emotion regulation strategies is muddled, with considerable overlap between terms. For example, Koole’s (2009) review covers suppression, repression, motivated reasoning, positive refocusing, positive reappraisal, effortful distraction, mindfulness, dissonance reduction, and several other variants, while other researchers have noted (decidedly Freudian) defense mechanisms such as denial, dissociation, rationalization, intellectualization, and projection (Erdelyi, 2006).

The impressions and beliefs that people have about counterintuitive agents also differ considerably. Among Christians, God may be considered punishing and wrathful, or caring and benevolent (Kirkpatrick, 2005). The analysis in Chapter 4 would seem to indicate that it’s often both at the same time. What should be relatively clear, however, is that if anxious individuals selectively recall counterintuitive agents based on their perceived threat, initial impressions of these agents should be negative, motivationally unattractive, and unlikely to precipitate belief. Few people would be inclined to believe in a malevolent supernatural entity (as Chapter 4 indicates)\(^\text{26}\), and yet such entities appear to be what we are inclined to

\(^{26}\) Although individual, cultural and environmental factors may increase this inclination.
remember. How might initial negative content translate ultimately to belief in largely benevolent gods?

I propose that belief is the product of emotion regulation strategies that transform initial reactions into motivationally attractive ones. There are many strategies individuals use to manage their emotional reactions; the most promising strategy in the present case may be repression, i.e., the implicit (unconscious) avoidance or reinterpretation of anxiety-causing thoughts. Indeed, as explained in Chapter 1, religious individuals would have a hard time justifying religious beliefs if the beliefs were a conscious effort to reduce anxiety (e.g., “I am just telling myself this to feel better”). Furthermore, the cognitive biases evident in repressors are a direct reversal of the biases evident in anxiety, suggesting they’re a direct response to anxiety and particularly relevant to comfort theories. Finally, these biases include an interpretive bias that could be described as a form of motivated reasoning (of importance to the religious agent template; see Chapter 4 Discussion). Unfortunately, repression has a controversial history that should be carefully considered (Erdelyi, 2006).

**Defining Repression**

In the past century, researchers and theorists have proposed many and varied definitions of repression, which have been received with correspondingly variable degrees of skepticism. Johann Herbart (1815/1891) first introduced the term to describe the nondefensive inhibition of thoughts by more pertinent thoughts in competition for conscious attention. It was Sigmund Freud, however, who is most closely, and most notoriously, associated with the concept, using it to describe a defensive, inhibitive process for dealing with emotionally unpleasant thoughts that “lies simply in the function of rejecting and keeping something out of consciousness” (Freud, 1915/1957, p. 147).

Interestingly, Freud never defined repression as an exclusively unconscious process and did not distinguish it from “suppression” (i.e., a mental control strategy in which a person is motivated to consciously and intentionally avoid thinking about something; Wegner, 1989). It was Anna Freud, reflecting on her father’s tendency to implicate repression in ‘unconsciously motivated memory loss’, who distinguished repression from suppression in terms of consciousness; Sigmund Freud may well have rejected this distinction as an unwarranted boundary on the “conscious-unconscious continuum” (Erdelyi, 2006). Consistent with the latter approach, Erdelyi (2006) proposed a “unified theory of repression” with two subclasses, both of which span this continuum: simple inhibition/avoidance, a subtractive process that includes both automatic avoidance and thought suppression, and elaborative
repression, an additive process which involves distorting, transforming, reinterpreting, and/or adding false information to thoughts. The theory was poorly received by suppression theorists, however (see commentaries in Erdelyi, 2006).

The unconscious, defensive characterization of repression – the *automatic avoidance or reinterpretation of negative thoughts* (Myers, 2010) – is relevant when considering religious belief, for the reasons outlined above (i.e., beliefs must be justifiable). Specifically, repression in this context can be thought of as the motivated unawareness of a thought, where motivations are unconsciously generated (such as via negative affective states; Koole, 2009), where unawareness proceeds unconsciously through cognitive biases for avoidance or reinterpretation (Derakshan et al., 2007), and where the target thought or stimulus can be classified as negative, threatening, or affectively unpleasant.

**Empirical Support for Repression**

The unconscious nature of repression has made it inherently difficult to verify empirically (Davidson & McGregor, 1998; Holmes, 1990). Some evidence, however, comes from discrepancies between self-report and physiological responses. For example, Weinberger, Schwartz, and Davidson (1979) observed that a number of people, whose physiological and behavioral responses to negative thoughts demonstrated high anxiety, nevertheless self-reported low levels of anxiety on state and trait measures. The researchers argued that such people “fail to recognize their own affective responses,” and are employing “strategies to avoid conscious knowledge of their genuine reactions” (p.338). As evidence, they measured participants’ tendency to describe themselves in socially desirable and admirable ways (e.g., always being a good listener), and associated the anomaly with defensiveness.

Weinberger (1990) went on to identify a “repressive coping style,” characterized by high defensiveness and low reported anxiety, and distinct both from high-anxious individuals, and nondefensive individuals regardless of anxiety. In particular, repressors, who account for around 10-20% of the population (Myers, 2010)\(^{27}\), are characterized by attentional avoidance of negative information, a positive or innocuous interpretation of ambiguous or threatening information and situations, and a failure to retrieve negative information about internal or external states from memory (for a review, see Derakshan et al., 2007). Repressors therefore demonstrate biases that are the exact opposite of those exhibited by anxious individuals (Eysenck, 1997; see also Chapter 1), and yet, repressors still appear to experience high

\(^{27}\) The criterion for being a “repressor” is arbitrary. Like any psychological trait, repression is a continuum.
anxiety as evidenced by their behavioral and physiological sensitivity to threat. Repressors, that is, appear to be highly anxious individuals who’ve developed an automatic coping style.

Derakshan et al. (2007) subsequently explained the discrepancy between physiological reactivity and self-report measures as supporting a “vigilance-avoidance theory.” The researchers utilized data on the time-course of repressors’ cognitive biases to explain the reactivity as based on an early bias towards threat, and the reports as based on later avoidance (Calvo & Eysenck, 2000, Caldwell, 2005). They argued that persistent physiological reactivity during threat processing relates to persistent activation of threat schemas (characteristic of high anxiety). Furthermore, they argued that repressors’ self-reports of low anxiety are a form of self-deceit rather than an intention to deceive others, suggesting that motivated unawareness during the defensive avoidance stage is implicit: they are not aware of their motivation to be unaware.

When repression is defined as unconscious suppression (Erdelyi, 2006) – implying significant equivalence between repression and suppression, with a few important differences – it can be found documented in the literature. For example, while some studies have found suppression and repression to be different constructs (Myers, Vetere, & Derakshan, 2004; Wegner & Zanakos, 1994), another study, applying the most common instruments used to measure them, found a positive correlation (r = .35; Szentagotai & Onea, 2007). The inconsistent results in the literature may ironically be related to repressors’ tendency to self-deceit, including when completing psychological instruments.

Other evidence suggests that the two strategies serve the same psychological function. For example, although older adults tend to score high on repression and low on suppression, this may be because most of their suppression needs may already be automatic; indeed, older adults appear to be more successful at thought suppression when they do use it (Erskine et al., 2015). Crucially, this is supported by studies that found repressors have a natural tendency to suppress negative thoughts with minimal effort (Barnier, Levin, & Maher, 2004; Geraerts, Merckelbach, Jelicic, & Smeets, 2006). When repression does fail, however, it can lead to chronic intrusions of a thought at a later date (Geraerts et al., 2006), which is also characteristic of suppression (Wegner, 1994). Indeed, trying not to think about something can produce the opposite effect, either while the strategy is in use, or via a rebound effect after the strategy has been abandoned.

These studies imply a developmental process in which regular use of suppression can transition to automatic repression. In support of this view, suppression traits have been shown to develop in childhood and are associated with an avoidant attachment style (Cooper, Shaver, & Collins, 1998), while repressors, who also exhibit this style (Eysenck, 2000), were found to
have limited access to negative childhood memories (Barnier et al., 2004; Dozier & Kobak, 1992), and to have experienced more traumatic childhoods (Derakshan et al., 2007).

Additionally, the adverse physical health outcomes associated with repression are also associated with suppression (Szentatotai & Onea, 2007), both likely caused by the avoidance of negative internal states/symptoms (Myers & Vetere, 1997).

Taken together, these correlational studies support a view of repression as an unconscious process: as suppression that has become automatic and effortless, resulting from frequent, practiced use of suppression in response to aversive stimuli that have become schematically represented as vulnerabilities.

Even with this evidence – that repression is an implicit process with distinct cognitive biases and related explicit constructs – some authors might characterize repression (or even suppression) of anxiety as a generally maladaptive process that is unlikely to contribute to the formation of widespread religious beliefs (Boyer, 2001; although see Boyer & Lienard, 2008). Indeed, the maladaptive consequences are obvious: ignoring threat can be costly; however, if repression is the automatic suppression of threats that have been frequently encountered, these threats may have already been consciously appraised as “safe” for avoidance or reinterpretation. Furthermore, while ignoring threat may be why 30-50% of people with chronic illnesses are repressors (Myers, 2010), it’s unclear if repression caused them to ignore initial symptoms, or if they developed repression to cope with the illness (perhaps via repeated suppression). It may be the latter, as a longitudinal study of elderly individuals found that repression develops over time, perhaps to avoid thoughts of death as it approaches (Erskine et al., 2015). Indeed, repression has been linked to better mental health in old age, appearing to serve a “psychologically protective function as one approaches the end of life” (Erskine et al., 2015, p.1017). Up to 50% of elderly individuals are repressors (Myers, 2010), which may explain why less depression and negativity is reported in old age28 and, paradoxically, why death anxiety appears to decrease with age (Jong & Halberstadt, 2016). In general, then, repression can be adaptive if it protects against excessively high levels of anxiety (Beck, Emery, & Greenberg, 2005; Levy & Anderson, 2002), and such protection may be necessary for repressors, who exhibit high levels of behavioral and physiological anxiety during their “vigilance stage” of threat processing. Other adaptive consequences might include a greater cultural acceptance of individuals who display less anxiety (Eysenck, 1997), and an improved ability to deceive others – it becomes easier to fool others if you’ve already fooled yourself (Badcock, 2000). This may be particularly important during religious

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28 This has been called the “positivity effect” – an example of the overlap between emotion regulation terms.
conversion, in which the credibility and authenticity of the claimant likely facilitates belief transmission (Henrich, 2009).

**Interpretive Bias**

Repressors’ ability to produce positive or innocuous interpretations of ambiguous or threatening stimuli and situations is, of course, particularly relevant to the proposed process by which beliefs in religious entities emerge. As shown in Chapter 4, religious agents are both ambiguous and ambivalent, presenting a mixture of positive and negative features. Religious belief may partially be a product of the successful repression of the negative features of counterintuitive agents that initially attracted attention.

There is considerable empirical support for repressors’ ability to reinterpret ambivalent stimuli and to recruit positive thoughts when needed. For example, Boden and Baumeister (1997) found that repressors recalled happy memories quicker than non-repressors after watching unpleasant films compared to neutral films, concluding that repressors access pleasant thoughts to cope with negative affective material. McKinney and Newman (2002) found that repressors were less pessimistic than non-repressors in their predictions of how friends would respond to inconsiderate behavior. Eysenck and Derakshan (1997) found that repressors were more optimistic than non-repressors about examination performance, while Myers and Brewin (1997) found that repressors were less likely than non-repressors to think they would experience negative events, or that negative words were accurate self-descriptions, concluding that repressors experience illusory optimism and self-evaluative biases.

Repressors are not uniformly positive, however. For example, Myers and Reynolds (2000) found that repressors were more optimistic than non-repressors about health issues, but they were especially optimistic about events they could prevent from occurring, such as tooth decay and skin cancer. Similarly, for existing health issues, repressors were optimistic and exhibited healthy behaviors regarding the treatment of things they could control (e.g., weight, diabetes, asthma), but avoided and were less optimistic about uncontrollable issues (e.g., heart disease, cancers; Myers, 2010). Although Myers and Reynolds (2000) found no group differences as a function of the seriousness of the health issue, a more comprehensive study found that repressors were more likely to deploy interpretive biases when threat was high and couldn’t be avoided by shifting attention away (Langens & Morth, 2003).

Reinterpretation of negative stimuli and events can be achieved either by adding positive thoughts, or by selectively ignoring or forgetting negative ones. The latter may be the dominant process, according to Myers (2010), who reported that repressors did not differ from
non-repressors on levels of optimism when stimuli were restricted to events, descriptors, or scale items that were already positively valenced. For example, Myers and Brewin (1995) found that compared to non-repressors, repressors retained as much positive and neutral information from a story but forgot more negative information. Intellectualization and denial are further examples of selectively subtracting negative information to produce a more positive interpretation (Erdelyi, 2006; Weinberger, 1990). Intellectualization involves separating factual from affective information, repressing only the affective part, while denial involves ignoring the deeper meaning or context of a stimulus. Subtraction and addition may be related, as the subtraction of negative information could theoretically produce memory blind spots, making a stimulus incoherent without the addition of new (likely positive) information (Roediger, McDermott, & Goff, 1997).

**Repression in Religion**

Many philosophers have argued that religious beliefs, such as in controlling gods, can mitigate anxiety associated with negative events (e.g., Hume, 1757/1889). However, it seems unlikely that one would find relief from a distressing event by attributing it to an equally distressing supernatural agent. Logically, mitigation of anxiety in this case requires repression of the agent’s potentially malevolent motives and capricious tendencies in order to establish that it had good reason for causing the event, and that it can be negotiated or traded with to establish indirect control over future events (e.g., via prayer, good behavior, worship, or ritual). This process may be important when questions such as “did God have a good reason for taking my family member away?” are answered with reference to a grand, benevolent plan that makes God’s apparent behavior appear less troubling. Indeed, it could be suggested that all comforting beliefs involving a religious agent must first assume the agent’s good intentions. Thus, if repression occurs in religious contexts, it should apply to how a god is perceived: What traits does it have? Is it comforting, loving, and benevolent, rather than angry, jealous, and punishing? Is it reasonable and controllable or whimsical and capricious? If positive interpretations of a god can be generated (as Chapter 4 indicates is likely for religious agents), then attributing it control over various negative events should result in those events being perceived as less troubling.

There is some support for this view. For example, Boyer and Lienard (2008) argued that ritual behavior swamps working memory, alleviating anxiety by employing a

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29 This consideration of social threats in the present and physical threats in the future is consistent with literature about when interpretive biases are observed in repressors (Walsh, 2015).
spontaneous and moderately efficient form of thought-suppression that specifically targets anxious thoughts. Additionally, Xygalatas et al., (2013) found that memories of highly-arousing religious rituals were suppressed after the event, revealing a “spectacular discrepancy” between heart rate measurements and self-reported arousal. This spontaneous and efficient “suppression” closely matches the definition and observable features of repression. However, it remains to be seen if this suppression (or repression) could target anxieties associated with the roles and features of gods, rather than anxieties artificially elicited and assuaged during rituals (Durkheim, 1912/1995).

With regards to the proposed hot cognition model of religious belief, the vigilance-avoidance model of repression in which early threat processing is facilitated, but late processing is inhibited (Calvo & Eysenck, 2000; Derakshan et al., 2007), fits neatly with a view that the early detection of potentially threatening gods can be followed by cognitive avoidance of their threatening traits, ultimately facilitating the formation of theistic beliefs. Indeed, the high and persistent physiological reactivity that repressors experience during their initial “vigilance” stage of threat processing should ensure the prolific detection of potentially threatening agents (i.e., hyperactive agency detection; see Chapter 1). For these agents to be reinterpreted favorably, the above discussion suggests that their threat level, controllability, and ambiguity should all be high. As seen in Chapter 4 (General Discussion), religious agents embody all of these characteristics, making them prime candidates for favorable reinterpretation via repression.

**Study 1**

As an initial test of the relationship between repression and god beliefs, Study 1 measured participants’ repressive tendencies and the extent to which they thought their god(s) possessed a number of positive and negative traits (i.e., “god positivity”). Additionally, to test the role that repression has in maintaining these positive interpretations, participants were presented with information that implied an association between their god(s) and a negative event (i.e., implied god negativity). It was predicted that religious participants would be more prone to repression than non-religious participants (hypothesis 5; Chapter 1), and that repression would mediate the relationship between the strength of their religious identity and the positive views of the gods they believe in. It was also predicted that the relationship between repression and god positivity would be stronger when participants were more upset about implied god negativity. This might therefore demonstrate that repression serves a
protective function, maintaining positive interpretations of gods when faced with contrary information (hypothesis 6; Chapter 1).

Finally, repression was contrasted with similar constructs. An examination of the emotion regulation literature (Koole, 2009) revealed positive refocusing and positive reappraisal to be two methods of conscious, defensive reinterpretation in which a negative event is coped with by (respectively) focusing on other, positive matters, or by attaching a positive meaning to it (Garnefski et al., 2001). It was predicted that while religious people might be similarly prone to refocusing and reappraisal, only repression would be associated with theistic beliefs.

Method

Participants

An a-priori power analysis, based on an effect size observed between repression and views of gods\(^3\), indicated that 227 participants would be required to obtain power of .80 when \(p\) is set to .05. Two hundred and fifty-three volunteers (113 female, 138 male, 2 identifying as “other”) were ultimately recruited from Mechanical Turk and paid US$70. All were native English-speaking U.S. nationals currently living in the U.S. Their average age was 35.7 years (SD = 11.3); 128 (51%) identified with a religion (of which 90% were Christian); 119 identified as “agnostic,” “atheist,” or “none.”; and 6 identified as “other” (e.g., spiritual).

Materials

Following Weinberger et al.’s (1979) definition, repression was measured using a combination of Reynolds’ (1982) 13-item social desirability scale (SDS; Form C) and the 20-item trait version of the STAI (Spielberger et al., 1983). The former asks participants if items such as “I’m always willing to admit it when I make a mistake” are “true or false of you”. The latter asks participants to rate from 1 (almost never) to 4 (almost always) the extent to which items such as “I feel secure” indicate how they “generally feel”. Rather than assessing repressors as a group (contrasted with Weinberger’s other three groups, for which I have no specific hypotheses), repression was operationalized as the difference between the

\(^3\) This pre-test of the relationship was obtained in Chapter 3, Study 1, however the results were not included in the thesis as there were concerns about data quality (no timing data were obtained on which to determine inattention). The correlation was nevertheless significant.
standardized scores on the two scales, such that greater repression was indicated by high SDS and low STAI scores (the SDS is indicative of defensiveness, and low STAI scores in concert are indicative of defensiveness applied to avoid anxiety). Similar continuous measures of repression have previously been used to assess its correlational relationships (e.g., Szentagotai & Onea, 2007; and reviewed in Derakshan et al., 2007).

Positive refocusing and positive reappraisal were measured with four-item subscales of the Cognitive Emotion Regulation Questionnaire (CERQ; Garnefski et al., 2001), which asks participants to rate from 1 (almost never) to 5 (almost always) the extent to which statements describe “what you generally think, when you experience negative or unpleasant events”. The positive refocusing subscale includes items such as “I think of pleasant things that have nothing to do with it”. The positive reappraisal subscale includes items such as “I look for the positive sides to the matter”.

God positivity was measured with the Views of God scale (VOG; Shariff & Norenzayan, 2011), which asks participants to rate from 1 (not at all) to 7 (completely) the extent to which fourteen traits, of which half are positive (forgiving, loving, compassionate, gentle, kind, comforting, and peaceful) and half negative (vengeful, harsh, fearsome, angry, punishing, jealous, and terrifying), “applies to your God (or gods)”. Non-religious participants were asked to rate how much each trait applies “to your culture’s conception of God (or gods)”.

A word unscramble task was used to prime participants with religious concepts (Shariff & Norenzayan, 2007; Srull & Wyer, 1979). The task required participants to unscramble ten sets of five words, dropping one word from each to create a grammatically correct four-word sentence. For example, “shoe thanks give God to” became “give thanks to God” and “dessert divine was fork the” became “the dessert was divine.” Five sentences incorporated the words spirit, divine, God, sacred, and prophet. The others contained only neutral words, unrelated to religion or any particular concept.

God priming occurred before participants read about a negative event, such that the priming might allow an association between their god(s) and the negative event (implied god negativity). Participants read one of two articles about a real (2011) earthquake that either occurred naturally in Virginia or as a result of fracking in Oklahoma. The Virginia earthquake was described as “wholly unpredictable and unavoidable” caused by the “random motion of tectonic plates” such that “no-one saw it coming”. The Oklahoma earthquake was described as “wholly predictable and avoidable” caused by “fracking engineers” such that another quake is “only a matter of time.” Participants’ gods might therefore be implicitly associated with these negative events in two ways: either as a potential cause of the earthquake (Virginia), or
as a potential punisher of the irresponsible fracking engineers (Oklahoma). Details of the earthquakes were gathered from news sources and adapted for the two conditions. Both articles can be found in full in Appendix E. Before reading one of the articles, participants were given the following instructions:

“On the following screens, you will be shown three sections from an article about a real event that occurred in 2011. Please read each section carefully. We will ask you about the article afterwards. To ensure a minimum reading time, there will be a short delay before the next button appears, but please spend as long as you like on each screen.”

The article sections were presented on separate screens for at least 10s, 14s, and 12s respectively (based on length) after which participants could click to continue. After finishing the article, participants were asked “how do you feel right now?” on a scale anchored at 1 (unpleasant) to 9 (pleasant). This therefore provided a measure of negative affect following implied god negativity. As both events concerned other people, repressors were expected to self-report their actual emotional state (Derakshan et al., 2007).

**Design and Procedure**

The study was administered in the Qualtrics survey environment and completed online. After providing informed consent and answering demographic questions (including a question about religious identity; the results of which are summarized in the “participants” section), participants completed the positive refocusing and positive reappraisal subscales, followed by the STAI, and finally the SDS. Items within each scale (and the later VOG scale) were randomly ordered for each participant. Participants next completed the word unscramble task before being randomly allocated to read one of the two articles about earthquakes. Finally, all participants completed the VOG scale and an attention check that required remembering what kind of event the article was about, before being debriefed.

**Results**

Eleven participants failed to answer the attention check correctly and were excluded from all analyses. Thirty participants were excluded from analyses involving their positive refocusing/reappraisal scores after giving insufficient attention to the rated items (i.e. responded in less than 2s on average). Similarly, 41 participants were excluded from repression analyses for spending less than 1.25s per item on the STAI or 1.75s per item on the
SDS, and 36 participants were excluded from god positivity analyses after spending less than 1s per item on the VOG scale. (These criteria were based on text-length of the items.) Finally, nine participants were excluded from analyses involving the “implied god negativity” conditions because they did not attempt the sentence unscrambling task or took more than 2 SD above the mean time to progress through the task and the article that followed.31

Unsurprisingly, participants who identified with a religion (in the demographics question32) produced higher god positivity ratings than non-religious participants, t(194) = 4.30, p < .001. As shown in Table 6, religious participants also scored higher than non-religious participants for repression, positive refocusing, and positive reappraisal. As expected, age was positively related to repression, r = .18, p = .016, but did not predict any other variables.

Table 6. The relationship between religious identity and repression, positive reappraisal, and positive refocusing.

<table>
<thead>
<tr>
<th></th>
<th>Positive refocusing</th>
<th>Positive reappraisal</th>
<th>Repression33</th>
</tr>
</thead>
<tbody>
<tr>
<td>Religious</td>
<td>M = 10.99; SD = 4.69</td>
<td>M = 13.29; SD = 4.22</td>
<td>M = 14.15; SD = 21.96</td>
</tr>
<tr>
<td>Non-religious</td>
<td>M = 9.62; SD = 4.42</td>
<td>M = 11.64; SD = 3.98</td>
<td>M = 0.66; SD = 24.67</td>
</tr>
<tr>
<td>t(df)</td>
<td>2.15(203)</td>
<td>2.87(203)</td>
<td>3.98(187)</td>
</tr>
<tr>
<td>p</td>
<td>.033</td>
<td>.005</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>r</td>
<td>.15</td>
<td>.20</td>
<td>.28</td>
</tr>
</tbody>
</table>

There were no differences in god positivity between the “implied god negativity” conditions; not via a main effect (p = .479) or via interactions with repression (p = .493), positive reappraisal (p = .748), or positive refocusing (p = .174). This indicated the conditions were equivalent in the extent and manner they associated god with a negative event. Condition was therefore not analyzed further as a between-subjects factor. Negative affect reported after the implied god negativity conditions was positively related to repression, r = .29, p = < .001, suggesting repressors were not under-reporting their negative affect.

To determine if the relationship between religious identity and god positivity was mediated by repression, with this mediation moderated by negative affect reported after an implied associated between god(s) and a negative event, the PROCESS macro for SPSS was

31 The mean time to complete these tasks plus two standard deviations was 615 seconds. It was thought that the priming procedure would become less effective with time.
32 Participants coded as “other” for this question were not included in analyses involving religious identity.
33 This normalized repression scale ranges from -60 to +60.
used, Model 14 (Hayes, 2013), displayed conceptually in Figure 18. The model revealed a significant indirect effect at mean levels of reported negative affect, $b = -2.589$, 95% CI [-5.123, -.586], indicating the relationship between religious identity and god positivity was partially mediated by repression. Furthermore, the relationship between repression and god positivity was moderated by negative affect, as shown in Figures 18 and 19. The Johnson-Neyman technique revealed that the relationship between repression and god positivity was significant when negative affect (i.e., unpleasantness rating) was more than 3.9 (or 0.37 standard deviations below the mean), encompassing 70% of participants, but not significant at lower values.

![Diagram](image)

**Figure 18.** Model of religious identity as a predictor of god positivity, mediated by repression, and moderated by reported unpleasantness. Bootstrap confidence intervals are based on 20,000 samples.

Similar mediation analyses were not justified when negative or positive views of gods were considered in isolation. Negative views were predicted by repression, $r = -.27$, $p < .001$, but not religious identity, $t(160.74) = -1.59$, $p = .113$. Positive views were predicted by religious identity, $t(127.20) = 5.35$, $p < .001$, but not repression, $r = .12$, $p = .107$. Splitting across religious identity revealed that repression predicted positive views of gods for religious individuals, $r = .28$, $p = .006$, but not for non-religious individuals, $r = -.17$, $p = .158$. Figure 20 shows how repression explains differences in overall god positivity between believers and non-believers.

The above models were repeated with either positive refocusing or positive reappraisal as a mediator. Neither predicted god positivity via a main effect or via an interaction with negative affect.
Figure 19. How repression predicts god positivity at values of reported unpleasantness.

Figure 20. God positivity as a function of repression for religious and non-religious participants.
Discussion

This study found that people identifying as religious were more likely to use repression, and that repression partially explained their positive interpretations of gods. Furthermore, the relationship between repression and god positivity was stronger when participants reported more negative affect after an implied association between their god(s) and a negative event. This indicated that repression serves a protective function – maintaining positive interpretations of gods when faced with troubling contrary information. As predicted, these effects on god positivity were not reproducible for explicit (conscious) forms of the interpretive bias (positive reappraisal and positive refocusing), even though religious individuals were also prone to using these strategies. This supports the claim that religious beliefs must be justifiable to adherents, necessitating implicit strategies. Curiously, non-religious repressors still reported fewer negative views of gods, but, unlike religious repressors, did not report more positive views. Possible explanations for these effects are discussed in the General Discussion.

The lack of a difference between the “implied god negativity” conditions might suggest that a punishing god and a disaster-causing god are equally negative and equally likely to be repressed (a disaster could be considered punishment). However, this result raises questions about whether the procedure worked as intended. It’s possible that negative affect related to any event might produce the same results, regardless of whether the event is negative, or whether god priming occurs beforehand. Future studies should include a larger number of conditions to understand the breadth of materials for which negative affect can strengthen the relationship between repression and god positivity (e.g., with a neutral prime; Shariff & Norenzayan, 2007).

More importantly, there may be alternative accounts of these correlational relationships. For example, positive interpretations of gods may be formed in another way, with repressive tendencies developing later to defend those interpretations against contrary information. To partially establish causality, the next study therefore considers the potential role that repression has in the generation of new beliefs about unfamiliar gods.

Study 2

In this study, I asked if repression can account for more than just the maintenance of motivationally attractive beliefs about gods that participants already believe in or are familiar
with. I asked if it also has the potential to influence the formation of beliefs about new, unfamiliar gods. Four “god concepts” were created for this study, one of which was modeled on the religious agent template defined in Chapter 4 (a beneficent, ambivalent, ambiguous, folk psychology violator34). The other three either lacked ambivalence or beneficence. It was predicted that repression would be correlated with greater god positivity (as in Study 1), but only for the concept that met the conditions to be a religious agent. If confirmed, this would support Chapter 4’s finding that religious agents have content that facilitates implicit emotion regulation strategies (hypothesis 4; Chapter 1), and, more importantly, indicate that new religious beliefs are more likely to be formed when repressors encounter god concepts that fit the religious agent template (hypothesis 6; Chapter 1).

**Method**

**Participants**

Based on the power analysis reported in Study 1, this study also required at least 227 participants. Two hundred and fifty-seven participants (136 female, 120 male, 1 identifying as “other”) were ultimately recruited from Mechanical Turk and paid US$.80. All were native English-speaking U.S. nationals currently living in the U.S. Their average age was 39.8 years (SD = 13.1); 124 (48%) identified with a religion (of which 85% were Christian); 128 identified as “agnostic,” “atheist,” or “none.”; and 5 identified as “other” (e.g., spiritual).

**Materials**

As a manipulation of god concepts, participants read one of four descriptions of a “being called Rigel”. In each description, Rigel was attributed two counterintuitive abilities from Table 2 (Chapter 2), establishing him as an MCI agent (Barrett 2008a, Johnson et al., 2010). One of these abilities violated a folk physics expectation and the other violated a folk psychology expectation, as these were found to be the most common violation types for religious agents (see Figure 14; Chapter 4). As shown in Table 7, abilities were chosen to produce versions of Rigel that were threatening, beneficial, both, or neither.

As minimally counterintuitive agents are often described as (or required to be) “mostly intuitive” (Atran & Norenzayan, 2004) such that relevant inferences can be generated about them (Boyer, 2001), each description of Rigel also included three intuitive statements, which

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34 To reduce the number of conditions, folk psychology and ambiguity were not manipulated, although each god concept received one folk psychology violation.
were the same in every condition: that Rigel “lives in a faraway place”, that he “enjoys the smell that rises off the forest after it rains” and that he “feels at his most content when he listens to the whales sing”.

**Table 7.** The four versions of Rigel. Ratings are the mean of the two abilities, based on data reported in Chapter 2.

<table>
<thead>
<tr>
<th>Abilities</th>
<th>Threat</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Be in two places at the same time.</td>
<td>2.99</td>
<td>4.57</td>
</tr>
<tr>
<td>Answer any question because he knows everything.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evaporate when he feels heavy.</td>
<td>2.91</td>
<td>2.65</td>
</tr>
<tr>
<td>Converse with billions of people simultaneously.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reverse the direction of time.</td>
<td>5.00</td>
<td>4.47</td>
</tr>
<tr>
<td>Directly control other people’s minds.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Split into an army of duplicate beings.</td>
<td>4.98</td>
<td>2.64</td>
</tr>
<tr>
<td>Send thunderstorms to villages that offend him.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Memory for Rigel’s abilities (as a manipulation check) was assessed in a surprise recall task, which presented participants with the first part of each of the five sentences used to describe Rigel (two counterintuitive, three intuitive), and asked them to “complete the sentences using what you can remember from the previous screen” by typing the rest of the sentence into an empty text box. For counterintuitive sentences, the missing part comprised an ability from Table 7. A filler task was administered afterwards (described in Chapter 3, Study 1).

The positive refocusing, positive reappraisal, STAI, SDS, and VOG (sub)scales from Study 1 were also administered. The VOG scale asked participants to think about Rigel (instead of about God), such that “If Rigel existed, to what degree do you think he would have the following traits?”

**Design and Procedure**

The study was administered in Qualtrics and completed online. After giving informed consent, participants completed the demographic questions and initial scales in the same order as Study 1. Participants were then presented one of the four descriptions of Rigel and asked to carefully read it. They were required to remain on the page for at least 45 seconds and asked

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35 The statements established that Rigel has a physical presence with biological senses and psychological states.
to use any extra time “to think about Rigel and what you’ve read” as “some of the following questions will be about this being”. Participants next completed the recall task, before being given four minutes to complete as much of the filler task as they could. Finally, participants completed the Views of God scale, before being debriefed.

**Results**

Based on the same criteria as Study 1, 18 participants were excluded from positive refocusing/reappraisal analyses, 16 from repression analyses, and 3 from god positivity analyses. Finally, 53 participants were excluded from analyses involving the god concepts manipulation after failing to recall both of Rigel’s counterintuitive abilities. The number of recall failures did not differ between conditions (p = .742).

As in Study 1, religious participants scored higher than non-religious participants for repression, positive refocusing, and positive reappraisal (see Table 8), and age was positively related to repression, r = .21, p = .001, but did not predict any other variables.

**Table 8.** The relationship between religious identity and repression, positive reappraisal, and positive refocusing.

<table>
<thead>
<tr>
<th></th>
<th>Positive refocusing</th>
<th>Positive reappraisal</th>
<th>Repression</th>
</tr>
</thead>
<tbody>
<tr>
<td>Religious</td>
<td>M = 11.35; SD = 4.24</td>
<td>M = 13.55; SD = 4.04</td>
<td>M = 9.88; SD = 22.73</td>
</tr>
<tr>
<td>Non-religious</td>
<td>M = 9.25; SD = 4.21</td>
<td>M = 11.98; SD = 4.18</td>
<td>M = 2.59; SD = 21.89</td>
</tr>
<tr>
<td>t(df)</td>
<td>3.80(232)</td>
<td>2.93(232)</td>
<td>2.51(234)</td>
</tr>
<tr>
<td>p</td>
<td>&lt; .001</td>
<td>.004</td>
<td>.013</td>
</tr>
<tr>
<td>r</td>
<td>.24</td>
<td>.19</td>
<td>.16</td>
</tr>
</tbody>
</table>

Participants identifying with a religion (in demographics questions) did not differ from non-religious participants in their ratings of Rigel’s positivity (p = .569). To investigate the relationship between repression and god positivity for the four god concepts, god positivity scores were submitted to a 2 (a-priori threat) x 2 (a-priori benefit) ANCOVA with repression as a covariate. Unsurprisingly, the entities with low threat abilities were rated more positively (M = 25.36, SD = 13.07) than the entities with high threat abilities (M = 6.82, SD = 21.13), F(1,184) = 85.94, p < .001. Likewise, the entities with high benefit abilities were rated more positively (M = 21.17, SD = 16.29) than the entities with low benefit abilities (M = 11.37; SD = 21.77), F(1,184) = 20.04, p < .001. Furthermore, threat and benefit interacted to predict god
positivity, $F(1,184) = 23.52$, $p < .001$. When the entity was low in threat, the benefit it afforded had no impact on its positivity. However, when the entity was high in threat, the benefit it afforded increased positivity (see Figure 21).

There was no main effect of repression on god positivity ($p = .627$). Repression interacted with threat, $F(1,184) = 5.97$, $p = .016$, to predict god positivity, but did not interact with benefit ($p = .347$), and there was no three-way interaction ($p = .400$). Parameter estimates detailing the relationship between repression and god positivity for each god concept are shown in Table 9 and displayed in Figure 21. Repression only had a significant positive relationship with god positivity when the god was ascribed abilities that were both threatening and beneficial.

**Table 9.** How repression predicts god positivity for four versions of Rigel.

<table>
<thead>
<tr>
<th>God concept</th>
<th>Threat</th>
<th>Benefit</th>
<th>$B [95% \text{ CI}]$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benevolent</td>
<td>Low</td>
<td>High</td>
<td>$-0.095 [-0.296, 0.105]$</td>
<td>0.350</td>
</tr>
<tr>
<td>Ambivalent</td>
<td>Low</td>
<td>Low</td>
<td>$-0.105 [-0.319, 0.108]$</td>
<td>0.332</td>
</tr>
<tr>
<td>Ambivalent</td>
<td>High</td>
<td>High</td>
<td>$0.242 [0.049, 0.435]$</td>
<td>0.014</td>
</tr>
<tr>
<td>Malevolent</td>
<td>High</td>
<td>Low</td>
<td>$0.059 [-0.143, 0.260]$</td>
<td>0.567</td>
</tr>
</tbody>
</table>

**Figure 21.** How repression predicts god positivity for four versions of Rigel.
The results were qualitatively unchanged when negative and positive traits were considered separately. When religious identity was included as a factor, it did not interact with any of the other variables to predict god positivity (or positivity/negativity in isolation). Positive refocusing and positive reappraisal did not predict god positivity via main effects or via interactions with threat or benefit.

**Discussion**

In this study, the relationship between religious identity and repression was replicated, and repression was found to be correlated with positive interpretations of a god created by the experimenter that matched the religious agent template, but not for gods that didn’t match the template. These results support Chapter 4’s finding that religious agents have content that facilitates implicit emotion regulation strategies (such as repression). More importantly, it demonstrated that positive interpretations of god concepts that fit the religious agent template are likely to be formed when repressors encounter them, biasing them towards religious belief.

**General Discussion**

Comfort theorists of religion often imply some form of emotion regulation as a mechanism through which religious beliefs mitigate anxiety (see Chapter 1). While this may answer “why” religious beliefs are used in this way, it does not explain “how”, nor does it explain belief in supernatural beings and concepts that may cause more anxiety than they prevent. In this chapter, I argued that repression, as a form of implicit emotion regulation with an interpretive bias, can generate and maintain positive interpretations of threatening counterintuitive agents. Given that such interpretations should be motivationally attractive, and therefore believable, I predicted that religious individuals would use repression more than non-religious individuals, that positive interpretations of their god(s) would be mediated by repression, and that the relationship between repression and god positivity would be stronger when participants reported more negative affect after an implied association between their god(s) and a negative event (i.e., implied god negativity). It was also predicted that repression would be related to more than just the maintenance of positive interpretations of gods, but also to their formation with regard to gods that fit the religious agent template described in Chapter 4.
In Study 1, it was found that religious identity was indeed associated with repression, that repression partially explained religious individuals’ positive views of gods, and that negative affect, reported after implied god negativity, strengthened this relationship. Taken together, this indicated that repressors are more likely to interpret gods positively, that religious individuals disproportionately use repression in this way, and that repression serves a protective function – maintaining positive interpretations of gods when faced with contrary information. However, the extent to which contrary information was required is uncertain. It may be that negative affect strengthens the relationship between repression and god positivity, regardless of priming or article valence. Future studies should examine god versus neutral primes, and negative versus positive events.

In Study 2, the relationship between religious identity and repression was replicated, and repression was related to greater positivity ratings for a god created by the experimenter when that god was described in a manner consistent with the religious agent template (i.e., with an ambivalent combination of abilities that afforded high threat and high benefit), but not when the described god was inconsistent with the template (i.e., with either low threat, low benefit, or both). This supported Chapter 4’s finding that religious agents have content that facilitates implicit emotion regulation strategies and indicated that positive interpretations of god concepts that fit the religious agent template are likely to be formed by repressors.

Although many comfort theories assume that religious individuals must have some propensity for emotion regulation or motivated reasoning, it is rarely measured. In the present work, the propensity of religious individuals to use repression was directly measured, revealing not only a bias for it, but also a tendency to use it in the formation and maintenance of motivationally attractive interpretations of religious agents. Thus, if positive interpretations of gods are maintained by repression, particularly when faced with contrary information, it is easy to see why some people maintain (or even increase) belief in God when faced with tragedy in their lives. When someone appears to betray all reason to maintain their beliefs about a deity (e.g., “God had a reason for taking my family member away”), the present work suggests this occurs via repression of the deity’s negative traits and an emphasis of its positive traits, making tragedy less unbearable.

An examination of positive or negative traits in isolation revealed a more nuanced pattern in non-religious than in religious individuals. While religious repressors downplay the negative and emphasize the positive, non-religious repressors downplay the negative and, to a lesser extent, the positive. Thus, the comparable (but non-significant; p = .158) reduction in ratings for positive traits in this group may indicate avoidance rather than reinterpretation – non-religious repressors avoid all/most of a god’s traits, while religious repressors avoid only
the negative and emphasize the positive. This might be explained if non-religious individuals characterize their culture’s god as less controllable, particularly if they lacked a developmental environment in which prayer and ritual were used to extract positive outcomes from the god (thereby making it appear controllable); avoidance is a more common strategy for dealing with uncontrollable threats (Myers, 2010; Myers & Reynolds, 2000). Alternatively, for non-religious individuals, repression might involve wholesale rejection of a god’s power or existence, making any retention of its positive traits unnecessary. Further research is necessary, however, to test the robustness of the differences between religious and nonreligious individuals, and the validity of these speculative causes.

Nevertheless, it was surprising that repression of a god’s negative traits occurred at all among non-religious individuals. This suggests threat detection systems operate regardless of whether threats are explicitly believed or not. This is consistent with an indiscriminate “hyperactive agency detection device” that is theorized as an important stage in the formation of religious beliefs (see Chapter 1). Indeed, if repressors are especially sensitive to the detection of potentially threatening agents, as might be indicated by their initial ‘vigilance bias’ and physiological sensitivity to threat, this would explain why the repressive coping style is seen more in religious individuals. In essence, given their vigilance toward potentially threatening agents and their disposition to cope with them, repressors are halfway religious already. From here, some repressors appear to avoid the god completely (non-religious), while others are disposed to reinterpret the god positively (religious).

However, Study 1 only concerned existing beliefs, referencing gods that participants were already familiar with. It may be that a repressive coping style develops after religious beliefs are formed in order to maintain the beliefs for the comfort they afford. Study 2, however, partially established causality by presenting participants with new “gods”. Only when the supernatural agent fit the template, established in Chapter 4, for religious agents – high threat (attracting vigilance) and high benefit (allowing for positive reinterpretation) – did repression predict positivity. In other words, repressors formed motivationally attractive interpretations of this new god, just as they would for a god they already believed in.

A potential criticism of Study 2 is that, in being consistent with the religious agent template, religious individuals saw the reinterpreted god as analogous to the god they believe in (i.e., it was familiar to them). Although this account cannot be ruled out, it seems unlikely given the nature of the experimental materials: a god that controls minds and reverses time is inconsistent with common theistic beliefs. Indeed, positivity ratings for the reinterpreted god did not differ between religious and non-religious participants ($p = .377$), suggesting no familiarity bias.
In fact, religiosity per se played no role in Study 2, an important difference between the two studies. Non-religious repressors were just as likely to emphasize the positive traits of a new god as religious repressors were, but, in Study 1, non-religious repressors did not demonstrate this tendency for their culture’s god. This suggests that repressors, regardless of their religious worldview, may be especially prone to religious belief when a god is first encountered, whereas the tendency for non-religious repressors to avoid most traits of a particular god emerges later (perhaps if this particular god is perceived as uncontrollable).

As an interesting aside, if repression is habitually used by religious individuals to avoid or reinterpret negative information about their deities, one might further predict that any rebound effect inherent to the termination of repressive activity (such as is often observed after suppression) should regularly apply when religious individuals deconvert from their religion – essentially “rebounding” them into a form of reactionary atheism. Indeed, Albert Einstein once claimed not to “share the crusading spirit of the professional atheist whose fervor is mostly due to a painful act of liberation from the fetters of religious indoctrination received in youth” (Gilmore, 1997). Although not tested in the current studies, this “reactionary deconversion” was recently observed among former Mormons, who tended to report the lowest possible religiosity ratings (McGraw, Peer, & Draper, 2018).

Even though religious individuals were disposed to conscious strategies of interpretive bias in both studies (positive refocusing and positive reappraisal), these did not predict god positivity. This was anticipated, as the importance of religious beliefs to adherents should require that the beliefs be personally justifiable, implicating implicit (i.e., repression) but not explicit interpretive biases in their formation.

In summary, religious individuals were disposed to use repression to manage beliefs about the positive and negative traits their gods possess, while non-religious individuals were not disposed to repression, but still used it to avoid the negative traits of gods. Repressors, in general, positively interpreted an unfamiliar god when the god possessed content common to religious agents. This may therefore explain the prevalence of repression among religious individuals, and it identifies repression as a potentially important component on the pathway from anxiety to religious belief via its generation of motivationally attractive impressions of counterintuitive agents.
Chapter 6
The Hot Cognition Model of Religious Belief

Cognitive scientists of religion – dedicated to how the mind works – still don’t know why people recall counterintuitive concepts well, why people believe in these concepts (that are implausible by definition), and why only some concepts inspire religious devotion. Social scientists of religion – dedicated to why cultural phenomena exist – still don’t know how anxiety leads to religious belief, how it leads to belief in discomforting agents, and how these beliefs address particular anxieties. Framed in this way, the two fields could be considered complementary – the questions left unanswered by one may be addressed by the other.

Accordingly, in this thesis, I have proposed an integrative, “hot cognition” model of religious belief, incorporating both cognitive and motivational mechanisms, and grounded in evolutionary precepts. Specifically, I proposed threat detection as an adaptive rationale for the MCI effect – the preferential recall of minimally counterintuitive (MCI) concepts – that predicts enhanced detection of MCI concepts among individuals in anxious states. I further proposed that an accumulation of threatening MCI concepts among anxious individuals would be more likely to culminate in belief in these concepts when individuals possess proclivities for implicit emotion regulation that can facilitate a reinterpretation of the concept’s threatening features. Finally, I proposed that MCI concepts within the cultural environment (i.e., potential god concepts) would be likely to attract religious belief and worship when their features can facilitate interpretive, implicit emotion regulation. In essence, then, I proposed an explanation for how a comfort theory of religion might work.

In general, the hypotheses contained within these proposals (specified in Chapter 1) were supported by the studies detailed in this thesis. These six hypotheses are now revisited:

1) MCI agents are more potentially threatening and more potentially beneficent (perceived to afford greater opportunities) than intuitive agents. In Chapter 2, agents with a single counterintuitive ability (MCI) that violated folk psychology, folk physics, or folk biology were judged both as more threatening and more beneficent than agents with an intuitive (INT) ability. However, only folk psychology violations were consistently rated more beneficial. These effects remained when the outcome of the abilities was kept constant between MCI and INT domains, and when humans were granted access to the MCI abilities. This suggested that counterintuitiveness is a
cue for fitness relevance, and that agents with an MCI ability are a priority for threat
detection systems because they may be appraised as especially able to help or hinder
personal goals. Additionally, abilities that violated folk psychology were rated more
intuitive and beneficial than violations of folk physics or biology, suggesting that
agents with these abilities are more motivationally attractive and “minimally”
counterintuitive than other MCI agents.

2) *A bias for recalling the threat potential of MCI agents can explain the MCI effect.* In
Chapter 2, the MCI effect was partially mediated by potential threat ratings (and by
potential opportunity ratings in a separate model). However, there was no mediation
when the outcome of the abilities was kept constant between CI and INT domains,
suggesting that for threat to explain the MCI effect, counterintuitive abilities must be
employed to produce fitness relevant outcomes, such as those related to death,
reproduction, or social goals, in ways that intuitive abilities are not. This appears to be
compatible with numerous real-world examples, in which religious agents utilize their
counterintuitive abilities to achieve outcomes that would be difficult or impossible to
achieve in any intuitive way (e.g., flooding the world). It also appears compatible with
the fact that the MCI effect can be eliminated when concepts are presented without
appropriate context, such as in item lists rather than in narratives (Atran &
Norenzayan, 2004; Gonce et al., 2006; Porubanova et al., 2014; Upal et al., 2007).
Placing a counterintuitive concept within a narrative establishes its relevance (and
fitness relevance; Coe, Aiken, & Palmer, 2006), which would otherwise be
compromised by the paucity of inferences that can be made about its behavior and
which may eliminate its recall advantage, particularly when counterintuitiveness is
substantial rather than minimal. Nevertheless, threat detection did not offer a complete
explanation of the MCI effect. The finding that folk physics violations were recalled
best suggests recall may also be related to the number and depth of changes to existing
knowledge networks (i.e., connectionism; see Chapter 2, General Discussion),
implying counterintuitive concepts are attended to because they present a learning
opportunity (Upal, 2010).

3) *Anxious individuals exhibit a stronger MCI effect due to increased threat processing*
*(in turn biasing them towards religious belief).* In Chapter 3, participants in
experimentally manipulated anxious states were indeed found to exhibit a stronger
MCI effect (i.e., they recalled more MCI abilities relative to INT abilities) than
participants in non-anxious states, but with some qualifications. Anxiety was initially
elicited with a mixture of stimuli regarding physical threat and mortality concerns. In a replication (Study 4 of Chapter 3), anxiety was further distinguished by social, physical, and mortality-related concerns, as well as by its impersonal and interpersonal origins. MCI effect intensification did not vary between anxiety domains, suggesting participants did not distinguish MCI agents’ relevance to the domains; that is, attention was drawn to these agents purely on the basis of their threat-potential. However, it may be that MCI agents were perceived as equally relevant in all domains, and that anxiety in other contexts would not produce enhanced MCI effects. Indeed, in Study 2 of that chapter, a social threat related to goal-conflict (i.e., making academic goals appear difficult to achieve) did not lead to MCI effect intensification, which might be explained if cognitive biases were focused on internal states (e.g., rumination regarding the repercussions of academic failure). The distinctions among the manipulations of anxiety should be interpreted cautiously, as they were made a priori, and could not be validated with existing instruments. Nevertheless, the finding that anxiety can intensify the MCI effect suggested that people in anxious states are likely to remember and accumulate more MCI concepts than people in non-anxious states.

4) Religious agents are counterintuitive agents with content that facilitates implicit, interpretive emotion regulation strategies. In Chapter 4, religious agents were found to differ from fictional (secular) agents in four ways. Participants perceived them to be more beneficent, ambivalent (similar levels of threat and benefit), ambiguous (their abilities were less domain-specific), and capable of violating folk psychology (e.g., omniscience, mind control, etc). These features should facilitate motivated reasoning and other implicit, interpretive strategies of anxiety regulation. For example, beneficence and folk psychology violations are motivationally attractive (the latter supported by findings from Chapter 2), thus providing information with which a positive interpretation of an agent can be constructed. Ambiguity facilitates motivated reasoning by broadening the number and scope of interpretations that can be constructed. Ambivalence makes agents appear intuitively compelling and controllable (e.g., through rituals), which encourages interpretive rather than avoidant forms of emotion regulation. Ambivalence also describes the combination of cognitively attractive threat and motivationally attractive beneficence that is necessary for the proposed anxiety-belief pathway.
5) **Individuals prone to implicit, interpretive emotion regulation strategies are more likely to identify as religious.** In Chapter 5, people identifying as religious were indeed more likely to be repressors. Repression is an implicit emotion regulation strategy, deploying interpretive and avoidant biases that are a reversal of those experienced by anxious individuals. Religious individuals were also prone to positive reappraisal and positive refocusing, which are explicit versions of the repressive interpretive bias (although explicit strategies had no effect on interpretations of gods; see below).

6) **Individuals prone to implicit, interpretive emotion regulation strategies habitually reinterpret threatening impressions of religious agents to produce more comforting impressions.** If believers in religious agents are prone to emotion regulation, and these agents possess content that facilitates regulation, this suggests theistic beliefs are formed or maintained through regulation. In Chapter 5, religious individuals rated god(s) higher on positive traits than on negative traits (god positivity) compared to non-religious individuals, and this relationship was partially mediated by repression. Furthermore, the relationship between repression and god positivity was stronger when participants were more upset after a primed association between god(s) and a negative event (an earthquake), suggesting repression maintains positive interpretations of gods among believers. In a second study, repression was related to higher God positivity ratings for a supernatural entity created by the experimenter, but only when it was described with features empirically consistent with being a religious agent (i.e., with an ambivalent combination of abilities that afforded high threat and high benefit; see Chapter 4). This result supports Chapter 4’s claim that beliefs about religious agents are formed because the agents embody content that facilitates anxiety regulation. These studies therefore identify repression as a potentially important component on the pathway from anxiety to religious belief, via its generation of motivationally attractive impressions of counterintuitive agents. Curiously, while non-religious individuals were not disposed to repressive coping, they still appeared to use it to avoid the negative traits of familiar gods, but without emphasizing the positive. However, in general, repressors positively interpreted an unfamiliar god (that fit the religious agent template), suggesting atheistic attitudes towards familiar gods are learned.

Thus, with a few caveats, the hypotheses listed in Chapter 1 were supported by the studies described in Chapters 2-5. Considered together, these studies support a hot cognition
model, with a pathway from anxious states to religious belief that includes the processes outlined in Figure 22. Conceptually, the pathway includes a motivational process (anxiety regulation), which determines the direction of belief, a cognitive process (threat detection), which determines the likelihood of belief, and various content biases, context biases, and individual differences, which moderate the strength of belief, and thus also its likelihood.

Figure 22. A pathway from anxious states to religious belief (solid line), with suggested individual and cultural level moderators (dotted line).

Regarding this model, I should stress that I am not saying anxiety explains religious belief. This is no magic bullet. I am saying Figure 22 describes a pathway (of unknown prevalence) to religious belief for people who are in anxious states. There may be other pathways that are procedurally similar, such as might follow other negative affective states (e.g., anger, shame, grief, guilt, loneliness), or even positive affective states (e.g., pride, love, awe, contentment). Dissimilar pathways may follow other goal-based states that are less affect-laden, such as to explain natural phenomena, the birth of the universe, or mental phenomena (e.g., dreams), and these may be facilitated by teleofunctional reasoning (see Chapter 1). Indeed, there is no denying that the various cognitive mechanisms identified by CSR should make it very easy to proceed along these pathways, but it seems absurd to suggest that a collection of content and context biases can explain belief simply by their sheer number or opaque interaction. You can’t have moderators without something to moderate. I contend that there must be at least one pathway of the kind described in Figure 22.

I am also not saying Figure 22 is the complete pathway for anxious states. For example, trait anxiety may interact with state anxiety to produce an even greater MCI effect, although it would also make repression appear less likely (repressors self-deceive, reporting
low trait anxiety). To correctly characterize repressors, trait anxiety would have to be measured with physiological instruments (repeatedly) rather than self-reports. Other aspects of religious cognition (besides minimal counterintuitiveness) may also feature. For example, (hyperactive) agency detection may be important for ensuring that agents, with their presumably enhanced qualities for threat, beneficence, and folk psychology violations, become the focus of attention. Teleofunctional reasoning may be important for establishing the potential threat of MCI agents by attributing large-scale events (e.g., earthquakes) to their counterintuitive capabilities. Theory of mind permits perceived interactions with these agents (e.g., prayer), which may foster perceived control over them, thereby encouraging the use of interpretive rather than avoidant biases during anxiety regulation. Ritual behavior appears to be an alternative form of anxiety regulation, largely consisting of behavioral rather than cognitive processes that may also foster perceived control (Boyer & Lienard, 2008). If cognitive emotion regulation (i.e., repression) is maladaptive in the present environment, rituals may be a less costly alternative, perhaps resulting in more malevolent gods. Indeed, in contrast to repression, rituals may be preferable for dealing with uncontrollable threats (Sosis & Handwerker, 2011), perhaps because the ritual makes the threat appear more controllable.

Thus, in contrast to the view that religion is an aggregate phenomenon, each aspect of religious cognition may have properties conducive to a shared religious function (e.g., anxiety regulation). This functional similarity may answer a question posed early on in this thesis: why has this particular cluster of cognitive mechanisms been mobilized in the manner we observe and how did the process unravel in our ancestral environment? It may be that only those mechanisms that could moderate the proposed pathways were employed. As mechanisms came online, they would have sequentially augmented various stages of proto religion, but only if they were functionally similar to prior mechanisms.

Returning to Figure 22, the mechanisms incorporated thus far have their own etiologies. For example, there are many reasons to feel anxious, such as becoming ill, living through a natural disaster, having financial troubles, pondering mortality, becoming infertile, or feeling socially excluded (Mattlin et al., 1990). Anxious states related to these events may occur for a moment, for a day, or for or a decade. Religious belief would depend on whether a threatening god concept is detected and regulated in that time. In other words, there may be atheists in foxholes if religious thoughts never enter their minds.

Outside of foxholes, however, most atheists have probably been exposed to religious materials in times of anxiety, so why aren’t they believers? It may be that atheists are less likely to use implicit emotion regulation strategies (such as repression, Chapter 5). Without
regulation, negative views of gods would remain, making belief unpalatable. Alternatively, regulation may occur but in a different form. It’s clear that many atheists form beliefs about God’s non-existence; calling God disproven rather than unproven (Dawkins, 2006). This “strong atheism” appears empirically unsupported and may require a motivated process like repression, but with avoidant rather than interpretive biases. This avoidance is presumably not of the subject matter – atheists can argue prolifically about the subject – but of the potential threat God represents (i.e., God isn’t a threat if he doesn’t exist). Argument may serve to consistently reinforce the belief, with deconverted individuals being the most vehement (McGraw et al., 2018) because they are most in need of assurance about God’s non-existence. Chapter 5 provided some support for this view. In Study 1, religious repressors downplayed negative and emphasized positive features of God, but non-religious repressors downplayed negative and positive features (although not significantly for positive). This indicated that atheists use repression to avoid God rather than to reinterpret him positively. In Study 2, however, even atheists positively reinterpreted an unfamiliar god, suggesting their avoidance of familiar gods is learned. As repression tends towards avoidance rather than reinterpretation when threat is perceived as uncontrollable (Myers, 2010; Myers & Reynolds, 2000), atheists may have developed a perception that God is uncontrollable. This perception might have followed a traumatic experience, or perhaps a developmental environment in which prayer and ritual were not used to control (i.e., extract positive outcomes from) God. Atheists may therefore have developed views of God that are incompatible with the religious agent template (e.g., ambivalent gods that require rituals should appear most controllable).

Belief formation might fail at other points in Figure 22. It may be that emotion regulation proceeds, positive views of gods are formed, but these views do not translate into beliefs. This seems unlikely if the individual is already disposed to emotion regulation, but given the implicit nature of this regulation, it may be that implicit beliefs are formed (e.g., Jong et al., 2012), but explicit beliefs are not because the atheist has learned other reasoning styles (i.e., critical thinking) that regularly prevent implicit beliefs from becoming explicit. More fundamentally, atheists may have other motivations that are stronger or more easily satisfied than the simple desire to feel less anxious, such as to satisfy accuracy goals with supportable conclusions (see p.14), to avoid expending time and resources on religious practices, or to reject a god because its traits do not appeal to the atheist’s personality. For example, some atheists may reject overseeing gods because of a greater desire for privacy

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36 Although religious beliefs about negatively viewed (malevolent) gods presumably still form under some conditions, such as in highly threatening environments where ritual participation may be preferable to emotion regulation strategies such as repression. Ultimately, though, Chapter 4 suggests the inclination is to believe in beneficial gods.

37 Strong atheism is sometimes called “positive atheism” or “hard atheism”.
and/or independence. Various cognitive mechanisms and biases of importance in CSR might then moderate this path towards unbelief just as easily as they would belief.

As an example of this moderation, consider context biases. Untested in the current studies, but supported by other work, is the claim that belief is facilitated when particular contexts are present, such as when a belief is also held by prestigious, authoritative, or numerous individuals, or when such individuals perform displays to demonstrate their belief is credible (Cofnas, 2018; Gervais & Henrich, 2010; Gervais et al., 2011; Henrich, 2009; Lanman, 2012; McCauley & Cohen, 2010). While these context biases have been touted as enough to explain religious belief, this account does not explain how contexts become established or favorable toward particular agents in the first place. They may just as well facilitate atheistic beliefs. If your father gives his possessions away to join a doomsday cult, would this credible display facilitate your belief in the apocalypse, or belief that he’s mad? The weight of contrasting motivations should determine the outcome: do you want to keep your possessions and avoid looking foolish, or do you want to remain close to your father? This necessitates the proposed position of “observed contexts” in Figure 22: as a moderator that is directionless without a guiding motivation.

In general, then, the hot cognition model suggests it is motivations, such as to reduce anxiety, that direct individuals towards religious belief, while the various content biases, context biases, and other mechanisms that are important for religious cognition moderate this process. Atheists, despite having the same biases, may lack belief because they do not prioritize motivations that direct these biases into producing beliefs.

Returning again to Figure 22, it may be that some apparently core components are replaceable. Although untested in the current studies, it is possible that beliefs about the positive traits of gods principally serve as a launch pad for other beliefs, in which gods may be seen as more likely to use their counterintuitive abilities to mitigate the original concerns that caused the anxiety (e.g., providing an afterlife to individuals concerned about death). Such gods would therefore have no necessary relationship to the cause of anxiety or its solution; serving simply as a medium through which anxiety regulation proceeds. Theoretically, anything could be a medium. If death anxiety drew attention to a threatening coworker, anxiety might be regulated by positively reinterpreting them (“maybe they’re not so bad?”), using information about the coworker that allows for construction of this interpretation (e.g., the coworker gave to charity). As with a god, the coworker has no necessary relationship with the cause of anxiety (mortality) or its solution (immortality). The difference appears to be that the coworker is a medium that can never become a solution. There is no intuitive path between believing your coworker isn’t as bad as advertised and
believing in an afterlife. But, if the medium is a god that can live forever, this may cause alarm, but it would mean the god can plausibly bestow this gift if it’s perceived as willing. This broadening of possibilities appears to be a reason why gods possess counterintuitive abilities.

To conclude this discussion, Table 10 demonstrates the advantages of the present integrative approach by illustrating how the model would answer questions that neither CSR nor comfort theories are able to answer in isolation.

Future Studies and Directions

Despite support for the proposed hot cognition model from the current set of studies, all of the findings require further investigation and replication. In particular, the extent to which these results are translatable to other cultural contexts remains unclear. American participants provided the data for these studies. While some research has found the MCI effect to be cross-culturally consistent (e.g., Boyer & Ramble, 2001), as one might expect if it depends on “folk” knowledge, other aspects of the hot cognition model, such as the cognitive effects of anxiety (attention: Bar-Haim et al., 2007; recall: Herrera et al., 2017; Mitte, 2008), make no mention of cultural differences (probably because the vast majority of studies have used Western participants). Equally disappointing was a review of repression that only briefly mentioned cultural differences, and the data were limited to comparisons of different ethnicities within Western cultures (Myers, 2010). Some findings that are specific to the current set of studies also cannot be generalized, such as those related to perceptions of threat, benefit, and various agents, and relationships involving repression. Thus, it would be premature to draw conclusions about the universality of the hot cognition model at this stage.

Beyond mere replication, cross-cultural studies could support other hypotheses. For example, repression is likely to vary cross-culturally in how adaptive it is as a strategy. Especially threatening environments could make repression maladaptive. Based on the current discussion, this may lead to more malevolent gods, and perhaps increased ritual participation as an alternative means of emotion regulation. Paradoxically, then, cultures more in need of comfort may be the ones with the least comforting deities (Lanman, 2012), such as in sub-Saharan Africa (Middleton, 1960) and Melanesia (Keesing, 1982). To explore this possibility, measures of repression could be obtained cross-culturally and compared with the ambivalence of local gods, the pervasiveness of environmental threats, and the frequency and perceived efficacy of rituals.
Table 10. Quick answers to persistent questions in the cognitive and social study of religion.

| How does anxiety lead to religious belief? | The cognitive effects of anxiety draw attention to the threatening features of counterintuitive concepts, such as gods. If anxiety is subsequently regulated, this can lead to reinterpretation of the agent in more comforting terms that are more likely to be believed. |
| How does anxiety lead to belief in malevolent gods? | Threatening gods are cognitively attractive, especially to anxious individuals. Threat is also a necessary component of a god’s ambivalence, which can facilitate belief. Substantially malevolent gods may be part of a polytheistic pantheon that maintains ambivalence with a mixture of polarized deities. Threatening environmental conditions may make anxiety regulation maladaptive, leading to malevolent gods, and perhaps greater ritual participation as an alternative means of regulation and perceived control. |
| Why do people recall counterintuitive concepts well? | Counterintuitive concepts are fitness relevant – they afford considerable potential threat and benefit. This can make them a priority for naturally selected memory systems. However, counterintuitive concepts also appear to represent a learning opportunity, with recall related to the number and depth of changes to existing knowledge networks. |
| Why is Mickey Mouse not a god? | Not all counterintuitive agents are worshiped. Those that have features that facilitate motivated reasoning: a process that can make belief easier. These features include beneficence, ambiguity, ambivalence, and violations of folk psychology. Mickey Mouse lacks ambivalence and ambiguity. |
| What attracts anxious individuals to gods rather than to other coping strategies? | Anxious individuals don’t appear to be attracted to gods because they think a god will help them cope. They are attracted to gods because they’re threatening. The god becomes the object of anxiety, and so regulation brings a god’s positive traits to bear, after which religious coping may proceed. |
| What attracts death anxious individuals to gods when an afterlife belief, in isolation, should suffice? | Gods have no obvious connection to death, but a death anxious individual will attend to the threat afforded by a god. Anxiety regulation permits positive reinterpretation of the god; likely including ways in which the agent can use its counterintuitive abilities to satisfy the individual’s goals. This may plausibly include helping the individual achieve the same ethereal status as the god. |
| Are religious beliefs explicitly formed out of a need for comfort, rather than just being comforting? | Beliefs about the positive traits of gods are formed or maintained in response to negative impressions about gods, which may arise from anxious states and a need for comfort. Beliefs about the positive traits of gods may then suffice as a launch pad for other beliefs, in which gods use their counterintuitiveness to mitigate the particular concerns that caused the anxiety, e.g., providing an afterlife to individuals concerned about death. |
Other Extensions of the Present Research

There are many other ways in which the present results could be extended. For example, human agents should afford more potential threat and benefit than other ontological categories, such as objects, animals, and plants; even if they have the same features or abilities. The elevated recall and transmission potential of agents has been supported by Barrett et al. (2009), who found that they feature prominently in religious materials, and Porubanova et al. (2014), who found a recall bias for MCI agents over other MCI concepts (which they attributed to elevated potential threat). Confirming that these recall and transmission effects are related to the threat and benefit potential of agents would provide considerable support for the studies outlined in this thesis. However, there are likely to be cross-cultural differences. Animal gods may be more common in cultures with less inter-human hostility and more threat from predation. Indeed, Fessler et al. (2014) suggested that belief in hazardous information depends on the frequency of hazards of that type in the environment. A cross-cultural survey of salient threats (e.g., Mort, Fux, & Lawson, 2015) and how they relate to the ontological categories of worshiped agents could determine if this is the case.

Similarly, it would be worth extending the current MCI effect intensification (via anxiety) studies to include other ontological categories, highly counterintuitive (HCl) and counterschematic (CS) stimuli, and stimuli other than abilities. Abilities may be a particularly efficient way of conveying fitness relevance, although the difference between “a person who was at two places at the same time” (Boyer & Ramble, 2001) and a person who “can be in two places at the same time” (Chapter 3), appears more syntactic than semantic. Furthermore, even though the stimuli in Chapter 3 were technically presented in narrative form, the format was structurally similar to a list. A large MCI effect was still observed, but the effects may be larger if a more natural narrative structure were used (e.g., Boyer & Ramble, 2001). The use of other ontological categories, HCl, and CS stimuli would be predicted to mirror what is seen in other MCI effect studies, with other categories demonstrating a similar (but perhaps slightly smaller; Porubanova et al., 2014) effect, and with MCI stimuli recalled better than HCl and CS stimuli, presumably also with MCI stimuli rated the most threatening and beneficial.

Regarding the features of religious agents, Chapter 4 established the importance of ambivalent gods, suggesting they make religious rituals intuitively compelling. A measure of how “intuitively compelling” a ritual is may be its perceived efficacy for dealing with real-
world problems. For example, Legare and Souza (2012) designed a number of rituals (e.g., “In a metal container, put the leaves of a white rose. After that, set fire to the leaves. Get the remaining ash from the leaves and put it in a small plastic bag. Take the small plastic bag and leave it at a crossroad”) and asked people how much they thought various problems (e.g., sadness, addiction, unemployment) could be effectively treated by the behavior. They found intricate, repetitive, and specific rituals were judged more efficacious, because, they argued, such rituals are more intuitively compelling. As a way of understanding these effects, a future study might examine when such rituals are perceived to be effective in influencing supernatural agents. Based on the work in this thesis, I predict that such rituals would be judged more effective in communicating with ambivalent, fitness relevant agents (high threat, high benefit) than with other types of agents (e.g., the four versions of Rigel; Table 7).

One shortcoming of the studies in Chapter 5 was the correlational nature of the relationship between repression and god positivity (although partially addressed in Study 2). Indeed, the studies assumed that trait repression leads to more positive interpretations without testing for this capacity. This issue could be addressed by experimentally manipulating the extent to which people use positive and negative interpretations. In one promising study, Tran, Siemer, and Joormann (2011) asked participants to imagine themselves as the main character in various written scenarios, such as giving a speech. The final word of each scenario had letters missing for participants to fill in. For some participants, the letters could only spell a word that ended the scenario with a positive outcome. For others, the outcome could only be negative. Participants trained to use a negative interpretive bias reported lower self-esteem after a stressful task, but this was not the case for participants trained to use a positive interpretive bias. This training method could be adapted for use in the present studies, rather than relying on a trait measure of repression as an indicator of positive interpretive bias. Similar to Study 1 in Chapter 5, participants trained to use positive interpretive bias would be predicted to report greater god positivity than participants trained to use negative interpretive bias, and positive interpretive bias would be predicted to maintain high god positivity when god priming occurs in the context of a negative event. A variation of this method could allow both a positive and a negative solution to the same word fragments, with repressors predicted to demonstrate a positive interpretive bias in most situations, supporting their use of this bias in relation to the rest of the study.

Interpretive bias training could be employed to investigate another hypothesis. Reduced working memory capacity (evident in anxious individuals; see Chapter 1) may facilitate motivated reasoning by reducing the scrutiny that is applied to motivationally attractive interpretations of MCI concepts. Anxiety occupies working memory, making it
difficult to focus on other tasks. While this shouldn’t affect threat detection (Eysenck, 2005), less time may be devoted to evaluative and interpretive processes, such as understanding the meaning of rituals (i.e. cognitive resource depletion theory; Schjoedt et al., 2013). As MCI concepts require more processing time than intuitive concepts (Harmon-Vukić, Upal, & Sheehan, 2012), and reaching an accurate conclusion likely requires more processing time than reaching a desired conclusion (Kunda, 1990), anxiety may place constraints on the processing of MCI concepts, largely restricting reasoning to desirable interpretations. This hypothesis could be tested with interpretive bias training, but by presenting MCI concepts in scenarios that can end positively or negatively. Anxious participants may have a generally negative interpretive bias (Eysenck, 1997), but this would be predicted to be reduced, eliminated, or reversed for scenarios involving an MCI concept.

Finally, to assess the “launch pad” hypothesis, in which positive theistic beliefs lead to other comforting beliefs, a study could induce mortality salience before presenting the god and neutral primes used by Shariff and Norenzayan (2007). If, on a subsequent questionnaire, the god prime leads to reduced death anxiety compared with the neutral prime, it could be concluded that thoughts of gods allow greater access to comforting afterlife beliefs.

**The Diversity of Comfort**

In this thesis, I have only looked at “views of gods” as a measure of comforting beliefs and impressions. However, it is likely that implicit emotion regulation strategies (e.g., repression) are correlated with other comforting beliefs (some of which may follow from a positive view of gods). Based on an informal review of the literature in Chapter 1 (see section: Comfort Theories of Religion), comforting beliefs appear to fall into three categories that could form the basis for a more general scale: order and meaning (e.g., Levine & Salter, 1976), security and control (e.g., Kay et al., 2008), and future comfort and certainty (e.g., Jong et al., 2012). An example of how these categories might be assessed appears in Table 11, although there’s no way to know if these are valid or even distinct items.

Referring to Table 11, note that such beliefs can in principle be endorsed by atheists as well as by religious individuals, and yet these comforting beliefs appear to be disproportionately represented among religious individuals (e.g., Levine & Salter, 1976). However, more extensive testing regarding “what religious beliefs do you have that make you feel good?” and “what religious beliefs do you have that make you feel anxious?” could be undertaken. Indeed, a distressing beliefs scale may also be possible.
**Table 11.** A proposed comforting beliefs scale.

<table>
<thead>
<tr>
<th>Beliefs about order and meaning</th>
<th>Beliefs about security and control</th>
<th>Beliefs about future comfort and certainty</th>
</tr>
</thead>
<tbody>
<tr>
<td>I have purpose on this Earth.</td>
<td>A powerful being or person cares about me and my life.</td>
<td>My life will never become unbearable.</td>
</tr>
<tr>
<td>Earth and human beings are an important part of the universe.</td>
<td>A powerful being or person helps me when I am in need.</td>
<td>Anything bad that I’ve done can be forgiven.</td>
</tr>
<tr>
<td>There is a purpose to the existence of the universe.</td>
<td>A powerful being or person listens to my questions or requests.</td>
<td>The future of humanity is predestined.</td>
</tr>
<tr>
<td>I am deeply connected to forces that are greater than me.</td>
<td>A powerful being or person responds to my questions or requests.</td>
<td>There are prophecies or predictions that are known and that are certain to come true.</td>
</tr>
<tr>
<td>My beliefs include answers to many of life’s big questions.</td>
<td>I engage in activities that improve my relationship with a powerful being or person.</td>
<td>Those who do evil things will receive justice eventually.</td>
</tr>
<tr>
<td>I know how a human being should live their life.</td>
<td>My beliefs help me overcome life’s challenges.</td>
<td>Those who do good things will be rewarded eventually.</td>
</tr>
<tr>
<td>I and others who follow my moral code are living in the correct way.</td>
<td>A force for good controls what happens in the world.</td>
<td>The circumstances of my death are predestined.</td>
</tr>
<tr>
<td>I behave in ways that I think would please a perfect being or person.</td>
<td>There is harmony and order in nature.</td>
<td>I will continue to experience things and exist somewhere indefinitely.</td>
</tr>
<tr>
<td>You either follow the correct path or you’re against it.</td>
<td>Miracles happen that will never be explained by science.</td>
<td>It’s clear what I need to do to ensure my future existence is pleasant.</td>
</tr>
<tr>
<td>My beliefs have transformed my life for the better.</td>
<td>All evil can be explained by its role in the greater good.</td>
<td>I will see deceased family and friends again as they were in life.</td>
</tr>
<tr>
<td>When other people adopt my beliefs, they become better people.</td>
<td>When bad things happen to me, it’s meant to make me stronger.</td>
<td>In the future, I will be rewarded more than those who have chosen different beliefs.</td>
</tr>
</tbody>
</table>
The advantages of such a project could be substantial, addressing such questions as: Does anxiety only lead to stronger comforting beliefs or also to stronger distressing beliefs? Are only some comforting beliefs bolstered, or all of them? Do particular anxieties target particular beliefs? For example, is the notion of prophecy more believable for participants who write down their anxieties about the future? Is ultimate justice more believable for participants who read an article about crime in their neighborhood? And, given that these explicit beliefs are not worded in religious terms, would atheists demonstrate increased belief too (instead of engaging in worldview defense)?

**Interpretation or Attribution?**

The extent to which positive interpretations of gods are based on the narrative (e.g., scriptural) features of gods or on an individual’s existing knowledge and beliefs could also be explored. In this thesis, I’ve suggested that narrative features determine the interpretation (e.g., beneficence and ambiguity), but motivated reasoning inevitably requires making an interpretation consistent with prior beliefs (Kunda, 1990). Indeed, some research suggests that people attribute features to gods based on their current beliefs and goals (e.g., a spirit who cares about alcoholism and littering; Purzycki, 2016), and even the narrative features of gods must have spawned from a human mind, however long ago. Thus, it could be surmised that gods are agents with intentionality and goals attributed to them by humans – our way of giving agency to the power and laws of nature. If personal goals are attributed to gods, it could be predicted that people often represent gods in ways that are more comforting to them than to other people. A test of this hypothesis might involve asking participants to list “what God wants” for the world, for humanity, and for the participant themselves, and to rate how comforting these goals are compared to how comforting another participants’ generated goals are. Another study might test the hypothesis that a god can be attributed human goals by replacing it with a powerful, rational, but intentionless “agent” – an artificial intelligence (AI). Would participants attribute their own goals to an AI?

**The Transmission of MCI Concepts**

Affectively arousing statements are recalled and transmitted better than non-affective statements (Fiacconi, Dekraker, & Köhler, 2015; Hirshman, Whelley, & Palij, 1989; Kleinsmith & Kaplan, 1963; Nichols, 2002; Purzycki, 2010; Schmidt, 1994; Sharot, 2004). Consequently, motivationally attractive statements that are part of religious worldviews appear to receive a transmission advantage (Nichols, 2004). CSR currently describes
counterintuitiveness as imparting transmission advantages without any affective component (cold cognition). However, based on the studies in this thesis, counterintuitiveness bolsters perceptions of potential threat and potential benefit, intensifying threat detection and providing motivationally attractive information for regulatory processes. Thus, counterintuitiveness is cognitively and motivationally attractive (hot cognition), although there is considerable variation in the contributions of each component. For example, in Chapter 2, participants rated the ability “I can send thunderstorms to villages that offend me” more threatening than beneficial, while the ability “I can answer any question because I know everything” was rated the opposite way. The former is likely to be cognitively attractive; the latter motivationally attractive. As Chapter 4 and Chapter 5 (Study 2) found, each ability in isolation is unlikely to generate belief, but, together, they may produce an ambivalent being that is likely to be believed. Indeed, non-comforting beliefs can be incorporated into belief systems if they add to cognitive consistency (McGuire, 1960). However, is there a similar additive advantage in transmission? Are ambivalent gods more likely to be transmitted than malevolent or benevolent gods?

A future study could test the transmission potential of these different forms of god, perhaps using the concepts (of “Rigel”) applied in Chapter 5 (Table 7). I would predict a transmission advantage for the ambivalent (high threat, high benefit) god, consistent with the popularity of ambivalent “big gods” that feature in monotheistic faiths (Norenzayan, 2013), and in participants’ perceptions of religious agents (Chapter 4). Indeed, when Christianity comes into contact with religions that have had a more peaceful lineage, it regularly supplants or merges with them (Robbins, 2004). However, it may be challenging to measure “transmission” in an experimental setting. One possibility is to present participants with all of the “Rigel” god concepts (giving them different names) and to ask them to write a novel story about the concepts (e.g., Tweney et al., 2006). The more transmissible concept would be that which is mentioned earlier and more frequently in the stories.

As an initial test of this hypothesis, I examined the frequency with which particular agents were mentioned in the study reported in Chapter 4, and the ambivalence ratings those agents received (see Appendix D). To remove some of the positive skew (many agents were mentioned once), the mean ambivalence at each value of N was used, and all agents were included (religious and fictional). This left twenty-three data points (values of N between 1 and 88). A significant positive relationship between ambivalence and N was found, $r_s = .419$, $p = .047$, suggesting ambivalent agents are more readily transmitted.
Integrating the HADD

When people are asked to create a novel story using concepts from a list containing an equal number of intuitive, MCI, and HCI concepts, they are especially likely to incorporate MCI concepts into the story (Tweney et al., 2006). A “hyperactive agency detection device” (HADD) might similarly be regarded as generating a “story” about how an agent is related to the occurrence of an ambiguous, random, or telic event, whether this is a bush rustling in the wind, a creaking floorboard, or a pattern in the clouds (Guthrie, 1995). Given Tweney et al.’s (2006) findings, this agent should be more likely to be MCI, all else being equal. The MCI effect may therefore provide a relative abundance of MCI concepts for the HADD to attribute to events, explaining the ease with which ghosts, spirits, and demons are perceived in the shadows, and gods in the sky. In other words, the HADD may use memories of MCI agents as input for the agents it concocts. This may bias threat detection towards intentional MCI agents and, in the context of this thesis, may somewhat explain why gods often become the medium for anxiety regulation. To test the assumption that the HADD employs memories of MCI agents, participants could be exposed to intuitive, MCI, and HCI concepts (as with Tweney et al., 2006), before being placed in a situation that is likely to result in hyperactive agency detection (e.g., a video with suggestive stimuli, such as creaking floorboards, snapping twigs, rustling bushes, or shapes in the clouds). Participants would be asked to describe aspects of the situation, with descriptions predicted to feature more MCI agents from the prior list than other concepts.

The Maladaptiveness of Religion

For obvious reasons, responding to threats and anxiety with behavioral or cognitive regulation is not always adaptive. Some threats may be ignored that shouldn’t be. Indeed, a defining feature of religious behavior is a time-consuming attention to activity that is, on its face, unnecessary for one’s immediate survival or well-being. While there may be adaptive benefits (see Chapters 1 and 5), these may be outweighed by costs when environments are particularly threatening. Thus, it may be no surprise that the first evidence of religious belief dates to around ~100,000 years ago (Stringer et al., 1989), long after the evolution of anxiety and the numerous cognitive mechanisms attributed to the proliferation of religion. In other words, religion may have only become possible once humanity had mastered its environment enough to regulate anxieties and expend resources on activities unrelated to immediate survival. Religion may have been available to us for millions of years, but it would have been unsuccessful before a threshold of experienced threat was reached. The unlucky trailblazers
would have been wiped out because they allocated too much time to fruitless spiritual activity and threat avoidance in an unforgiving world. The timing of this threshold (~100,000 years ago) may therefore be coetaneous with human advances or environmental changes that reduced the level of experienced threat. Further elaborations of religious beliefs and practices may similarly be related to decreasing environmental threat. This hypothesis has been partially supported by recent work in which the emergence of three religions in the first millennium BCE coincided with a period of increased affluence and prosperity (Baumard, Hyafil, Morris, & Boyer, 2015). Further examinations of the archaeological record might provide additional support (perhaps with use of the Pulotu database; Watts et al., 2015).

Concluding Remarks

In summary, the hot cognition model provides a plausible answer to many of the questions that have been left unanswered by CSR and comfort theories (Table 10) and provides one testable pathway from anxiety to religion (Figure 22). The pathway describes the cognitive effects of anxiety, including fast-acting biases that unavoidably direct our attention and memory to threats, such as the threatening features of gods found in many religions. By virtue of their counterintuitive abilities, these gods are fitness relevant to a degree that intuitive agents are not, making them a priority for naturally selected memory systems, and potentially relevant to anxieties that may have no Earthly solution. These gods may therefore receive a cultural evolutionary advantage over non-threatening gods, but at the cost of becoming the object of our anxieties. When anxiety motivates us to seek comfort, then, it is this object that must necessarily be made palatable. The gods must be transformed in comforting ways. Their ambiguous features and heightened potential for beneficence make it possible to reason towards a fulfillment of this motivation. A god that brings disease and famine captures our attention, but a god that can also avert such calamities, given plausible means of persuasion, can be reframed as a source of comfort, and transformed into an entity that motivates belief. “The god who destroys trees, animals, and men with his thunderbolt is the selfsame god who fructifies the fields and meadows with his rain” (Feuerbach, 1851). And fructifying the fields, granting immortality, averting disasters, and a multitude of other beliefs about existential concerns may intuitively follow from belief in a being with counterintuitive powers who we’ve convinced ourselves wants to help.
References


Myers, L. B. (2010). The importance of the repressive coping style: findings from 30 years of research, Anxiety, Stress, & Coping, 23(1), 3-17.


Appendix A: Agent Counterintuitiveness Manipulation

Note: Participants see either the “intuitive” condition, or the “counterintuitive” condition. They all see the same instructions. Italicized text is not shown to participants. A horizontal line denotes a page break.

Instructions:

On the following screen you’ll see an important press release that is due to be published soon. Afterwards, you’ll be asked questions about it. Your feedback is important to us, so we’d like you to read it carefully.

Note that the scientist's name has been changed due to copyright issues.

Please click next to proceed to the press release.

________________________________________________________________________

**Intuitive condition (i.e., intuitive agents can do counterintuitive things)**

For release 2017

**The Boundaries of Science May Be Further Than We Think**

An article published in the journal Nature is set to trigger a scientific revolution. Author Henry Marsden, a renowned American scientist, describes how currently available technologies could be used to construct devices that allow people to enhance their physiology, manipulate reality, and even exhibit extrasensory abilities.

The article cites a multidisciplinary study funded by the Templeton Foundation. In the study, Marsden found that many supernatural abilities, which most people would consider the stuff of science fiction, are now within reach for humanity.
For example, extrasensory abilities, such as transporting one’s mind across distances, can be achieved with the construction of a headset that detects, transmits, and amplifies the wearer’s brainwaves in targeted ways. Marsden goes on to describe how what we think of as physical impossibilities, such as two solid objects occupying the same space, can be made possible by manipulating the way gravitational waves interact with other dimensions and universes, where the laws are physics are thought to operate differently to our own.

Additionally, Marsden provided evidence to suggest the limitations of human biology could be overcome with nanotechnology that produces, alters, and prevents damage to DNA. He summarized this exciting result, saying "preliminary tests made by my team prove the ease with which the human body can be altered on a molecular and cellular level".

These scientific breakthroughs mean that so-called "superheroes" who can enhance their bodies, read minds, and bend reality will be doing far more than gracing our television screens in the near future. In fact, the technology could soon be widely accessible, leading to a number of difficult legal questions about its potential uses.

Unsurprisingly, the Nature article produced considerable interest in the academic community. According to Marsden, the community largely agrees that it will soon be possible to construct some of the proposed instruments. Indeed, research councils are already considering ways to fund the development of many of the devices described in Marsden's article.

[end]

**Counterintuitive condition (i.e., only counterintuitive agents can do counterintuitive things)**

For release 2017

**The Boundaries of Science May Be Closer Than We Think**

An article published in the journal Nature is set to discredit numerous supernatural beliefs. Author Henry Marsden, a renowned American scientist, describes how it would be
scientifically impossible for people to do things that involve enhancing their physiology, manipulating reality, or exhibiting extrasensory abilities.

The article cites a multidisciplinary study funded by the Templeton Foundation. In the study, Marsden found that many supernatural abilities, which most people would consider the stuff of science fiction anyway, are in fact completely out of reach for humanity.

For example, extrasensory abilities, such as transporting one’s mind across distances, could never occur because of the dependent relationship between one’s thoughts and the neurons that are unique to each individual brain. Marsden goes on to describe how physical impossibilities, such as two solid objects occupying the same space, could also never happen because certain physical laws and phenomena, such as gravitational waves, must be constant in all dimensions and universes.

Additionally, Marsden provided evidence to suggest the limitations of human biology are impossible to overcome because our DNA cannot be altered in "real time" without the changes being rejected. He summarized this frustrating result, saying "every time my team attempted to augment the genome, it immediately mutated into random noise".

These scientific boundaries mean that so-called "superheroes" who can enhance their bodies, read minds, and bend reality might make good television, but we will unfortunately never encounter such people in our actual lives. On the positive side, the fact that supernatural technology is impossible will avoid a number of difficult legal questions about its potential uses.

Nevertheless, the Nature article produced considerable interest in the academic community. According to Marsden, the community largely understands the important constraints this research puts on our advancement as a species. Indeed, research councils are already considering ways to reallocate funds into more realistic endeavors than those which were proven impossible by Marsden’s article.

[ends]
Appendix B: Image Locations

Database and file names for images used in the “Anxiety Types Manipulation” (see Appendix C). Some images are used in several conditions.

Social anxiety:
1. NAPS, Faces_303_h.jpg
2. SFIP, social_003.jpg
3. SFIP, social_004.jpg
4. SFIP, social_042.jpg
5. NAPS, Faces_154_h.jpg
6. NAPS, Faces_161_h.jpg
7. WSEFEP, HW_0452.jpg
8. NAPS, Faces_162_h.jpg
9. SFIP, social_039.jpg
10. WSEFEP, KS_0993.jpg

Physical anxiety (impersonal):
1. NAPS, People_210_h.jpg
2. NAPS, People_010_h.jpg
3. NAPS, People_007_h.jpg
4. NAPS, Faces_150_h.jpg
5. NAPS, People_001_h.jpg
6. NAPS, People_147_h.jpg
7. NAPS, People_219_h.jpg
8. NAPS, Faces_146_h.jpg
9. NAPS, People_011_h.jpg
10. NAPS, People_133_h.jpg

Physical anxiety (interpersonal):
1. IAPS, A8.jpg
2. NAPS, People_140_h.jpg
3. NAPS, People_007_h.jpg
4. NAPS, People_001_h.jpg
5. NAPS, Faces_146_h.jpg
6. NAPS, People_147_h.jpg
7. NAPS, People_065_h.jpg
8. NAPS, People_127_h.jpg
9. NAPS, People_219_h.jpg
10. NAPS, People_133_h.jpg

Death anxiety (impersonal):
1. NAPS, Faces_146_h.jpg
2. NAPS, People_212_h.jpg
3. NAPS, People_200_h.jpg
4. NAPS, Faces_165_v.jpg
5. NAPS, People_235_h.jpg
6. NAPS, People_219_h.jpg
7. NAPS, People_147_h.jpg
8. NAPS, Faces_159_h.jpg
9. NAPS, People_022_h.jpg
10. NAPS, Faces_367_h.jpg

Death anxiety (interpersonal):
1. NAPS, People_238_h.jpg
2. NAPS, People_212_h.jpg
3. NAPS, People_235_h.jpg
4. NAPS, People_225_h.jpg
5. NAPS, People_022_h.jpg
6. NAPS, Faces_159_h.jpg
7. NAPS, People_147_h.jpg
8. NAPS, People_219_h.jpg
9. NAPS, People_231_h.jpg
10. NAPS, Faces_367_h.jpg

Control (non-anxious):
1. NAPS, Faces_234_h.jpg
2. NAPS, People_051_h.jpg
3. NAPS, People_157_h.jpg
4. NAPS, Faces_252_h.jpg
5. NAPS, Faces_068_h.jpg
6. NAPS, Faces_103_h.jpg
7. NAPS, People_173_h.jpg
8. NAPS, People_154_h.jpg
9. NAPS, People_191_h.jpg
10. NAPS, Faces_140_h.jpg
Appendix C: The Anxiety Types Manipulation

Note: Below are the instructions participants read before the manipulation. The bracketed terms show what appears in the control condition. A horizontal line denotes a page break. On the following pages, the six conditions are shown. The images on these pages are shown at a reduced size and without denoting the page breaks that appear between statement-image pairs.

IMPORTANT INFORMATION ABOUT THIS SURVEY:

On the following pages, you’ll be shown some facts and statistics that have appeared in recent news articles. The facts we’ve collected are unpleasant [pleasant] to think about. An [unpleasant/pleasant] photograph will appear after each one. The sequence of 10 facts and photographs will advance at its own speed. If you do not wish to look at these materials, please remember that you can withdraw from the survey at any time.

When reading about these facts and statistics, we would like you to involve yourself personally. Try to see how each one is, or may become, personally relevant to your life and the difficulties you might [inspiration you will] experience along the way.

Please click next to continue.

We reiterate, once again, how important your personal involvement is in what appears in the facts and photographs. Later, you’ll be asked about how they affected you.

Please click next to begin the sequence.
1. A study about the causes and effects of poverty estimated that a majority of people are one bad decision away from destitution and, regrettably, the pity or contempt of their peers.

2. Of people who have failed an important test or exam at some point in their life, more than 90% reported feeling negatively judged by friends and family.

3. A survey found that 43% of individuals who’d recently spoken to an audience or small group thought they’d embarrassed themselves. Generally, audience members were even harsher in their anonymous criticism of speakers.

4. The most commonly cited reason for the breakdown of relationships is “saying the wrong thing” and offending friends or family.

5. A study about social networks found that most people incorrectly believe their friends, family, and coworkers have good impressions of them.

6. A study found that almost everyone is lied to more often than they think, and the number of lies you’re told is related to how gullible people think you are.
7. A cross-cultural survey found that the situation most likely to result in personal ridicule is “meeting someone new for the first time”.

8. Researchers have determined that dating or staying in a relationship is now twice as difficult as it was 50 years ago. They attributed this to “an increased focus on personal imperfections”.

9. A study found that people who missed social events were more likely to be regarded negatively by their peers after as little as one missed event.

10. Physiological tests have revealed that everyone sweats in social situations, yet studies show 92% of people underestimate the strength of body odor they produce.

**Physical anxiety (impersonal)**

1. In a medical survey, 53% of people enduring lifelong pain from nerve damage reported that it was caused by a commonplace accident, such as slipping on an icy sidewalk.

2. Falling down a flight of stairs happens to thousands of people every year and is the most common cause of paralysis in all age groups.
3. According to a new study, stepping inside a car increases your risk of being injured tenfold. In most cases, drivers are overwhelmed by a rapid turn of events.

4. Many accidents happen at home or work. Evolutionary biologists have determined that the machines we surround ourselves with, such as hot stoves and trash disposals, are not in our nature to use.

5. According to the fire service, the vast majority of house fires are “unforeseeable,” occurring in circumstances such as hot weather, focused sunlight, lightning, and random electrical faults.

6. Genealogists estimate that 63% of people will develop a partially or completely debilitating health condition at some point in their lives.

7. A recent study found that 62% of local water supplies are naturally contaminated with bacteria or other microbes that can cause multiple health problems.

8. A groundbreaking study found that more than 60% of common illnesses are related to bites from insects, mites, and bed bugs.
9. Scientists and geologists have never predicted a major earthquake. Multiple studies confirm it’s impossible to know when and where they will strike.

10. As seen on the news, major floods hit all manner of places with little warning. A meta-analysis suggests there’s no way to know which area will be hit next.

**Physical anxiety (interpersonal)**

1. The unwillingness of male and female victims to speak out about sexual assault means it’s far more common than the numbers suggest. It’s known that 60% of rapes occur during home invasions.

2. According to the Department of Justice, nearly half of all violent assaults occur during home invasions, and over 2 million homes are broken into each year.

3. Alcohol and drug-impaired drivers cause nearly half of all traffic accidents. It’s impossible to know when one will put you in harm’s way.

4. The Justice Department report that arson is one of the most common premeditated crimes. When a culprit is identified, it often turns out to be an ex-partner or vengeful neighbor.
5. The most common way to catch a virus or disease is from an object that was carelessly contaminated by another person, such as a door handle or shopping cart.

6. Around 80% of sexually transmitted diseases are caught from people who never got themselves checked. The other 20% simply don’t tell their partners.

7. Medical malpractice is on the rise. The number of people getting ill after routine appointments and surgeries has doubled in the last 10 years.

8. The Justice Department report that the number of unprovoked violent assaults, commonly known as “street beatings”, has risen 73% since last year.

9. A recent study found that 62% of local water supplies have been intentionally contaminated with farm waste or factory-produced pollutants that can cause multiple health problems.

10. Human-produced climate change is becoming noticeable in the form of stronger storms and increased flooding. A meta-analysis suggests there’s no way to know which areas will be hit worst.
Death anxiety (impersonal)

1. The likelihood of developing cancer at some point in your life is 50%. There is no way to know who will die from it and who won’t.

2. According to NASA scientists, it only requires one random collision in space to send an asteroid hurtling towards Earth, threatening our species with extinction.

3. The CDC report that it’s only a matter of time before a disease becomes resistant to all antibiotics and causes a pandemic that kills billions.

4. It’s true that sandwiches are more lethal than sharks. Choking is a leading cause of unintentional death. One moment you’re eating happily, and the next it’s all over.

5. Millions of people have unruptured brain aneurysms and don’t know it. Every 30 minutes, somebody will suffer a fatal rupture, usually with no warning signs.

6. You can’t see it, smell it, or taste it, but carbon monoxide silently kills thousands each year. The gas is emitted from old heaters and boilers.
7. Alzheimer’s progresses from memory loss to a failure of bodily functions, ultimately killing 2 million annually. Many cases are “early-onset” in people under 65.

8. According to the fire service, more than 60% of deaths from fires are “unforeseeable”, caused by hot weather, focused sunlight, lightning, and random electrical faults.

9. According to a new study, stepping inside a car increases your risk of dying tenfold. In most cases, drivers are overwhelmed by a rapid turn of events.

10. Falling down a flight of stairs happens to thousands of people every year and is one of the most common causes of accidental death in all age groups.

**Death anxiety (interpersonal)**

1. The FBI reports there have been more terrorist attacks in the last 10 years than the previous 100, and that people from all backgrounds can be victims of terrorism.

2. It wasn’t long ago when the entire world was gripped in war. A new study has determined we’re overdue for another, and that our military buildup is a sure sign.
3. The murder rate has been rising quicker than at any time in the last 25 years. Researchers say this is related to rising social and political tensions.

4. Safety cannot be guaranteed in our own neighborhood, or even in our own home. It’s reported that two thirds of murder victims knew their attacker.

5. Alcohol and drug-impaired drivers cause nearly half of all road deaths. It’s impossible to know when one will involve you in a fatal crash.

6. The Justice Department report that arson is increasingly being used to commit murder. When a culprit is identified, it often turns out to be an ex-partner or vengeful neighbor.

7. HIV is a protracted death sentence. Around 80% of HIV infections are caught from people who never got themselves checked. The other 20% simply don’t tell their partners.

8. Medical malpractice is on the rise. The number of deaths from infection after a routine appointment or surgery has doubled in the last 10 years.
9. A study found that poison is the most effective murder weapon because victims are often oblivious to the cause of their deterioration.

10. The Justice Department report that murders following home invasions were up 53% last year. Many victims were killed trying to flee the scene.

Control (non-anxious)

1. According to multiple historical studies, there has never been a more peaceful, conflict-free time in human history. In that, there is reason to be hopeful.

2. A cross-cultural study has determined that human society is safer than it’s ever been. The researchers attribute this to intellectual and technological advancements.

3. When people were asked what they find beautiful, 92% cited the flora and fauna of the natural world - from the flutter of a hummingbird to the vast spectrum of floral color.

4. When people were asked what they find special about humanity, a survey determined that it’s our capacity to love that epitomizes and unites our species.
5. A study in which participants exchanged small cash rewards discovered that human beings have a natural disposition for kindness and giving, even when expecting nothing in return.

6. When asked about how adversity affects our lives, more than 90% of people reported coming out stronger on the other side.

7. Psychological research has determined that when we achieve our goals, big or small, the happiness we feel encourages us to achieve even greater goals.

8. The history of science has taught us that, ultimately, we are part of nature, and our inspiration to learn about the natural world is drawn from its vibrant and celestial beauty.

9. What we can achieve when we set out minds to it is truly staggering. Studies into placebos have shown that belief may be all that’s required to produce remarkable feats of brilliance.

10. Relationship studies have shown that the affection we receive from those we love makes us feel safe, confident, and secure in our environment.
Appendix D: The Fitness Relevance of Distinct Counterintuitive Agents

The mean threat, benefit, and valence (absolute threat-benefit difference) of distinct religious and fictional agents, where $N$ is the number of participants who named the agent in their list of five well-known beings and entities.

**Religious Beings and Entities**

<table>
<thead>
<tr>
<th>Agent</th>
<th>N</th>
<th>Threat</th>
<th>Benefit</th>
<th>Valence</th>
</tr>
</thead>
<tbody>
<tr>
<td>God</td>
<td>88</td>
<td>6.216</td>
<td>6.375</td>
<td>0.750</td>
</tr>
<tr>
<td>Jesus</td>
<td>88</td>
<td>5.125</td>
<td>6.148</td>
<td>1.386</td>
</tr>
<tr>
<td>Zeus</td>
<td>66</td>
<td>6.348</td>
<td>5.758</td>
<td>0.712</td>
</tr>
<tr>
<td>Buddha</td>
<td>64</td>
<td>3.250</td>
<td>5.109</td>
<td>1.953</td>
</tr>
<tr>
<td>Allah</td>
<td>33</td>
<td>5.667</td>
<td>5.697</td>
<td>1.061</td>
</tr>
<tr>
<td>Satan</td>
<td>30</td>
<td>6.400</td>
<td>2.933</td>
<td>3.467</td>
</tr>
<tr>
<td>Muhammad</td>
<td>25</td>
<td>3.800</td>
<td>4.200</td>
<td>1.440</td>
</tr>
<tr>
<td>Ra</td>
<td>15</td>
<td>6.867</td>
<td>6.267</td>
<td>0.600</td>
</tr>
<tr>
<td>Odin</td>
<td>13</td>
<td>6.000</td>
<td>5.923</td>
<td>0.846</td>
</tr>
<tr>
<td>Shiva</td>
<td>13</td>
<td>5.538</td>
<td>5.846</td>
<td>0.923</td>
</tr>
<tr>
<td>Thor</td>
<td>13</td>
<td>5.923</td>
<td>4.615</td>
<td>1.615</td>
</tr>
<tr>
<td>Poseidon</td>
<td>10</td>
<td>6.500</td>
<td>5.800</td>
<td>1.100</td>
</tr>
<tr>
<td>Vishnu</td>
<td>10</td>
<td>5.100</td>
<td>5.000</td>
<td>0.100</td>
</tr>
<tr>
<td>Athena</td>
<td>9</td>
<td>5.778</td>
<td>5.889</td>
<td>0.111</td>
</tr>
<tr>
<td>Apollo</td>
<td>8</td>
<td>5.500</td>
<td>6.500</td>
<td>1.000</td>
</tr>
<tr>
<td>Krishna</td>
<td>7</td>
<td>6.000</td>
<td>6.000</td>
<td>0.286</td>
</tr>
<tr>
<td>Angel</td>
<td>6</td>
<td>5.000</td>
<td>6.000</td>
<td>1.667</td>
</tr>
<tr>
<td>Hades</td>
<td>6</td>
<td>6.000</td>
<td>3.167</td>
<td>2.833</td>
</tr>
<tr>
<td>Holy Spirit</td>
<td>6</td>
<td>5.167</td>
<td>6.500</td>
<td>1.333</td>
</tr>
<tr>
<td>Anubis</td>
<td>5</td>
<td>6.600</td>
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Appendix E: Supernatural Attribution Materials

Note: Participants see either the unknown earthquake text (275 words), or the human-caused earthquake text (273 words). They all see the same instructions. Italicized text is not shown to participants. A horizontal line denotes a page break.

Instructions:

On the following screens, you will be shown three sections from an article about a real event that occurred in 2011. Please read each section carefully. We will ask you about the article afterwards. To ensure a minimum reading time, there will be a short delay before the next button appears, but please spend as long as you like on each screen.

If you understand these instructions and the next button is visible, please click it to begin the article.

Unknown Earthquake

Section 1 (minimum time 10 seconds)

On August 23rd, 2011, people living Mineral, Virginia, got a nasty shock. At 1:51 p.m., a 5.8 magnitude earthquake shook the ground, damaged buildings, and put a crack in the Washington monument.

It was the most powerful earthquake ever recorded in Virginia, but, as with most earthquakes, it was wholly unpredictable and unavoidable. The quake was caused by the apparently random motion of tectonic plates, causing seismic waves to pulse through the Earth’s crust.
Section 2 (minimum time 14 seconds)

Several people were injured in the earthquake, but what continues to terrify Virginia residents is that no-one saw it coming. In fact, no-one ever sees an earthquake coming. It’s impossible to know when and where they will strike.

For decades, scientists have tried and failed to find precursors to major earthquakes. They’ve studied foreshocks, surface deformations, chemical changes in groundwater, radon gas concentrations, electromagnetic activity, and even animal behaviour. In each case, nothing has been shown to reliably predict a quake.

“When you really bring the whole weight of statistical rigour to it, nothing stands up,” says Susan Hough, a geophysicist at the California Institute of Technology.

Section 3 (minimum time 12 seconds)

The Virginia earthquake highlights just how unpredictable earthquakes can be. Although they usually occur around fault lines in the tectonic plates beneath the Earth’s surface, there were no active fault lines in the area of the Virginia quake.

Furthermore, despite knowing that earthquakes are caused by shifting tectonic plates, these plates don’t send out a memo before they shift - the motion occurs without warning. For this reason, the ultimate cause of when, where, and why they shift remains a complete unknown, making it impossible to know when the next big one will strike.

Human-Caused Earthquake

Section 1 (minimum time 10 seconds)

On November 5th, 2011, people living near Prague, Oklahoma, got a nasty shock. At 10:53 p.m., a 5.7 magnitude earthquake shook the ground, damaged buildings, and buckled U.S. Route 62 in three places.
It was the most powerful earthquake ever recorded in Oklahoma, but, as with most manmade earthquakes, it was wholly predictable and avoidable. The quake was caused by fracking engineers injecting millions of gallons of wastewater into deep underground wells, destabilizing the bedrock.

Section 2 (minimum time 14 seconds)

Several people were injured in the earthquake, but what continues to terrify Oklahoma residents is that fracking operations have continued in the area. It’s only a matter of time before another large earthquake is triggered in the same location.

For decades, the oil and gas industry have pumped wastewater underground, but only recently has it produced major earthquakes. Scientists who studied seismic activity in the region found that it’s a scale problem. The booming fracking industry is simply injecting too much wastewater into the ground, making quakes a predictable result.

“This underlines the importance of seismic monitoring in areas of subsurface fluid injection” says Nicholas van der Elst, a seismologist at Columbia University.

Section 3 (minimum time 12 seconds)

The Oklahoma earthquake highlights just how predictable manmade earthquakes can be. There were no active fault lines in the area of the Oklahoma quake, leaving the fracking industry as the only obvious culprit.

However, despite knowing that earthquakes are caused by their operations, fracking companies are routinely placing profit above their social responsibilities. For this reason, the ultimate cause of the next big manmade quake will be sitting in an office somewhere, well away from the epicentre, knowing exactly when, where, and why it struck.