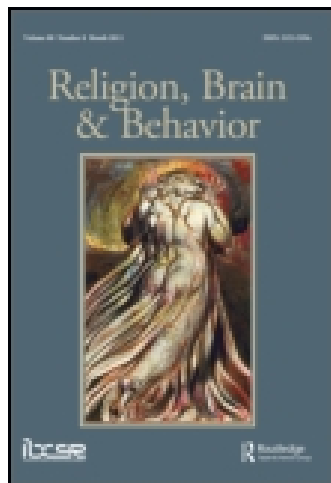


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Motivational and neural systems of religion

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TARGET ARTICLE

The need to believe: a neuroscience account of religion as a motivated process

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Religious belief has been shown to offer substantial benefits to its adherents, including improved well-being and health. We suggest that these benefits might be explained, at least in part, from a “motivated meaning-making” perspective. This model holds that people are motivated to create and sustain *meaning* (i.e., a sense of coherency between beliefs, goals, and perceptions of the environment, which provides individuals with the feeling that the world is an orderly place), and that religious beliefs buffer the distress associated with disruptions to meaning, thus leading to decreases in distress. We further propose that religion’s palliative attributes can be measured at the level of the brain, specifically in the anterior cingulate cortex (ACC), which produces a “distress signal” upon the detection of errors, conflict, and expectancy violation. Using a social neuroscience paradigm, we investigate four main predictions that arise from this model: (1) religion should be associated with activation in the ACC; (2) religion should decrease activation in the ACC; (3) this attenuation of ACC activity should be related to religion’s ability to buffer bodily states of distress, and not to decreases in motivation, attention, or control; (4) religion should have these effects because it provides meaning and thus buffers people from uncertainty. All predictions were supported, thus providing evidence, at the neural level, for the motivated meaning-making model’s account of the salutary properties of religion.

Keywords: religion; meaning-making; motivation; social neuroscience; anterior cingulate cortex

Introduction

God is not great. At least that’s what the patriarchs of the New Atheist movement would like us to believe. According to them and their myriad adherents, organized religion is a virus that infects the modern world (Dawkins, 2006; Harris, 2004; Hitchens, 2007). They maintain that the “god hypothesis” has failed, that predictions derived from religion have been falsified, and that belief is, in fact, delusional. However, this focus on the truth-value of religion and on whether or not it is based on actual facts and verifiable claims has perhaps distracted the New Atheists from another set of facts – that religion has undeniably positive effects, at least for individual believers.

A large body of research suggests that, on average, religious people are happier and healthier than nonreligious people. For example, individuals with strong religious faith report higher levels of life satisfaction, greater personal happiness, and fewer

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negative psychological consequences of traumatic life events compared to those without faith (Diener, Suh, Lucas, & Smith, 1999; Ellison, 1991; Gartner, Larson, & Allen, 1991). Further, in several longitudinal studies, researchers have demonstrated that religiosity (in particular, religious service attendance), was strongly and consistently linked to a reduction in the risk of mortality and in the incidence of cardiovascular disease (Powell, Shahabi, & Thoresen, 2003). Some have even suggested that religious attendance can add 2–3 years to a person's life (Hall, 2006). One longitudinal study found that religious attendance stems the cognitive decline that is typical of the elderly, leading its authors to encourage religious practice as a form of therapy (Corsentino, Collins, Sachs-Ericsson, & Blazer, 2009). There is also reason to believe that religion may foster self-control – a trait that has been widely implicated in health, happiness, and success (McCullough & Willoughby, 2009). Finally, many of the findings listed above hold even after statistically controlling for important “third-variables” such as gender, age, pre-existing physical health, etc. (e.g., Powell et al., 2003), implying that there may be something *unique* about religiosity that promotes mental and physical well-being.

Given these findings, a focus on whether religion is based on facts may be beside the point; other facts indicate that it may allow believers to live the good life. This is good news to many, as most people around the world engage in some form of religious belief. Some have suggested that about 85% of the world's population could be classified as religious (Zuckerman, 2005). Why is religion so widespread? And how does it confer such undeniable benefits to the individual? These are the central questions driving our paper. Our thesis is straightforward: we suggest that religion is prevalent and beneficial because it fulfills one of our most basic needs, which is the need to create and sustain meaning. Meaning can be conceptualized as the perceived coherence between one's beliefs, goals, and perceptions of the environment. When these things align, we are left with the sense that the world is ordered, controlled, and understandable. When this coherence is disrupted, however, meaning is threatened and we feel distressed and anxious as a result (e.g., Festinger, 1957). We view religion as a means through which the motivation for meaning is satisfied, and offer as evidence brain data relating religiosity to the reduction of distress and anxiety. In particular, we present data indicating that both religion and beliefs in an orderly universe predict muted distress responses in the human brain.

Toward a cognitive science of religion

Our work is hardly the only research to address the question of religion's prevalence, roots, and function. Recent work in psychology, neuroscience, cultural anthropology, and archaeology has been addressing such questions in building a new cognitive science of religion (e.g., Barrett, 2000; Bering, 2006; Boyer, 2001; McNamara, 2006; Norenzayan & Shariff, 2008; Sosis & Alcorta, 2003). One of the core themes of this research is that religious beliefs are a natural product of the way human minds and brains work. As such, there are a number of complementary explanations to the questions about religion's prevalence and benefits. Comprehensive coverage of all of these accounts is beyond the scope of this paper, but we briefly discuss two of them, before going into greater detail on a third of these, the motivational account, which we think has been under-developed or at least under-appreciated by the new breed of scientists of religion.

Hyperactive agency detection

The first account suggests that belief in God is a by-product of the evolutionarily adaptive ability to detect agency in the external world (Atran, 2002; Barrett, 2000). Agency detection describes humans' tendency to perceive events as being caused by a purposeful actor, even in situations where it is clear that no agent is present. Although such a tendency can lead to errors, it also confers survival advantages. In situations where the presence of a potentially dangerous agent is uncertain, it makes sense to assume such a presence. It is safer to confuse a rock for a bear, in other words, than the other way around. The high cost of failing to detect agents has led researchers to propose that humans have a module for agency detection. Belief in God, according to this view, is a by-product, a non-adaptive spandrel that is the result of overactive agency detection.

Prosociality, costly signaling, and the evolution of large groups

The second account, rooted in evolutionary psychology, suggests that religion flourished because it promotes prosocial tendencies among humans (Norenzayan & Shariff, 2008). One prosociality account suggests that religion flourished in part as a by-product of other evolutionarily adaptive traits, namely, the human sensitivity to prosocial reputation. Some have suggested that such traits may have contributed to the stability of reciprocal cooperation within groups (Fehr & Fischbacher, 2003; Henrich et al., 2006). When an all-knowing God observes and punishes misdeeds, this sensitivity will foster good behavior and prosociality even between complete strangers and within very large groups (Norenzayan & Shariff, 2008; Shariff & Norenzayan, 2007). A related idea known as the costly signaling perspective (e.g., Sosis & Bressler, 2003) holds that religion flourished and that religious groups became large and dominant because religious behaviors and rituals are often "costly" and difficult to fake (i.e., they involve doing things that are unpleasant such as fasting, abstaining from certain foods, and abstaining from sex, etc.). This effectively provides a signal of true commitment to the group and reduces the likelihood of the group attracting uncommitted freeloaders. Because costly rituals and behaviors deter such freeloaders from joining a group, trust among members increases, and intragroup cooperation and prosociality is maximized. The result is that religion allows for large, committed, and cooperative groups that, through the process of cultural group selection, are more likely to survive and flourish than smaller ones.

Religion as motivated meaning-making

While both of these ideas can, in many ways, account for why religion became so successful, they may not present the full story. Namely, these accounts claim that many of the traits that directly contributed to religious belief were originally selected to do other things. What is missing, we suggest, is the consideration of the role that motivation and emotion may play in the prevalence and salutary properties of religious belief. In contrast, we suggest that belief is prevalent because people need to believe; they are strongly motivated to create *meaning* within their world.

What is meaning?

Although the meaning of “meaning” has been thoroughly discussed in the scientific literature, it is clear that a single, simple definition does not exist. Dilthey (1910/2002) proposed that meaning arises when we consider the connectedness between life events. Proulx and Heine (2010) defined meaning as “mental representations of relationships between committed propositions” (p. 8). Finally, McGregor and Little (1998) conceptualized it as “consonance among the temporally extended and contextually distributed elements of the self” (p. 496). Following these lines of thought, we define meaning as the perceived coherence between beliefs, salient goals, and perceptions of the environment. When this coherence exists, we feel that the world is an orderly, controlled place that we can understand and explain (Frankl, 1946; Heine, Proulx, & Vohs, 2006; Peterson, 1999). Although people orient and react strongly to negativity (Baumeister, Bratslavsky, Finkenauer, & Vohs, 2001), they react even more strongly to uncertainty, the unknown (Hirsh & Inzlicht, 2008; Tritt, Peterson, & Inzlicht, 2011). That is why when people’s needs for order, control, and explanation are met, people feel calm; when, however, these needs are not met, people feel anxious, afraid, and inhibited, and they are highly motivated to reduce these states of distress (Gray & McNaughton, 2000; Proulx & Heine, 2008). We suggest that religion provides meaning, and reduces anxiety and distress as a result. This account explains why religion is correlated with, and in fact leads to, a reduction in a brain-based “distress signal” (Inzlicht, McGregor, Hirsh, & Nash, 2009; Inzlicht & Tullett, 2010; Tullett, Inzlicht, & Kay, 2011).

We should quickly note that we do not view any of these three accounts as mutually exclusive. Rather, these explanations likely overlap. For example, the hyperactive agency detection account is not incompatible with the idea that perceiving an external mind may allow people to create meaning out of random events and thus feel that they can understand and possibly control the events around them (Epley, Waytz, & Cacioppo, 2007; Kay, Gaucher, Napier, Callan, & Laurin, 2008). Similarly, the costly signaling perspective suggests that because co-religionists perform costly rituals and behaviors, one develops a set of expectations for these in-group members that foster trust and reduce uncertainty with regard to their level of commitment. Our view that these accounts are not mutually exclusive can also allay some criticisms of a motivated meaning-making account (e.g., Boyer, 2001). If religious explanations are soothing, these critics charge, why are these explanations sometimes bizarre and why are they sometimes terrifying? While we suggest that even a frightening explanation is less unsettling than no explanation at all (Dickerson & Kemeny, 2004; Kagan, 1972; Tritt et al., 2011), we also admit that the other accounts above are perhaps better suited to explain the specific *content* and *form* of religious explanations (e.g., Atran, 2002; Barrett, 2000; Epley et al., 2007).

The account of religion as motivated meaning-making is by no means new. Scholars of religion, from James (1902/2002) to Durkheim (1912/1954), have noted that religion imbues life with meaning. Freud (1939/1955) commented that religion structures the outside world thus giving people a sense of control. Furthermore, this feeling may act as a kind of palliative against life’s travails and may have contributed to Marx’s view that religion is a kind of opiate of the masses. While the theory is not new, what is new is the evidence that we use to support the motivated meaning-making account – evidence from the human brain.

Social neuroscience

Research in human neuroscience has exploded in the past two decades, with more and more research relating social and cultural phenomena to basic information processing functions implemented by the brain. This new social neuroscience approach (Cacioppo & Berntson, 2002; Harmon-Jones & Winkielman, 2007; Ochsner & Lieberman, 2001) allows for the integration of multiple levels of analysis and therefore refines and constrains psychological theories (Cacioppo & Berntson, 2002; Wilson, 1998; however, see Kihlstrom, 2006).

This approach captures implicit and non-conscious processes as they occur, produces results that are reducible to a core set of functions and mental modules, and, above all, is reliable. The approach, however, does have some problems (see Kang, Inzlicht, & Derks, 2010; Vul, Harris, Winkielman, & Pashler, 2009). Because each brain area accomplishes many functions, there is no one-to-one mapping between area and function, meaning that when we discover that some psychological construct of interest is related to a specific brain area, we may not understand why without more information (Poldrack, 2006). For example, as we describe below, the anterior cingulate cortex (ACC) plays a role in, among other things, self-control, negative emotion, and psychological pain (Shackman et al., 2011). So, when we find that belief in God is related to less activity in this part of the brain is it because believers have less self-control, experience fewer negative emotions, or experience less pain? The challenge, then, is not to find a “God-spot” in the brain, but to correlate God with brain activity and then figure out why this association exists. And the only way to navigate through the mess of brain data is with good psychological theory (Kihlstrom, 2006), which is why the motivated meaning-making account is so important here.

Religion as motivated process

Epistemic motivation

As humans, we need to construct explanations about the way the world works (Kruglanski & Webster, 1996). We are especially attracted to answers that organize a diverse set of stimuli because they provide meaning (i.e., a sense of coherence among one’s beliefs, goals, and perceptions of the environment), and attendant feelings of order, control, and explanation (Preston & Epley, 2005). This need is a motivated tendency and can result in feelings of threat when the need is not met, and feelings of serenity when it is (Heine et al., 2006; McGregor, Zanna, Holmes, & Spencer, 2001). This is why we pay so much attention to things we cannot easily categorize or understand (Tritt et al., 2011); and why we find uncertainty and randomness especially aversive (Grupe & Nitschke, 2011; Hirsh & Inzlicht, 2008; McGregor, 2006).

There has been considerable research on the “negativity bias,” which is the tendency to orient and react to negative more than positive things. Recent research, however, suggests that although “bad is stronger than good” (Baumeister et al., 2001), uncertainty may be even stronger (Tritt et al., 2011). For example, in a recent meta-analysis of acute psychological stressors and their impact on cortisol response, Dickerson and Kemeny (2004) found that psychological stressors related to uncertain, uncontrollable threat increased cortisol levels more dramatically than any other stressor. We also attend, orient, and react to uncertain stimuli more than negative stimuli (Hirsh & Inzlicht, 2008; Tritt et al., 2011). In fact, not knowing

whether a dreaded event will occur is frequently more anxiety-producing than knowing with certainty that it will (Grupe & Nitschke, 2011). Because people are motivated to see the world as an orderly, controlled, and understandable place, and to reject suggestions that events can happen randomly, people should be drawn to systems of belief that foster this worldview. From this perspective, religion might be a particularly adaptive way of understanding or giving meaning to a world that often seems disorderly, random, and uncertain.

Religion as a meaning system

Research consistently shows that one of the ways that people react to violations of meaning is to increase affirmations of religious beliefs. For instance, one way in which people try to insulate themselves against the anxiety associated with the unknown is by affirming the existence in a controlling God. In one study, respondents claimed higher belief in a controlling and benevolent God when they were exposed to randomness (Kay, Moscovitch, & Laurin, 2010). Critically, this study also indicated that it was the feeling of aversive arousal, fostered by a sense of randomness (i.e., lack of order), that led to increased belief in God. This kind of uncertainty–God link has also been found in naturalistic settings, where political instability is often followed by increases in faith (Kay, Shepherd, Blatz, Chua, & Galinsky, 2010; Kay et al., 2008).

Having faith in God may also be a way to increase feelings of (external) control, and thus provide another buffer from the uncomfortable reality that randomness can determine life outcomes (Kay, Whitson, Gaucher, & Galinsky, 2009). Indeed, the pursuit and maintenance of control has long been considered a key human motivation (Kelley, 1971), and the perception that one can predict and steer events is an important contributor to wellbeing (Langer & Rodin, 1976). People are thus sensitive to threats to control and will go to great lengths to avoid feeling anxious about such a loss, including imbuing the heavens with power. For example, studies that experimentally lower personal control result in increases in belief, specifically in an interventionist or controlling God (Kay et al., 2008). People, in other words, have a strong need for control, and violations of this need may motivate people to perceive the world as being controlled by an external agent.

In addition to the perception of a controlling God, religious belief facilitates meaning-making in an uncertain world because it offers a framework for understanding why things, particularly unexpected things, happen (Silberman, 2005). Take, for example, death. Our inevitable non-existence is notoriously difficult to comprehend and accept – pondering it is a particularly powerful way to threaten people's sense of meaning (Heine et al., 2006); it leads to feelings of distress that promote efforts to regain a sense of meaning (Greenberg et al., 1990; Rosenblatt, Greenberg, Solomon, Pyszczynski, & Lyon, 1989). As such, people may be comforted by ideas of afterlife or reincarnation, variations of which are proposed by all of the world's major religions. Indeed, there is some evidence that believing in an afterlife is associated with reduced death anxiety (Cohen et al., 2005; Swanson & Byrd, 1998; cf. Thorson & Powell, 1989). Religious belief systems also commonly offer explanations for why some people are fortunate and other people are unfortunate (i.e., notions of karma and of godly rewards and punishments). They also provide accounts of how humans came into existence and why suffering occurs. In this way, religion suggests that there is an order to the universe, even when things appear inexplicable.

Religion may also have an advantage over other systems of belief in that the explanations it provides aren't necessarily testable (Dawkins, 2006). Take, for example, a person who believes that fairness is a law that governs events – that people generally get what they deserve, good or bad. This theory might work much of the time, especially if one is free to speculate about aspects of a person's past in order to make sense of the good or bad luck they might experience. Inevitably, however, this rule will be violated – whether it's by an infant who suffers a painful illness or a psychopath who wins the lottery – and thus the reliability of this belief system will be called into question. Religious belief, on the other hand, entails that there is an order to the universe that believers are not always able to comprehend, and for this reason even the most inexplicable events become explicable: God works in mysterious ways.

If religion is, in fact, an effective meaning system, it should protect us against anxiety and distress when we face conflict or uncertainty. Although findings reviewed above (e.g., Kay et al., 2008, Kay et al., 2010) suggest that making people uncertain can cause them to turn to religion as a palliative, we have yet to see whether religion actually has these palliative effects. In the next section, we turn to neuroscientific evidence to assess whether religious belief can, as we predict, buffer against anxiety.

The neuropsychology of anxiety

Given our view of religion as a motivated process – that we need meaning, order, and control and that religion may help meet these needs and thus help buffer against uncertainty and the attendant feelings of anxiety – it follows that religious belief should not only be associated with low anxiety, but also prevent it. According to Gray and McNaughton's (2000) neuropsychological theory of anxiety, which is based on animal models, lesion studies, and pharmacological effects, anxiety is produced whenever an organism is uncertain about how to act. This can come about because the situation evokes two or more conflicting response options, for example when a dieter is presented with a delicious, albeit fattening, dessert (Gray & McNaughton, 2000; Corr, 2008). It can also arise when people's expectations are violated or when they make errors, as these occurrences imply that our assumptions about the effects of our actions are flawed (Gentsch, Ullsperger, & Ullsperger, 2009; Plaks & Stecher, 2007; Oliveira, McDonald, & Goodman, 2007). It can also come about when facing explicit uncertainty, such as when people are deprived of diagnostic performance feedback (Hirsh & Inzlicht, 2008) or are unsure of when aversive feedback will be administered (Grupe & Nitschke, 2011).

So conflict, expectancy-violation, error, and uncertainty are all states associated with anxiety. They are also states that activate the anterior cingulate cortex (ACC), a region of the medial prefrontal cortex that is important for cognition and emotion (Bush, Luu, & Posner, 2000; Shackman et al., 2011). The importance of the ACC in the experience of anxiety is confirmed by a number of sources. Lesions to the ACC reduce anxiety and autonomic reactivity, with patients often described as apathetic and unconcerned when significant events occur, including the commission of errors (Critchley et al., 2003; Eslinger & Damasio, 1985; Laplane, Degos, Baulac, & Gray, 1981). Neuroimaging studies further reveal that patients who suffer from anxiety disorders and normal healthy volunteers chemically induced into an anxious state show elevated ACC activity (Benkelfat et al., 1995; Rauch, Savage, Alpert, Fischman, & Jenike, 1997).

In EEG studies, activation of the ACC is associated with an event-related brain potential called the error-related negativity (ERN), which emerges between 50 and 100 ms after people make errors (Dahaene, Posner, & Tucker, 1994; Gehring, Goss, Coles, Meyer, & Donchin, 1993). Although there is wide agreement that the ERN reflects aspects of performance monitoring, a new consensus is emerging that suggests that the ERN also reflects aspects of motivation and emotion (Olvet & Hajcak, 2008). The ERN is larger for patients suffering from various anxiety disorders (Hajcak, McDonald, & Simons, 2003b; Gehring, Himle, & Nisenson, 2000), is diminished by alcohol and other anxiolytic agents (Johannes, Wieringa, Nager, Dengler, & Münte, 2001; Ridderinkhof et al., 2002; Bartholow, Henry, Lust, Sauls, & Wood, in press), and is associated with heart-rate reactivity and skin conductance (Hajcak, McDonald, & Simons, 2003a). This work suggests that the ERN, at least in part, is a product of affective responses to one's performance (Bartholow et al., in press; Luu, Collins, & Tucker, 2000) or a neural "distress signal" indicating when attention, vigilance, and control are needed (Bartholow et al., 2005, p. 41).

The ACC and ERN, then, are connected to distress and negative affect more generally, including psychological pain (Shackman et al., 2011). Given the predictions of the motivated meaning-making account of religion – which sees religion serving a palliative, anxiolytic function and predicts that religious belief will not only be related to an alleviation of distress, but also contribute to this alleviation – we wondered if religion's effects could be observed at the level of the ERN. If religion is a meaning system that people are motivated to endorse because of the order, control, and explanation it creates, then it should protect against distress in the face of uncertainty and this effect should be identifiable in the ACC and the ERN.

Neural marker of religious conviction

In a series of studies (Inzlicht et al., 2009; Inzlicht & Tullett, 2010; Tullett et al., 2011), we tested four hypotheses derived from the motivated meaning-making account of religion. First, we hypothesized that religious belief would be associated with less error-related ACC activity. Second, we hypothesized that experimentally activating religious thoughts in the minds of believers, either consciously or not, would lower this same type of ACC activity; in contrast, we hypothesized that similar religious activations would increase ACC activity in non-believers because of the distress such meaning-violations could cause them. Being mindful of the reverse-inference problem stemming from the lack of a one-to-one relationship between mind-states and brain-states (e.g., Poldrack, 2006), our third hypothesis is that the association between religiosity and low ERN activity is at least partially explained by religiosity's influence on distress, and not by the ERN's association with a lack of attention, motivation, or mental flexibility. Our final, and perhaps most critical, hypothesis is that religion's effects on distress-related ACC activity are similar and perhaps reducible to the effects of meaning on the same distress-related ACC activity. In sum, we hypothesize (1) that religion is associated with error-related brain states and (2) that religion buffer such brain states, (3) that this association is related to religion's impact on bodily states of distress, and (4) that religion is effective because it provides meaning and thus acts as a bulwark against randomness and chaos.

We tested these hypotheses in a series of studies that each used a similar set of methods (see Figure 1 for a schematic of the standard experimental procedures)¹. Participants were all college students participating for extra course credit. These

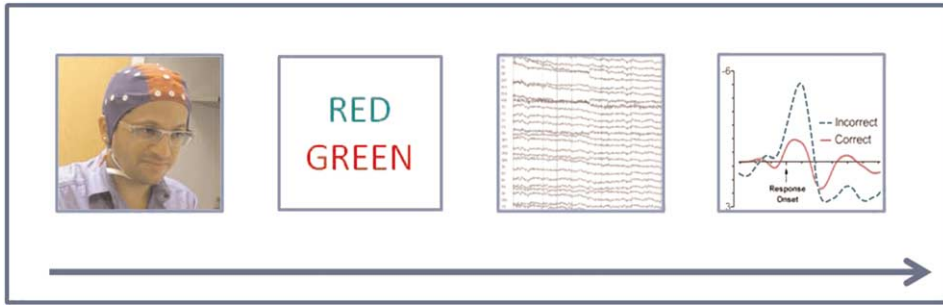


Figure 1. Illustration of our standard experimental procedure: participants are first fitted with an electrode cap connected to a digital EEG amplifier while they complete a standard color-naming Stroop task. The continuous EEG recording from all 32 channels is processed, cleaned, and averaged. The end of result is an error-related negativity (ERN) measured at fronto-central electrode sites, locked on participants' responses and showing a prominent negative deflection when participants make errors.

students came from a diverse set of ethnic and religious backgrounds; so while many were Christian, there were also sizable numbers of Muslims, Hindus, Buddhists, Sikhs, and Atheists. Participants were first fitted with electrode caps, each embedded with 32 tin electrodes located in standardized locations such that they would sit over strategic spots of the scalp. Once fitted, the caps were connected to EEG digital amplifiers and recording computers, which amplified and recorded the continuous EEG waves at all 32 electrode locations.

Participants then completed the main behavioral measure, the Stroop color-naming task (MacLeod, 1991). This task requires participants to name the color in which a sequential series of color words are presented. Sometimes the semantic meaning of the word is congruent with the display color (e.g., "red" presented in red), making it easy to name the color; other times, however, semantic meaning and display color are incongruent (e.g., "red" presented in green), making color-naming difficult. The Stroop is widely thought to index attentional control and inhibition because, on incongruent trials, naming colors requires overriding the prepotent word-reading response.

Although we were interested in response times and behavioral measures of control, the main reason we used the Stroop was because it involves cognitive conflict, generates a lot of errors, and thus allows us to assess our central index of ACC activity, the ERN. As discussed above, the ERN occurs within about 50 ms of making an error, and, is thought to relate to the negative affect, distress, and autonomic response of having just made an error (see Olvet & Hajcak, 2008, for a review).

Religious conviction predicts the ERN

In our first study (Inzlicht et al., 2009; Study 1), we tested our first hypothesis, that religiosity would predict error-related ACC activity, by correlating the ERN with religious zeal (McGregor, Haji, Nash, & Teper, 2008). Religious zeal is an ardent, even fanatic form of belief, measured with items such as "In my heart I believe that my religious beliefs are more correct than others," "My religious beliefs are grounded in objective truth," and "I would support a war that defended my religious beliefs"

(McGregor et al., 2008). Participants completed this scale, and in the same session, they completed the Stroop task while their ERN was recorded. If religious conviction is associated with less distress, then we should find that the more people believe, the lower their ERN. And, as shown in Figure 2, this is precisely what we found. The more willing people were to endorse fervent statements about their religious belief, the lower their error-related response. Source localizations confirmed that the brain signal was generated by an area consistent with the ACC.

In our next study (Inzlicht et al., 2009; Study 2), we tried to replicate the association between religious conviction and the ERN, but this time with a less militant and ardent type of belief. In this second study, we simply asked about belief in God with a single-item belief in God question ranging from certain God does not exist to certain that God exists. As with our first study, we found a reliable association between religious conviction and the ERN. Also, replicating our first study, we found that religious conviction predicted fewer errors on the Stroop task. So, in two studies we found that religious conviction predicted less error-related brain activity, consistent with the view that religion acts like a palliative.

Religious primes lower the ERN

In addition to the two studies discussed above, we have also tested for the association between belief and the ERN, using other forms of religiosity including religious service attendance, in papers that are published (e.g., Inzlicht & Tullett, 2010) and those that are still in progress (Teper & Inzlicht, 2011; Hirsh, Nash, McGregor, &

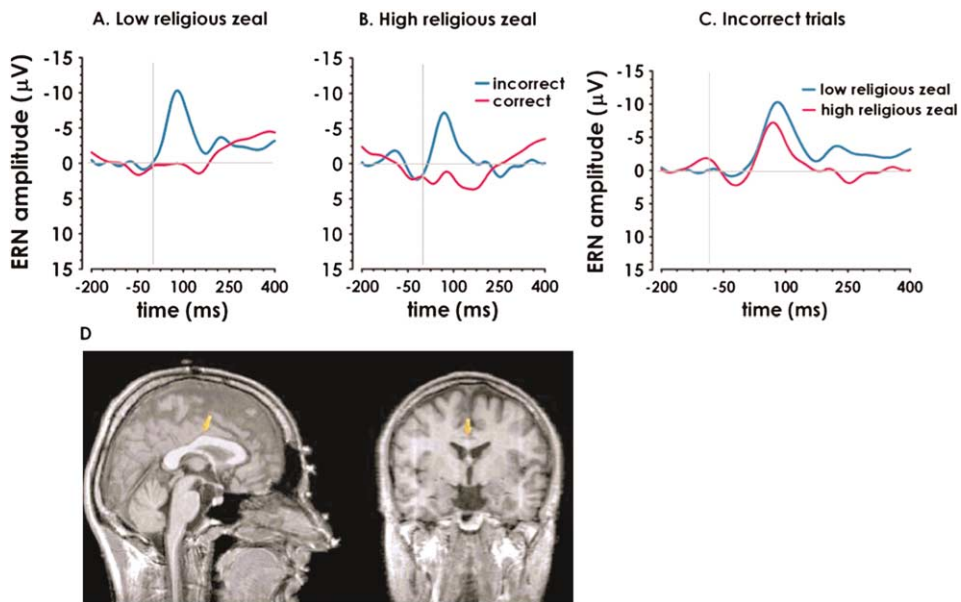


Figure 2. The relation between religious zeal and anterior cingulate cortex (ACC) activity: event-related potentials for (A) participants low in religious zeal and (B) participants high in religious zeal, (C) error-related negativities (ERNs) for people high and low in religious zeal, and (D) illustration of the neural generator for the ERN in the ACC, as determined by source localization. Image taken from Inzlicht et al. (2009), reproduced with permission.

Inzlicht, 2011). Across all studies, the results were the same: religious conviction predicts lower error-related ACC activity. We are thus confident that the association between religiosity and error-related ACC activity is robust; however, the causal direction of this relationship is unclear. The motivated-meaning-making account of religion casts religion as an anxiolytic and predicts that religion buffers this brain-implemented distress signal; however, given the heritability of the ERN (Anokhin, Golosheykin, & Heath, 2008), it is also possible that people born with a particularly low ERN will become attracted to religion. So, does religion cause a low ERN or does a low ERN lead to religion?

In a series of two studies (Inzlicht & Tullett, 2010), we examined this very question. In our first attempt (Inzlicht & Tullett, 2010, Study 1), we brought religious people from a broad spectrum of religious denominations into the lab to complete our now typical Stroop-EEG paradigm. However, we added a twist: right before they started the Stroop task, we had them write a short paragraph for five minutes. Half of the religious participants wrote about what their religion meant to them personally and what it explained in their lives. The other half of the participants wrote about their favorite season and what it meant to them personally – something positive but not relevant to religion or belief. If religion is indeed a palliative, then when religious people think about their religion, they should feel less distress about making a mistake and this should be reflected in lower ERNs compared with religious people who did not think about their religion. And this is precisely what we found. Religious affirmation, in other words, soothed error-related and brain-mediated distress.

In our second attempt (Inzlicht & Tullett, 2010, Study 2), we took this finding a step further. Our first study indicated that consciously reflecting on one's religion can alleviate distress, and in our second study we wanted to see if being non-consciously primed could do the same. We also wanted to see what would happen to non-believers when they were experimentally primed with religion. In this study, both believers and non-believers completed the Stroop task as their error-related brain activity was measured. Right before the Stroop, however, participants completed an ostensibly unrelated word-scramble task. In this task, participants saw a series of five words that had to be rearranged to form a grammatical four-word sentence. Importantly, for half of the participants some of the presented word series contained one word related to religion (e.g., sacred, prophet, etc.); the other half of the participants (the control group) saw no such words. This type of scrambled-sentence task is commonly used to prime concepts nonconsciously (Bargh & Chartrand, 2000) and has been used successfully in the past to prime religion (Shariff & Norenzayan, 2007).

Consistent with our first study, when religious believers were primed with religion they showed muted error-related brain responses. Non-believers, in contrast, showed elevated levels of such brain activity. After being primed with religion, non-believers seemed to be more distressed about their errors, which is in line with the idea that the religious primes violated their own meaning-system. Taken together these two experiments indicate that religion is not only associated with lower error-related brain states, but that it has the potential to actually lower these brain states. This is consistent with the idea that religion buffers against distress when people face error and uncertainty and supports our view of religion as the product of a motivated process to create and sustain meaning.

Interpretation of the religion–ERN link

We have thus far provided support for our first two hypotheses: that religious belief is related to error-related brain activity and that religion actually lowers said brain activity. But what does such brain activity, the ERN, actually signify? We have been suggesting that it reflects an association between religion and lower levels of negative affect, anxiety, and distress (Inzlicht et al., 2009). However, because each brain area, including the ACC (e.g., Shackman et al., 2011), accomplishes many things, it is also possible that the relationship between religion and the ERN could reflect something else. Given the association between the ERN and attention, motivation, flexible responding, and negative affect (see Olvet & Hajcak, 2008, for a review), we consider four broad explanations for the religion–ERN link: religious people are (1) less likely to attend to errors, (2) less motivated to perform the Stroop task, (3) less able to adapt to conflicting response tendencies, and (4) less distressed about their own errors.

While all of the above explanations are possible, it should come as no surprise that we think there is most support for the fourth explanation – that religious people are less anxious and defensive about the errors they make. We think the first two possibilities relating religion to lower attention and motivation are untenable. While past research has linked the ERN with both error monitoring (e.g., Botvinick, Braver, Barch, Carter, & Cohen, 2001) and motivation (Hajcak, Moser, Yeung, & Simons, 2005), both of which contribute to better task performance, we do not think that a lower ERN among those who are highly religious reflects these aspects of the ERN. That is because, in our studies, religion tended to be associated with *improved* performance on the Stroop task, consistent with other work on religion and self-control (McCullough & Willoughby, 2009). If our effects were produced by religious people paying less attention or being less motivated, we should find the opposite pattern of results.

We also do not think our data support the third explanation – that religious people are cognitively less flexible. Because religiosity is associated with a preference for certainty and a motivation to avoid uncertainty (e.g., Jost, Glaser, Kruglanski, & Sulloway, 2003) and because the ERN may index flexible attentional control (Yeung, Botvinick, & Cohen, 2004), it's possible that lower ERNs among the religious reflects inflexibility, closed-mindedness, or even low intelligence (e.g., Amodio, Jost, Master, & Yee, 2007; Lynn, Harvey, & Nyborg, 2009). We found, however, that the relationship between religion and the ERN – and between religion and performance – held after controlling for measures of close-mindedness and IQ (Inzlicht et al., 2009). This is inconsistent with the (lack of) cognitive flexibility explanation.

These results indicate that something other than attention, motivation, or cognitive flexibility are contributing to our findings. This something else, we suggest, is religion's palliative effect. However, because of the reverse-inference problem (Poldrack, 2006), more direct evidence is needed to strengthen our claim. We found such evidence in a pilot study (Inzlicht & Tullett, 2010, discussion) where we once again measured religious belief and the ERN (during a Stroop task), but this time we also measured a well-validated index of bodily states of defensive activation, the startle blink response (Lang, Bradley, & Cuthbert, 1998). The startle blink response – which is measured by placing an electrode under the eye and measuring the electromyographic blink response when participants hear a loud noise – is an evolutionary old response promoting bodily defense and involving the central nucleus of the amygdala (Davis, Walker, & Myers, 2003). Figure 3 illustrates that we found that the more participants believed in God, the lower the amplitude of their

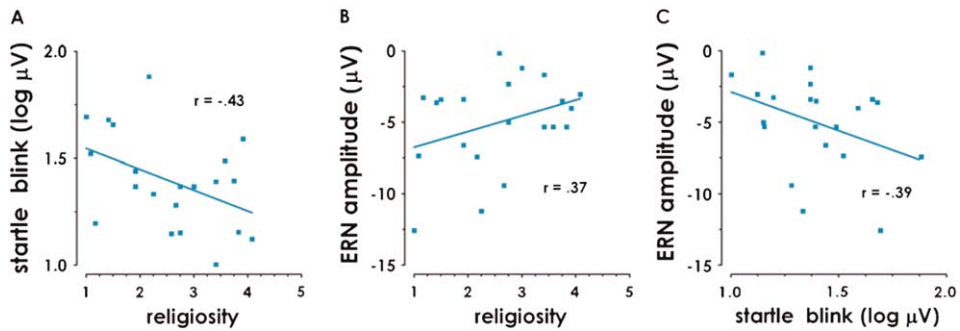


Figure 3. Scatter plots illustrating association between trait religiosity, startle–blink response, and error-related negativity (ERN). (A) Scatter plot indicates a negative correlation between religiosity and the magnitude of startle blink, (B) a positive correlation between religiosity and ERN amplitude, and (C) a negative correlation between religiosity and the magnitude of startle blink. Note that higher amplitude ERNs are more negative; so a positive correlation between religion and the ERN means that the more religious people get, the more positive (lower amplitude) their ERN.

ERNs, but also the lower the amplitude of their defensive startle response. So not only did we replicate our past work (Inzlicht et al., 2009), we also extended it by showing that religion (and the ERN) predicts lower states of distress using a well-validated measure of defensive motivation (Lang et al., 1998; see Hajcak & Foti, 2008). All told, our results are inconsistent with the view that the religion–ERN link is due to attention, motivation, and cognitive flexibility, but is consistent with our view that religion acts like a palliative, buffering against defensive arousal during times of error and uncertainty. So why does religion appear to reduce distress?

Order, randomness, and the ERN

Our final study sought to understand the possible mechanism through which religion might reduce distress (Tullett et al., 2011). The motivated meaning-making account suggests that religion’s palliative qualities come about because religion is a meaning system that offers explanation, order, and protection from chaos. In our final study, we explored whether exposure to the simple idea that the world is orderly, although not fully comprehensible to humans (i.e., an ideological framework akin to many religions, particularly those that emphasize that only God can know how the world truly operates) can offer the same kind of protection from error-related distress as religion. We asked, in other words, if religion’s effects on the ERN were similar or even reducible to the effects of order. As a comparison, we also tested the effect on the ERN of exposure to an idea that the world is orderly, and fully comprehensible to humans (i.e., an alternative ideological framework that is *not* akin to religion, since it proposes that humans can understand the order of the world; this may be more akin to the order provided by science).

Participants completed our standard EEG paradigm with a reaction-time task very similar to the Stroop. Critically, right before they started the Stroop, participants read one of three fabricated newspaper articles, all of which detailed a supposed conference where the world’s top scientists discussed “an issue that has fascinated and frustrated the human species for centuries: is there a meaning, a

greater purpose or order, to the events that make up our lives?" Through the ideas conveyed in the article, participants were primed with one of three ideas: (1) that the world is random and chaotic, (2) that the world is ordered, although not comprehensible for humans, and (3) that the world is ordered and humans can fully comprehend this order. We hypothesized that the comprehensible order prime should give rise to a smaller ERN than the randomness prime, since understanding and order should reduce distress. We also predicted, perhaps less intuitively, that the incomprehensible order prime should reduce the ERN relative to the randomness prime, and perhaps even to the same level as the comprehensible order condition. In other words, we predicted that order in itself, even without comprehension, should buffer people against anxiety.

This pattern is precisely what we found: participants in the randomness prime showed higher ERNs than participants in either of the other conditions. Participants in the two ordered conditions, however, were not different from each other, even though one prime emphasized comprehension of the world's order while the other emphasized that comprehension is impossible. So primes of order resulted in reduced states of distress. Importantly, order was all that mattered; whether this order was personally scrutable or not did not affect subsequent states of error-related distress. In other words, our two order conditions capture two kinds of epistemologies, one where order is personally known, and one where it is exclusively known to some external force (or agent). The fact that incomprehensible order also relieved states of distress suggests that what is important is the existence of a "master-plan," and that personal knowledge of this plan is almost superfluous. This is consistent with research indicating that people seek to increase feelings of control, even if that means it is someone (or something) else that is doing the controlling (Kay et al., 2008).

Taking stock: existential neuroscience

The view of religion as a motivated process suggests that people have a need to believe in something transcendent because of the meaning and order this belief provides. The main claim of this model is that religion acts like a meaning system that offers order and control, protecting people against anxiety and distress when faced with uncertainty. People flock to religion, in other words, because religion provides confidence in the orderliness of one's environment, thereby acting as a bulwark against anxiety-producing uncertainty and minimizing the subjective pain of error.

Although there remain questions about the precise meaning of our effects, what is less questionable is that we have found a robust connection between religion and error-related brain activity. We have interpreted this connection as meaning that religion leads people to feel less anxious about their mistakes. But is this a good thing? There is no clear answer here, as there are both pros and cons to error-related distress. On the one hand, distress is uncomfortable and sometimes paralyzing. High error-related brain activity is related to the personality dimension of neuroticism (Luu et al., 2000), which at its extremes contributes to a host of psychopathologies, including generalized anxiety disorder, obsessive-compulsive disorder, and depression (see Olvet & Hajcak, 2008). Low error-related brain activity is also related to subjective well-being (Larson, Good, & Fair, 2010). On the other hand, being

distressed about errors may be adaptive. Because anxiety and distress are uncomfortable emotions, they prompt us to avoid doing the things that make us feel that way – theoretically, they should help us to learn from our mistakes (Holroyd & Coles, 2002). This may be why error-related brain activity is related to better academic performance, and to task engagement and motivation more generally (Hajcak et al., 2005; Hirsh & Inzlicht, 2010).

So, is it good to feel anxious about being wrong? Although the available evidence is equivocal, we suspect there exists an optimal level of distress, high enough to alert us that something is wrong and that we need to change course, but not so high that we become incapacitated with conflicting tendencies and paralyzed by indecision (e.g., Yerkes & Dodson, 1908). Given evidence that religious people not only show less error-related distress, but also make significantly fewer errors, we wonder if religion can buffer against the paralyzing forms of anxiety and leave people at that anxiety sweet spot.

Although we have found an association between religion and brain states that we have interpreted as indexing a form of anxiety and distress, we should also note that others have not always found a relation between religion and low anxiety. While research often suggests that religion predicts low anxiety (e.g., Amrai, Zalani, Arfai, & Sharifian, 2011), it has not done so consistently (e.g., Frenz & Carey, 1989). In fact, a meta-analysis of the religion–anxiety link revealed that religion is sometimes related to increases in anxiety (Shreve-Neiger & Edelstein, 2004). The study of this link, then, has yielded mixed and often contradictory results likely attributed to a lack of reliable measures and limited assessments of anxiety (Shreve-Neiger & Edelstein, 2004). We suggest that our social neuroscience approach may be an improvement over past explorations because of our ability to not only rely on reliable measures of error-related distress, but also to capture it online, precisely as it occurs. We also note that our account of religion as a motivated process suggests that religiosity may be related to both high and low anxiety, depending on when we measure it in a person's developmental trajectory. People who are dispositionally anxious and threatened may be attracted to religion's salutary promises, hence the occasional positive relationship between religion and anxiety; but once people are well entrenched in a religious community and become more committed believers, they may cash in on the promises and experience low anxiety. Furthermore, people may temporarily increase religious practices (e.g., prayer) during transitory states of anxiety (e.g., waiting for one's medical test results), which would be extremely difficult for researchers to capture outside of experience sampling methods. Future research using a longitudinal social neuroscience approach is needed to explore these possibilities.

Another potential area for future research is the question of whether the effect of religious primes on the ERN differs by religious group. It is possible that different religions may vary greatly in the extent to which they provide their adherents with frameworks of order, control, and explanation. While participants in our studies comprised a wide variety of religious backgrounds, meaningful between-group comparisons were not possible because of the small number of individuals in each of these different religious groups. Future research should explicitly test whether the effect of religious primes on the ERN is greater for religious groups whose beliefs are characterized by the provision of greater order, control, and explanation.

Religion, brain, and body

Our data indicate a robust connection between religion and brain activity in one region of medial prefrontal cortex, the ACC. However, because of the vast interconnections between brain areas and because of the connections between brain and body, it would be a gross simplification to conclude that the ACC plays some privileged role in religious belief. On the contrary, the ACC is only one small node of a threat network that becomes dampened by religion. Although a detailed discussion of these other brain area and body systems is beyond the scope of the current paper, Figure 4 illustrates some other likely biological targets of religion's palliative effects. These include the amygdala, which is active during motivated states of arousal, threat, and fear (Ledoux, 1998; Öhman, 2005) and may be less active among religious people after they are exposed to acoustic startles (Inzlicht & Tullett, 2010). It also likely includes the right dorsolateral prefrontal cortex, which is a node in the behavioral inhibition system (Gray, 1976; Shackman, McMenamin, Maxwell, Greischar, & Davidson, 2009) that is theoretically dampened by belief (Inzlicht et al., 2009). Religion is also associated with reduced stress reactivity in the hypothalamic–pituitary–adrenocortical (HPA) axis, as indexed by lower amounts of blood cortisol among religious adherents exposed to acute stress (Tartaro, Luecken, & Gunn, 2005). A dampening of the HPA axis among believers is also associated with changes in heart rate, peripheral blood pressure, and cardiac output such that religious people tend to react with less physiological threat and more physiological challenge (Weisbuch-Remington, Mendes, Seery, & Blascovich, 2005). Given the casting of religion as a palliative, we expect that religion could have other unexplored effects. For example, we suspect that religiosity could dampen parts of

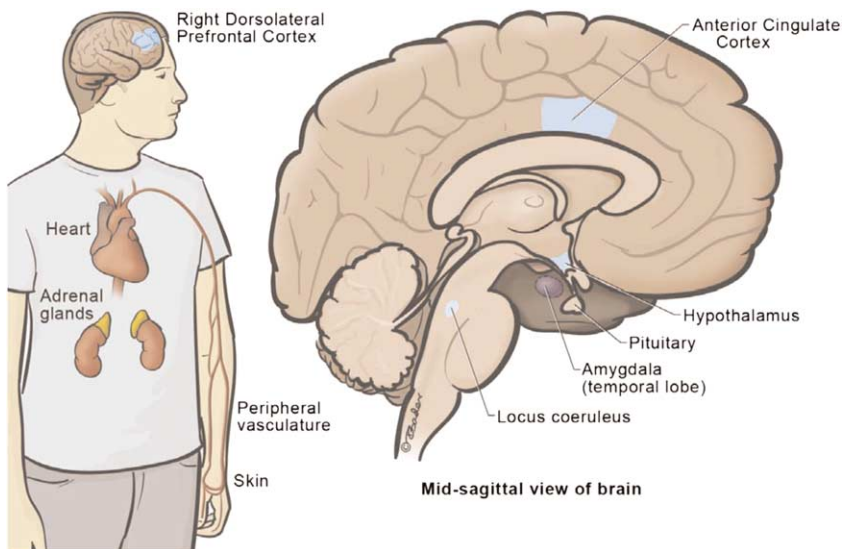


Figure 4. Biological targets of religion's palliative effects. In the brain, religion's palliative effects can be seen in the anterior cingulate cortex (ACC), the right dorsolateral prefrontal cortex, the hypothalamus and pituitary (as part of the HPA axis), and (in theory) the locus-coeruleus–norepinephrine system. In the body, these targets include the adrenal glands, which produce cortisol (also part of the HPA axis), the heart and peripheral vasculature, and (in theory) sweat glands in the skin. Illustration by Danielle Bader, MScBMC.

the sympathetic nervous system, for example the stress-induced sweating response, which can be measured by skin conductance. We also suspect that it could moderate the orienting reflex, which governs how an organism attends to unfamiliar stimuli, and so may have effects on the locus-coeruleus–norepinephrine system (Aston-Jones & Cohen, 2005). In short, religion's palliative effects are likely widespread in the brain and body and are certainly not limited to the kinds of error-related ACC activity that we have found.

Conclusion

Two simple, yet astonishing facts about religion have motivated our work: first, that it is widespread throughout the world and second, that it is usually positive for the individual believer. We join a growing rank of scientists of religion when we ask why it is so widespread and why it confers such benefit. In response, we suggest that religion is the product of a motivated meaning-making process; that religion is prevalent and beneficial because it fulfils the need to create and sustain a sense that the world is orderly and meaningful. When religion meets this need, it allows individual believers to cope with life's stresses, to feel secure in unfamiliar territory, and to feel calm under pressure. Religion provides a framework for understanding and acting, and reduces cognitive uncertainty as a result. Religion also espouses an order that is not transparent, often mysterious, and only knowable to an external agent. It therefore offers an advantage over other forms of belief or meaning – it is immune from falsification and thus adherents can be confident that it will stand the test of time. The evidence presented here makes it increasingly difficult to see religion as simply a curious, or even insidious, byproduct of our cognition. People refuse to believe that they're at the mercy of a chaotic and meaningless universe, and in many ways religion assures them that this is not the case.

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Note

1. A thorough discussion of our specific methods or the more general techniques of EEG are beyond the scope of the current paper. We direct readers who are interested in our specific methodology to the original papers (Inzlicht et al., 2009; Inzlicht & Tullett, 2010); and we direct readers interested in learning more about EEG and event-related potential methods and analyses to excellent treatments by Luck (2005) and Fabiani, Gratton, and Federmeier (2007).

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COMMENTARIES

Religion, health, and the social signaling model of religion

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Religion and health

Research conducted over the past several decades has demonstrated a positive correlation between religion, health, and longevity (Hummer, Rogers, Narn, & Ellison, 1999; Koenig, 2008; Matthews et al., 1998; McCullough, 2001; Murphy, Ciarrocchi, Piedmont, Cheston, & Peyrot, 2000). Lower blood pressure, lower rates of myocardial infarction, reduced levels of pain in cancer patients, lower rates of coronary disease, emphysema and cirrhosis, decreased functional disability in nursing home residents, and reduced anxiety, depression, and suicide have all been found to be significantly associated with religion (Gartner, Larson, & Allen 1991; Koenig, 2008; Matthews et al., 1998). Psychologist Michael McCullough notes “People who are highly religious have 29% higher odds of being alive at given follow-up than do people who are less religious” (McCullough, 2001, p. 61).

Inzlicht, Tullett, and Good (IT&G) advance our understanding of the religion–health connection by identifying some of the proximate mechanisms involved. This work not only shows correlation, but also causation, with religious belief and primes reducing activity in the anterior cingulate cortex (ACC) in response to error. The direct interconnections of the ACC with the hypothalamic–pituitary axis (HPA) provide a physiological pathway for religion to impact autonomic, immunological, and stress responses, as well (Koenig, 2008). These findings help elucidate the “how” of the religion–health connection. What is less obvious, however, is *why* religion is able to reduce anxiety and distress.

Motivated meaning-making model critique

The authors propose a “motivated meaning-making model” of religion to explain religion’s ability to decrease anxiety and distress. They argue that religion “fulfills the need to create and sustain a sense that the world is orderly and meaningful” (“Conclusion”). Yet, if it is merely a sense of epistemic order that produces religion’s palliative effects, it is difficult to understand why people everywhere are willing to bear the frequently high costs of religious rituals and beliefs. This is particularly puzzling given the fact that experiments conducted using *profane* primes of meaning and order also resulted in reduced states of distress (“Order, randomness, and the ERN”). If meaning-making is the ultimate function of religion, and low cost profane systems can provide the same benefits as higher cost religious systems, why are religious meaning-making systems so prevalent across human societies?

The second and more significant problem with the motivated meaning-making model, however, is its failure to adequately account for the experimental findings

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themselves. Neither the startle blink response results nor the ACC findings for non-religious participants can be parsimoniously explained by this model.

Startle blink response

The startle blink response is “an evolutionary old response promoting bodily defense” (“Interpretation of the religion/ERN link”). It originates in the amygdala, the primary function of which is to assess threat and evaluate social trustworthiness (Adolphs, 2002; Adolphs, Tranel, & Damasio, 1998). Reduction of the startle blink response indicates a reduced perception of threat and/or increased social trust. Experimental results showed that this response, like ACC activation, exhibited a negative correlation with religious belief; participants who professed belief in God showed an attenuated startle blink response, as well as reduced ACC activity in response to errors in the Stroop Test. The researchers attribute these findings to religion’s meaning-making capacity and its attendant reduction of anxiety and distress. It is, however, difficult to understand how epistemic meaning-making could reduce a primarily defensive response such as the startle blink. The results obtained suggest social processes at work rather than epistemic ones.

ACC results for non-religious participants

Increased ACC activity for non-religious participants was also found in experiments incorporating religious questionnaires and conscious/subconscious religious primes. The researchers interpreted these findings as evidence of increased anxiety on the part of non-religious participants because “the religious primes violated their own meaning-system” (“Religious primes lower the ERN”). No evidence is presented to substantiate this claim. Whether Western educated college students who have been exposed to scientific meaning-making models would experience cognitive distress as a result of primes for religious epistemic models is questionable. Alternatively, religious primes would most certainly evoke social responses in non-religious participants, particularly within the context of a dominant religious American culture.

The social, rather than epistemic nature of both these experimental findings is further supported by a third experimental result. In religious prime experiments religious participants not only exhibited reduced ACC activity in response to errors on the Stroop test; they also made fewer errors overall. Such improved performance suggests heightened attention and focus to the task at hand, a state that would naturally ensue from reduced perceptions of social threat since such a reduction would allow for decreased vigilance.

Inclusion of religious belief questionnaires and conscious/subconscious religious primes introduced potent social signals into the experiments. For religious participants these signals could be expected to reduce perceptions of threat and increase those of trust. For non-religious participants, however, these signals could be expected to heighten “out-group” perceptions of threat and negative social judgments, thereby increasing both the startle blink response and ACC activity in response to error while diverting attentional resources available for the task at hand.

Social signaling model

If religion is viewed as primarily a *social* rather than an epistemic meaning-making system, however, *all* of the experimental results are parsimoniously explained. This model of religion makes sense of the costliness of religious ritual, as well, and provides an explanation of religion as a meaning making system that is not only unfalsifiable, but also empirically efficacious in the promotion of trust and cooperation (Ruffle & Sosis, 2007; Sosis & Bressler, 2003). The social signaling model posits that the primary function of religion is to inculcate in-group frameworks of social meaning that have motivational force (Alcorta, 2006, 2009; McManus, 1979). These frameworks reduce personal anxiety by allowing us to predict the motives and behaviors of others and optimally pattern our own individual behaviors and choices. By facilitating social interaction, they also establish a foundation for trust and collaborative cooperation (Ruffle & Sosis, 2007; Sosis & Bressler, 2003). While religious belief systems provide a metaphorical model of this social framework (Durkheim, 1915/1969), religious ritual imbues this model and its representational symbols with emotional significance and motivational force (Alcorta & Sosis, 2005). These symbols and beliefs provide potent social signals for in-group members that decrease defensiveness and increase trust (Sosis, 2005). They also elicit a shared framework of social expectations. These same signals could be expected to *increase* defensiveness and anxiety for non-group individuals. These responses are precisely the experimental results reported.

Conclusion

It is increasingly clear that religion has numerous palliative benefits for participants. The experiments reported here expand our knowledge of the proximate mechanisms involved in this religion/health connection. The motivated meaning-making model of religion fails to adequately explain the “why” of this connection. However, when viewed through the lens of a social signaling model, the experimental results offer important insights into both “how” and “why” religion works.

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Believing, belonging, meaning, and religious coping

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Introduction

The provocative findings by Inzlicht, Tullett, and Good (IT&G) indicate that religious belief reduces brain responses associated with anxiety. They show that this is linked to perception of the world as orderly, and they interpret it all as supporting their contention that religion is a matter of motivated meaning-making. Our intent in this comment is to sharpen up the conceptual structure so as to facilitate proper interpretation of these findings. We hope readers will see our comments as seeking to build on and improve a fine contribution by Inzlicht et al., rather than as critical.

What is meaning, and can it be made?

IT&G explain their notion of motivated meaning-making in only one paragraph, after which they quickly move along to the question of “what is meaning?” The explanation for motivated meaning-making boils down to the assertion that people have a “need to believe” and are “strongly motivated to create meaning within their world.”

They define meaning strictly in terms of thought processes. In the three definitions they offer, meaning is either a result of thinking, or is the thinking (mental representation) itself, or some even more vaguely conceptualized “consonance” based on the self (which apparently assumes that the self exists prior to meaning).

None of these definitions is close to satisfactory. The meaning of a sentence is neither a product of its being thought nor a property of the single brain or mind thinking it. The fact that one person can understand another person's thoughts based on hearing sound waves coming out of the other's mouth should be sufficient proof to convince anyone that the meaning is not “in” a single brain or the result of its activities. Language only works because different people understand words as having the same meaning. IT&G recapitulate the mistake that others make in confusing the concept

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with its representation. The very definition of representation entails that something is being represented, so it is inadequate to define meaning as representation.

Mathematics can be regarded as rather pure meaning, so it provides an instructive example. A mathematical fact (e.g., $4 \times 7 = 28$) can be represented by a brain and mind, but that fact's meaning is independent of any particular brain. A brain might think that $4 \times 7 = 35$, but that is wrong. The feeble definitions of meaning offered by IT&G (this issue) do not allow for its wrongness: all meaning is simply whatever you think, or the result of what you think (or, in their third and abstruse definition, something about the consonance of the extended self).

This raises the question of whether meaning can be made at all. Using the terminology of IT&G, it seems fair to say that Carlos "makes meaning" one Tuesday afternoon when he thinks that $4 \times 7 = 35$, and the same goes for Lisa who thinks that $4 \times 7 = 28$. But is anything new really created in either case? To be sure, there has been mental and presumably neurological activity. Still, both meanings ($4 \times 7 = 35$ and $4 \times 7 = 28$) existed prior to that Tuesday afternoon. Moreover, Lisa's meaning was correct while Carlos's was wrong, and the differential correctness was radically unchanged by those thoughts. In particular, if Carlos had really made meaning, then in the total universe, presumably, in some way, 4×7 must have moved a bit closer to 35 as a result of his creative action. We think it did not move. No meaning was actually created.

Most mathematicians regard their work as discovery, not invention. In much the same way, one could argue that meaning in general is discovered rather than invented. The assertion that meaning is made would require evidence that something existed that did not exist previously, such as in the creation not just of a new word but of a new concept that could not possibly have existed, even in imagination, previously. Certainly the use of religious ideas to interpret events in one's life does not seem to qualify.

Thoughts (as events) are made, and so IT&G were consistent when they defined meaning as thought and then proposed that thoughts can be made. But we think the field would benefit from a careful and disciplined conceptualization of meaning, and that would require separating meaning from its representation. Hence the notion of meaning-making is suspect and, at present, unsupported.

Using meaning

Instead, following Baumeister (1991), we suggest that it is best to think of meaning as the basis of an integrated, organized network of concepts. That network enables people to think about the physical world in a distinctively human way, but it is itself not physical. A person may say "Put that fork on the table," and the utterance has physical properties as a set of sound waves, but the link between those sound waves that comprise the spoken word "table" and the actual, physical table is not a physical relationship. A thorough inspection and analysis of the sound waves will teach us nothing about the table.

Many primates can think, solve problems, and exert intentional control over their environment, but humans are unique in the ability to understand the world in terms of invisible causes and realities (Tomasello, 1999). Such an understanding is too much for one individual to achieve in a normal lifetime, and so the human understanding of the world has been built up across many generations, thanks to the human penchant for culture. That cultural progress, in turn, depends on communication, so that people can share their ideas.

We think that when IT&G discuss meaning-making, they are referring to the use of religious contexts to interpret specific events from one's life. In our view, it is less a matter of creating something new than of using existing concepts and relationships to furnish an appealing way of understanding events.

It has long been known that people find comfort by embracing religious explanations for their misfortunes. This is where the work by IT&G is especially valuable. The new findings indicate how this process reverberates in the brain, as well as revealing some important determinants – including their profoundly fascinating evidence that believing in an orderly universe is comforting even if that order is supposedly impossible for humans to understand.

Needs for meaning

A meaning of life is thus a link between a nonmaterial reality (meaning) and a series of physical events (life). It is a matter of interpreting and understanding life. As analyzed by Baumeister (1991), living things are constantly changing, but they are highly motivated to achieve stability (e.g., exist in harmony with stable environment). Meaning is one of the tools people use to achieve stability amid the fluctuating changes of life. Baumeister further concluded that the process of endowing life with meaning consisted of satisfying four needs for meaning: purpose, value/justification, efficacy, and self-worth.

These considerations help explain why religion is so useful at providing meaning. Religious ideas tend to be highly stable, indeed often evoking eternity. They purport to explain the world as having purpose, and they prescribe moral and other values. Religions have also sought to satisfy the needs for efficacy and self-worth, though these can have dangerous consequences, and indeed attempts to provide material efficacy have rendered religion vulnerable to disconfirmation and discrediting (e.g., when prayed-for benefits do not materialize; Stark & Bainbridge, 1985). Senses of collective superiority based on religious elitism have contributed to intergroup hostility and violence. Hence we think the most positive contributions of religion to individual life involve providing purpose and value.

Believing and belonging

Baumeister (1991) analyzed religion in terms of the need to believe and the need to belong. IT&G focus on the former, but the latter is worth considering also. Research on religious cults, for example, has shown that people move into and out of them based much more on social relationships than on personal belief in the cult's doctrines (Robbins, 1988; Stark & Bainbridge, 1985). Indeed, among the various Protestant Christian denominations, membership seems far more based on social factors than doctrinal ones, and many members can scarcely articulate what the doctrinal differences are (but they often know just what sort of people belong to each church).

Meaning and belonging are often quite intertwined in people's minds. Stillman et al. (2009) showed that social exclusion led people to regard life as less meaningful than non-rejected control groups. When people are asked to articulate the meanings of their lives, family relationships feature prominently in their answers (Lambert et al., 2010). Some of the appeal of religion is almost certainly based on its provision of a sense of belonging to an extended family, headed by a god who is regarded as an

exalted father figure. Although such interpretations have been associated with Freudian analyses of religion (Freud, 1927/1961), they do not require much of the heavy interpretive efforts often associated with psychoanalytic work. Christianity, for example, overtly refers to God as “our father” and instructs believers to address clergy as “father,” “sister,” and so forth.

Hence our suggestion for further work is to explore whether some of the palliative effects of religion (including brain patterns) may reflect belongingness rather than, or in addition to, belief. There is ample evidence that belongingness and social exclusion can alter the degree of pain one feels (e.g., DeWall & Baumeister, 2006; MacDonald & Leary, 2005). Some research also suggests that the anterior cingulate cortex (ACC) is more active during social exclusion than inclusion (Eisenberger, Lieberman, & Williams, 2003). Comparing this finding to IT&G’s, one could cautiously make the connection that belief or participation in religion and social inclusion have similar brain pattern activity. Religion may have more than one pathway to ease pain.

Concluding remarks

Baumeister (2005) concluded that humans evolved to do culture. Humans cooperate, share knowledge, and participate in large systems of interlocking roles. Religion has facilitated the operation of such systems, and trust is an important element of them. It would not be possible for any person to directly verify even 10% of the information received from the social group.

That may explain IT&G’s finding that people are comforted (and their pain reduced) just by believing that there is a master plan, even they cannot know or understand it. In order to share information and work together, humans must accept much on faith. Extending that faith to a supernatural being who orders the universe (especially a being who is often regarded as an exalted family member) is perhaps not such a huge step.

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Toward an evolutionary social neuroscience of religion

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We prefer an alternative functional model to the “motivated-meaning hypothesis.” To explain its appeal, we work through the implications of three observations.

Observation 1: it is unclear whether the Stroop test is an ecologically valid stressor

The authors find that religious zeal and religious belief are associated with reduced activity in the anterior cingulate cortex (ACC) after Stroop matching-errors. This effect is used to support the theory that religion acts as a “... buffer against uncertainty and the attendant feelings of anxiety.” We lack confidence for this interpretation. In the Stroop paradigm, ACC signals are generated after a participant becomes confident about committing a mistake. Because confidence is the opposite of uncertainty, it remains questionable whether Stroop tasks are relevant to the author’s theory. A parsimonious interpretation of the error-related negativity (ERN) signal is that reduced activity in the ACC after Stroop errors indicates inattention to conflict.

Observation 2: religion(s)’s functions should not be inferred from only one or two psychological traits

The authors correctly avoid what might be called a “Godspotting” approach, according to which the neuroscience of religion is considered to be a search for regions of cortex that are functionally specialized for religion. For readers unfamiliar with recent developments in neuroscience, we emphasize the importance of their holistic stance to neural processing. Neuroscientists believe that it is the temporal and spatial properties of activations along networks in the brain that produce specific perceptions, thoughts, emotions, motivations, and behaviors (Fuster, 2003). Ultimately it is the task of cognitive neuroscience to understand the computational processes associated with such temporally and spatially distributed brain activations. However, the complexity of religious traits, and of the neural substrates that support them, suggests that even moderate advances in our understanding of how cortex supports religious cognition remain at some distance on the horizon (Spezio, 2001).

Keeping in mind such reservations, social cognitive neuroscience is learning something about the core practices that affect cortical operations associated with religious cognition. A recent experiment (fMRI) involving Orthodox Christians from The Inner Mission of Aarhus Denmark investigated the neural effects of repetitive and interpersonal prayer. Both types of prayer were associated with activations in dorsal striatum, a crucial node in a cortical network that computes reward expectations (Schjoedt et al., 2008). However, only personal prayer was associated

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with activations in Theory of Mind networks (precuneus, temporopolar cortex, anterior medial prefrontal cortex, and temporoparietal junction). These findings suggest that the properties of religious cognition vary, at least in part, in response to different types of ritual practices.

While the authors of this target article sensibly notice that religions “may vary greatly in the extent to which they provide their adherents with frameworks of order, control, and explanation,” we think that this point should be taken further. Recent studies show that significant cognitive variation extends even to members of ostensibly homogeneous religious groups, depending on which activities they are performing and with widely varying interpretations (Malley, 2004). Genetic polymorphisms may also play a role in generating and maintaining cognitive and behavioral variance (Luhrmann, 2012). Moreover, because the category of “religiosity” fractionates into diverse psychological traits (Boyer, 2003), neuroscientists surely have their work cut out for them. Inferences from the covariates of one or two religious traits and brain activations, on the one hand, to functional theories of religion, on the other, remain speculative.

Observation 3: motivated meaning is unlikely to be a basic evolutionary function

The authors notice that suppressing anxiety can be harmful because anxiety is an engine of adaptive response. Why then do religions endure? The authors conjecture that anxiety reduction targets individual cognitive performance and health outcomes. By contrast, we favor an approach to the neuroscience of religion that is more firmly grounded in evolutionary theories of cooperation (for a recent examination of evolutionary applications, see McNamara, 2009). Elsewhere we have argued that religious traits are functionally and computationally closer to goal states than they are to ordinary belief states (Bulbulia & Schjoedt, 2010; Bulbulia & Sosis, 2009). We notice that when religious goals are stably expressed at the level of populations, cooperative interaction becomes more reliable even at large social scales (Bulbulia, 2011), and may become supported by processes of cognitive dissonance (Bulbulia & Sosis, 2011). Such theories predict that religious cognition may be pervaded by effortful activities (Schjoedt, 2009).

There are four reasons to prefer the cooperation model for religion’s evolutionary functions. First, it explains why religions are almost always associated with social norms and regulations (Atkinson & Bourrat 2010) and why moralizing gods appear to be favored at times of crisis (Johnson 2005), perhaps by cultural selection (Norenzayan & Shariff, 2008). Such normative associations remain unexplained by the motivated meaning-making theory. Second, the cooperation model explains why religions remain strongly conserved over evolutionary time despite their ostensible costs (Irons, 2001): such costs are arrayed to support cooperative predictions as hard-to-fake signals of social commitment (Alcorta & Sosis, 2005). Third, the model is compatible with the evidence, reviewed in the authors’ target article, that religious cultures suppress anxiety and support health outcomes. In the cooperation model, religion’s homeostatic effects may be favored by the specific ways in which anxiety-reduction and placebo healing support cooperative prediction as hard-to-fake signals of religious/within-group cooperative commitments (Bulbulia, 2006). Finally, the cooperation model is compatible with evidence that religions evoke distress (Whitehouse, 2008) and even terror (Berger & Luckmann, 1972). The model notices that pain, in the context of community, forges social solidarity (Aronson & Mills, 1959).

A willingness to suffer may also verify social commitments as hard-to-fake signals of religious/within-group cooperative commitments (Sosis & Alcorta, 2003). Fourth, wherever suffering leaves permanent body marks, suffering may pre-commit partners by foreclosing social alternatives (Sosis et al., 2007). Once marked, forever branded.

Conclusion

Nothing we have said here detracts from the significance of the authors' experimental findings. Their work suggests that religious believers attend to signals of conflict somewhat differently than nonbelievers. Why this should be so remains unclear. We have advertised a view according to which meaning making may occur, but as a secondary function to community making.

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Differences in cognitive style, emotional processing, and ideology as crucial variables in understanding meaning making

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Neuroscientifically specifying the hypotheses of Hume, Marx, Freud, and others on the motivational sources of religion, the authors present an important case for religiosity as an anti-anxiety device to buffer against feelings of diminished certainty, order, control, and knowledge (stipulated components of meaning). The general evidence for this hypothesis is data showing a reduction in a previously well-characterized error-related neuronal response in the anterior cingulate cortex (ACC) among religious persons. The authors' interpretation of these effects as a marker of religion's inherent anxiolytic influence is an intriguing one. In addition to the paper's focus on degrees of general reactivity to perceived threats to certainty, order, control, and knowledge, we feel it would also be very interesting to consider the ways in which this conflict/uncertainty is resolved *across* individuals. Specifically, we suggest that individuals who rely differentially on fast/automatic/intuitive versus slow/controlled/reflective reasoning (Evans, 2003; Sloman, 1996) will arrive at different solutions when encountering the same questions of meaning making.

Tasks like the Stroop (used by the authors) are very useful for examining one's reactivity at the onset of an error. Examining how people choose to resolve these uncertainties, however, is more challenging in tasks where two responses (correct and incorrect) are quickly available, and furthermore, the presence of incongruence is known from the outset. A task in which one response (the incorrect one) is more readily available to all participants while another response (the correct one) requires acknowledging that the fast/automatic/intuitive choice was wrong and reflecting further, we believe, can provide a more powerful measure of an individual's preference for different kinds of solutions. Using a task with exactly these properties (Cognitive Reflection Test; Frederick, 2005), Shenhav, Rand, and Greene (2011) recently showed that individual differences in the tendency to rely on intuition versus reflection influences belief in God. Intuitive style predicted stronger present belief in God and having strengthened belief in God since childhood (but not family religiosity during childhood), and these effects were not mediated by education level, income, political orientation, or IQ. Experimentally inducing a mindset that favors intuition over reflection increased immediate reports of belief in God. Given these results, we argue that people eventually become religious at least in part because when surrounded by questions of certainty, order, control, and knowledge, they are not as likely to rely as much on slow/controlled/reflective answers to these questions. These results can supplement the authors' data on religiosity and error onset (Stroop performance), as the Cognitive Reflection Test helps shed light on the more protracted process of human meaning making.

In addition (as the authors speculate), religious individuals may also be more vulnerable to the anxieties that surround these complex questions of meaning making.

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A constitutionally intuitive cognitive style may increase vulnerability since a more reflective cognitive style may provide a more flexible and novel set of answers that do not depend on immediate responses to the world. In addition to cognitive style, another source of vulnerability may be due to differences between religious and non-religious persons in emotional processing capabilities. For instance, compared to atheists, religious persons display more alexithymia (a deficit in clearly identifying, differentiating/categorizing, and describing emotional states). Yet at the same time, religious persons report more intense and vivid negative as well as positive emotions, for example when recalling an autobiographical experience of love or after reading a tragic news story (Burris & Petrican, 2011). Experiencing the world in an emotionally more vivid, intense, and undifferentiated manner may leave one more immediately anxious about questions of certainty, order, control, and knowledge. Less complex emotional processing may also feed back into cognitive style by making one less able to rely on slow/controlled/reflective processing of answers, and so might only further potentiate a retreat towards, and comfort in, the kinds of intuitive answers offered by religion.

As with the general prescribing of anti-anxiety medication for anxiety disorders, if religion is a palliative, people will vary not only in how much they need it to begin with (based on differences in complexity of emotional processing), but also the degree to which it is their only or best option for relief (based on differences in cognitive style). We therefore find explanations for religiosity that focus on differences in approaches to resolving uncertainty (i.e., cognitive style) and processing emotions to be very much complementary to the proposals advanced by the authors.

Finally, the essence of religion's palliative effects may derive from a deeper and more generalized phenomenon: ideology. Human motivational needs for certainty, order, control, and knowledge are needs within a social, intelligent species that existed long before there ever were monotheisms, or even organized religions. Thus, although it is one route, we should not expect that the fulfillment of these needs is an inherently religious phenomenon. These needs have been fulfilled for hundreds of millions of persons (currently 500–750 million) who are non-religious/not supernaturally inclined by alternative ideologies, such as Confucianism, communism (at one point encompassing nearly one-third of the planet's population), humanism, nationalism, and many varieties of liberal and conservative ideologies (Zuckerman, 2007). Indeed, counter to religious stereotypes, countries with non-religious majorities are the happiest, healthiest, least prejudiced, most peaceful, egalitarian, and woman-friendly places in the world (Zuckerman, 2009). If the authors' results are essentially about the deeper and more generalized variables of ideology and degrees of commitment to it, many predictions follow. In the author's data, non-believers implicitly presented with religious primes showed increases in error-related brain responses. Believers implicitly presented with alternative ideology worldview primes (non-supernatural or otherwise) should show increases in error-related brain responses, a condition not tested by the authors. One would also expect an association between ideological conviction in general and decreased error-related negativity (ERN), bodily states of distress, diminished uncertainty, and a greater sense of coherence and control. For instance, governments and gods are alternative sources of feelings of external control (Kay, Gaucher, Napier, Callan, & Laurin, 2008).

We commend the authors on their impressive synthesis, and hope we have been able to suggest how differences in cognitive style, emotional processing, and ideology may be crucial complementary variables in their account of meaning making.

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Dissonance and distress

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Inzlicht, Tullett, and Good (IT&G) present a provocative model with supportive data suggesting that individuals who possess religious beliefs have lower distress in response to disruptions in meaning, as measured by lowered anterior cingulate cortex (ACC) activity to errors committed during a Stroop task. In this commentary, we consider their model and data from the perspective of cognitive dissonance theory.

IT&G suggest that when meaning or the “perceived coherence between one’s beliefs, goals, and perceptions of the environment” is disrupted, individuals feel distressed; they note that this statement is consistent with the research of cognitive dissonance theory (Festinger, 1957). According to dissonance theory, inconsistency between important cognitions has the potential to cause dissonance, a psychologically uncomfortable state that motivates one to reduce the cognitive inconsistency.

Dissonance theory has been utilized in research on religion. Consider a little-known article by Burris, Harmon-Jones, and Tarpley (1997). In one study, religious individuals’ beliefs were disconfirmed, by having them read a newspaper article that described the drive-by shooting death of an infant boy in his grandmother’s arms as she and the child’s father prayed for protection. The article highlighted the inconsistency between the tragic outcome and the belief that God answers prayers. After reading this article, participants completed a self-reported emotions scale and a measure of transcendence, which asked questions like *How often does God work in mysterious ways?* The emotions and transcendence questionnaires were completed in counter-balanced order, and participants who completed the transcendence questionnaire first experienced less distress the more they endorsed transcendence. These results supported the prediction that religious transcendence protects individuals from dissonance-related distress. A second experiment demonstrated that when

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religious participants completed religious belief measures after reading the article, dissonance-related negative affect decreased relative to two comparison conditions.

Thousands of studies have produced dissonance effects in humans, but it is less well known that the theory's predictions have been supported in research using rats (Lawrence & Festinger, 1962), monkeys (Egan, Bloom, & Santos, 2010), and perhaps dogs (Shenger-Krestovnik, 1921; reported in Gray, 1987). In this latter experiment, a dog was taught to discriminate between an ellipse and a circle on the basis of their shape. When the dog pointed its nose at the circle, it received food. In contrast, when the dog pointed its nose at the ellipse, it received nothing. Gradually, over a period of weeks, the ellipse was made more round, so that it became difficult for the dog to discriminate the ellipse from the circle. When this occurred, the dog began showing signs of distress, including whining and defecating. Pavlov considered this experimental neurosis, and we suggest that it could also be thought of as dissonance-related loss of meaning. The circle had lost its meaning as a guide for the dog's behavior and as a sign that food was forthcoming. These results indicate that disruptions of meaning can cause distress in non-human animals, suggesting that the process is relatively basic.

One variable found to influence the negative affect of dissonance is trivialization, a term coined by Simon, Greenberg, and Brehm (1995) to explain how priming individual's important values may make dissonance-evoking situations seem less important and hence produce less distress. Applied to the research of IT&G, religious beliefs or primes of religious beliefs may cause individuals to perceive the errors made in the Stroop task as less important and this reduction in importance may cause the reduction in ACC activity to the errors.

Along these lines, we also wonder whether religious individuals (or those primed with religion) would show lower ACC activity if the error involved something of more importance. We suspect that behavioral violations of a religious belief (e.g., "sinning") might instead cause greater ACC activity in religious than non-religious individuals. Thus, whether religious belief protects from, or increases, error-related anxiety might depend on the characteristics of the error. Similarly, research has found that individuals low in racial prejudice respond with increased ACC activity to errors indicating they might be racist but not to errors on standard cognitive tasks (Amodio, Devine, & Harmon-Jones, 2008).

As IT&G noted, religions often require costly, unpleasant behaviors of their adherents, such as fasting, tithing, and abstaining from sex. These behaviors are often so difficult to accomplish that many individuals violate the dictates of their religion. Violations such as these should lead to a loss of meaning, thereby increasing anxiety rather than buffering it. However, perhaps individuals use their religious beliefs to transcend their transgressions, as they transcend other events that violate the tenants of religious belief (Burris et al., 1997). The relationship between "sin," anxiety, and religious transcendence could provide a fruitful basis for future research.

We also wonder if the end result of the motivation to seek religion is to guide effective action. In our action-based model of dissonance, we proposed that cognitions have the power to create dissonance because those cognitions implicate actions (Harmon-Jones, Amodio, & Harmon-Jones, 2009). Conflict between cognitions is problematic because it has the potential to interfere with effective action. In our model, the proximal motive for discrepancy reduction is to reduce distress, whereas the distal result is to facilitate effective, unconflicted action. Religions often provide individuals with guides for behavior and these guides may be the pillars supporting the comforting meanings offered by religion.

We applaud IT&G for recognizing that religion's origins and effects are complex and unlikely to be related to a single outcome such as anxiety buffering. Future research might integrate religions' anxiety-buffering function with the hyperactive agency detection mechanism and prosociality functions. For example, the hyperactive agency detection model suggests that humans are motivated to develop religious beliefs when exposed to dangerous and uncertain circumstances, whereas the anxiety-buffering model suggests that religious beliefs successfully manage the anxiety evoked in such situations. Furthermore, the need to manage anxiety may provide the proximal motivation for religion, whereas prosociality and group cohesion via costly signaling may be important distal, adaptive functions of the resulting religious behavior.

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Motivational and neural systems of religion

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Inzlicht, Tullett, and Good (IT&G) have provided a new and valuable insight into the neuroscience of religion, demonstrating that religious people show less activity in the anterior cingulate cortex (ACC) after Stroop task errors. Why might this occur? The ACC acts as a processing module for integrating input from, and sending output to, various motivational, cognitive, sensorimotor, and emotional processing brain regions (Bush, Luu, & Posner, 2000). IT&G suggest that religion provides a kind of cognitive scaffolding, or stabilizing structure, for dealing with mundane occurrences and for managing the anxieties of daily life.

However, religion doesn't always "make sense" – prayers are not always answered, bad things happen to good people, and it is often the irrationality of religious belief that is derided by non-believers. Another plausible explanation of IT&G's findings is that religious people have a history of self-monitoring and tend to

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notice departures from the norm. They may simply be more experienced at judging the things in their environment against an ideal goal, giving careful consideration to what is right or wrong, and adjusting their behavior accordingly.

These varying possibilities regarding IT&G's research encourage us to expand our thinking about how these and other neural systems may be involved in various aspects of religion. The many cognitive systems that are involved in religion have already been discussed. Boyer (2001, 2003) has identified several possible cognitive systems and the corresponding neurological components that are implicated in religious beliefs and behaviors. For instance, religious commands for purity may recruit systems related to disgust, and belief in non-human agents is thought to recruit agency detection and theory of mind systems.

Building on IT&G's and Boyer's insights, we consider how religion can involve not just cognition but also motivation, which impels us to theorize about how religion can involve both controlled and automatic processes. Many religious beliefs and practices that seem quite intentional and deliberate may be associated with more automatic processes of which individuals are unaware (e.g., Harris et al., 2009; Kapogiannis et al., 2009; Newberg & d'Aquili, 2000; Zhong & Liljenquist, 2006).

Kenrick, Griskevicius, Neuberg, and Schaller (2010) proposed that all humans are motivated to solve a similar set of recurring social problems: self-protection, disease avoidance, status acquisition, mate selection, mate retention, and kin care. These fundamental social motives appear to influence religious beliefs and practices in a variety of ways (Johnson, Li, & Cohen, 2011; Kirkpatrick, 1999). For example, people are more religious when they are faced with poor mating prospects (Li, Cohen, Weeden, & Kenrick, 2010). People are less religious when motivated by short-term mating goals (Weeden, Cohen, & Kenrick, 2008). Other motivational systems affect religion as well. Disease threat is associated with out-group derogation, leading to increased religious diversity (Schaller & Duncan, 2007). With regard to self-protection, when mortality is made salient, people are more likely to believe in supernatural or invisible non-human agents (Norenzayan & Hansen, 2006).

Motivational and cognitive mental processes are often a combination of automatic and controlled responses. Because of the fundamental nature of the social motivations we discuss, we propose that these are largely automatic, but tempered by certain controlled, cognitive processes. In Table 1, we outline a framework in which this set of basic, automatic, social motives may activate a related set of more controlled cognitive processes, ultimately leading to the attitudinal and behavioral outcomes we refer to as various aspects of religion. What is especially interesting to us about this conceptual framework is the possibility that certain aspects of religion may have developed in an attempt to regulate or even *inhibit* – rather than satisfy – these more basic, automatic desires and motivations, a perspective which is a novel consequence of IT&G's work.

Although a considerable amount of empirical investigation has been done on the interplay between automatic and controlled processes in social cognitive neuroscience (e.g., Lieberman, 2007; Ochsner, 2004; Satpute & Lieberman, 2006), these processes have not been directly implicated in the underlying mechanisms involved in religious cognitions and motivations. If religion provides a framework to regulate automatic tendencies, different predictions of brain region activity can be made depending on the religiosity of the individual and which fundamental motive is active.

For example, Nili, Goldberg, Weizman, and Dudai (2010) investigated courageous behavior using fMRI by having participants voluntarily decide to move a live snake

Table 1. Fundamental motives and related automatic and controlled processes related to religion.

Motive	Automatic		Controlled		Relevant research
	Representative activity	Brain area	Representative activity	Brain area	
Self-protection from predators	Fight/flight	Temporal lobe (e.g., amygdala)	Courage in battle; <i>jihad</i> and “just wars”	sgACC, vlPFC, dlPFC, dmPFC	Ochsner et al. (2004); Nili et al. (2010)
Survival (basic needs)	Eating	Hypothalamus	Fasting; food taboos	ACC, dlPFC, OFC	Kringelbach (2005); MacDonald et al. (2000); Wang et al. (2009)
Coalition formation	Agent detection	pSTS, temporal pole	Interactions with immaterial agents	TPJ, TPR mPFC, Caudate	Schjoedt et al. (2008, 2009); Newberg et al. (2006)
Status acquisition	Social dominance	Ventral striatum	Shaman and priestly rituals; meditation	PFC, CG	Ly et al. (2011); Newberg & Newberg (2005); Insel & Fernald (2004)
Mating	Mating	Amygdala, temporal pole, hypothalamus	Abstinence from premarital sex	sFG, aCG, mOFC	Beauregard et al. (2001); Stoléru et al. (2003)
Kin-care	Protecting kin	Temporal lobe (e.g., amygdala)	Circumcision; rights of passage	IPFC, OFC	Kalisch et al. (2005); Ochsner et al. (2004)
Cognitive consistency	Eliminate uncertainty	Amygdala, hypothalamus	Worldview; meaning-making	ACC, dlPFC	Inzlicht et al. (2009); Inzlicht & Tullett (2010)

Notes. a, anterior; l, lateral; m, medial; p, posterior; s, superior; sg, subguneal; dl, dorsolateral; dm, dorsomedial; vl, ventrolateral; ACC, anterior cingulate cortex; CG, cingulate gyrus; FG, frontal gyrus; OFC, orbitofrontal cortex; PFC, prefrontal cortex; TPJ, temporo-parietal junction; TPR, temporopolar region; STS, superior temporal sulcus.

closer to (or further from) their heads. Increased activity in the subgenual anterior cingulate cortex (sgACC) and decreased activity in temporal lobe structures (e.g., amygdala) was associated with overcoming fear, whereas succumbing to fear resulted in increased temporal lobe activity. These results suggest that controlled processes can countermand reflexive tendencies in fearful situations. The same can be true for the suite of cognitions and motivations that are involved in religion, as IT&G suggest.

More generally, our approach underscores a variety of cognitive mechanisms that may underlie cognitive control processes related to religious beliefs. Instances in which religious belief requires inhibition of automatic social motives leads to testable predictions of the specific brain regions involved in controlled processing, and correlating religiosity with brain activity in these different regions can allow for a better understanding of how religion works. In the earlier example, decreased sgACC activity could implicate religion as a meaning-making system responsible for reducing anxiety during internal conflict, whereas increased activity could suggest the importance of suppressing basic motivational tendencies in order to follow a strict religious rule system. Regardless of the exact underlying mechanisms, we are enthusiastic about the possibility that there may be a wide range of motivational states and cognitive processes related to religion. Importantly, we believe that interactions of these processes are amenable to experimental manipulation and investigation with social and cognitive neuroscience techniques.

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Religion is the opiate of the masses (but science is the methadone)

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Introduction

In their target article, “The need to believe”, Inzlicht, Tullett, and Good (IT&G) outline a motivational account of religious belief as a sense-making system that provides believers with existential meaning and buffers against anxiety in the face of uncertainty. This account of religion complements the current social–cognitive

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models, and also provides an empirical rebuttal to those who criticize religion as a wholly deleterious force on society. I agree with the authors that religion does create order, and by doing so provides an important emotional benefit to believers. In this commentary I suggest that this function may not be unique to religion. Science also helps to create order and a meaningful set of interrelated propositions. Consequently, science may also provide the same kind of emotional benefits to those who are engaged in the scientific enterprise.

Meaning-making systems

IT&G propose that religion is a meaning-making system that reduces uncertainty and stress in believers. Meaning is created by the perceived coherency between one's beliefs, explanations, perceptions, and goals that together produces an overarching sense of order. But is religion unique in this regard? Science, like religion, is a broad social institution that encompasses many interrelated beliefs and connects with deeply held norms and behaviors of the culture. How, then, does science measure up to religion as a system of creating meaning?

First, science provides specific answers and explanations for understanding the world. The inherent goal of science is to provide greater understanding of the natural world, and advances in science are always in the direction of improved understanding and order. The parallel function of religion and science as meaning systems is evident in the stormy relationship between the two throughout history. Often, spiritual and scientific answers are pursued together and seen as two sides of the same coin. For example, Pope John Paul II stated in his address to the Pontifical Academy of Sciences: "truth cannot contradict truth" (1996). At other times, religion and science fiercely conflict when new scientific theories clash with accepted doctrine (e.g., the heliocentric model of planetary motion, evolution by natural selection). Perhaps the reason for the intensity of the religious–scientific conflict is that by providing these alternate explanations for the big questions in life, science also offers an alternate route to existential meaning in life (Preston & Epley, 2009).

As IT&G note, meaning is more than just the capacity to explain. Meaning is also forged from a connection to personal goals and cohesion between these goals. These aspects of a meaningful belief system can also be satisfied by science. For scientists, the scientific enterprise connects to personal goals of discovery, rigor, and a philosophical value of objectivity and empiricism. It also places the scientist in a community of like-minded individuals that reinforce these goals and values. Furthermore, science can inspire deep feelings of awe and wonder (Sagan, 2006), powerful emotions elicited by the perception of vastness and a perception that things are somehow connected in a greater whole (Keltner & Haidt, 2003). Science thus shares many important characteristics of religion: it provides order, explanation, satisfies personal goals, and fulfills an existential sense of wonder at the universe. In short, science can also provide meaning to those who believe in it.

Neurophysiological studies

The proposition that religion helps its followers to understand and predict their environment is not new (Frazer, 1922), though the idea has been underemphasized in recent psychological research. But here, the authors further argue that the meaning established by religious belief helps buffer against daily stress and anxiety, allowing

greater resilience in the face of uncertainty. Moreover, this idea is supported with neurophysiological evidence from their own research in a series of cleverly designed studies. Using a Stroop paradigm, activation of the anterior cingulate cortex (ACC) is measured as a marker of anxiety following errors on the task. Consistently, they find that religion buffers against the stress caused by errors. Lower activation of the ACC following errors is observed in individuals high in “religious zeal” (Inzlicht, McGregor, Hirsh, & Nash, 2009). Further, activating religious cognition (via priming) also reduced ACC activation in believers, but religious primes *increase* ACC activation in non-believers (Inzlicht & Tullett, 2010), arguably because religion represents a failure of meaning and order to non-believers.

Above I have briefly argued that science (broadly construed) can provide an alternative to religion as a source of meaning. If so, it follows that meaning in science may also provide similar emotional benefits to its believers. This hypothesis could be tested by modifying the Stroop-task studies to include a group of self-identified scientists as subjects. As a parallel to their study with religious zealots (Inzlicht et al., 2009), we would expect that people who strongly identify with science (“scientific zealots”) would show less ACC activation than a control group (who do not strongly identify with religion or science). Another test of this hypothesis could modify the design of the religion-prime study (Inzlicht & Tullett, 2010) to include experimental manipulations of science primes. If meaning helps buffer against anxiety and uncertainty, priming science concepts could likewise reduce ACC activation among scientists. However, just as religion primes increased ACC activation in nonbelievers (Inzlicht & Tullett, 2010) science primes could increase ACC activation among people who reject science. Together, such new evidence would further support the argument that the sense of greater order in the universe (whether spiritual or scientific) serves as a powerful palliative against anxiety and uncertainty.

Conclusion

In their article, IT&G have outlined a clear and insightful account of religion as a meaning-making system. More than a just a by-product of other cognitive forces, religious belief is also driven by a basic need for understanding and order. But certainly religion does not have a monopoly on meaning. Science also provides meaning, although ultimately the explanations and goals derived from science are different than those of religion. Despite these specific differences in explanation, the underlying motivation behind science and religion is the same: to reveal the hidden order in the universe, and to marvel at its wonder.

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Understanding the role of religion's palliative effects, within and between cultures

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Inzlicht, Tullett, and Good (IT&G) provide compelling evidence that religious belief can reduce reactivity in the ACC following errors. They interpret this finding at a broader level, suggesting that in general religious belief may limit emotional reactivity to complex problems and frustrating experiences in life. However, they note that in doing this religion may be interfering with cognitive processes and learning mechanisms in much the same way alcohol does. This leaves an obvious functional dilemma: if a religious perspective is interfering with adapted processes, how could it be functional such that it has emerged and spread universally? Additionally, defining religion by its modern day examples leaves open the issue that modern religions may *contain* ideas that are palliative, but also many components that are neither necessary nor sufficient to produce this effect. Both of these points are discussed below.

Focusing solely on religion's palliative effects (i.e., disregarding benefits of certain world religions such as enhanced in-group cooperation; Shariff & Norenzayan, 2007), the authors argue that religion may have provided cognitive relief for a social and physical world that has become increasingly complex over time. Although the authors do not elaborate on this, they appear to argue that anxiety itself is not the problem, but rather the issue is anxiety brought about by minds increasingly selected for creating symbolic thought and abstract problem solving. That is, as the human species improved in their ability to make meaningful abstract connections in the world, it may have become important to have psychological strategies to reduce the need to understand an unexpected event if it was too complex to actually solve, or entirely random (i.e., finding connections where none really exist). Assigning these problems to an external agent or causal system may have provided cognitive relief, freeing up resources to focus on problems that were more tractable. This is an adaptationist argument that is similar to Terror Management Theory (TMT) in certain ways, but manages to avoid some of the theoretical issues that TMT has been criticized for (Kirkpatrick & Navarrete, 2008; Proulx & Heine, 2006; Randles, Proulx, & Heine, 2011). In particular, whereas TMT argues that an abstract awareness of death became a specific and unique problem for humans because it chronically activated our instinct to avoid death (Solomon, Greenberg, Schimel, Arndt, & Pyszczynski, 2004), IT&G focus on practical, stimulus-dependent problems that lead to the need for religion. In their account, a mind motivated to form more connections than it can manage may benefit from a "safety valve," or a style of thinking which reduces the motivation to impose comprehensible order when doing so is either not worthwhile or impossible.

An important direction for future research would be to verify whether religion is as blunt a palliative as the authors suggest, or if it can be more selectively employed

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to disengage from fruitless problem-solving. Given that when our expectations are violated there is often a real potential problem or threat, having some mechanism for selectively activating religious thought (either consciously or otherwise) would presumably be far more useful than a blanket palliative. Despite the authors' current findings, which suggest that reactions as broad and basic as the startle response are less pronounced in religious individuals, further evidence is needed before rejecting the possibility that religion's palliative effect is generally more intermittent, and more strongly evoked by certain types of errors more than by others.

An additional area of focus that will likely be fruitful is to better understand which components of religions are palliative. Given the diversity of major religions in the authors' sample, it is reasonable to suspect that most major religions (though possibly not all religions) are sufficient to reduce threat through compensatory affirmation, but likely more than necessary. That is, the rich set of beliefs, rituals, and norms that a religion has may contain a number of ideas that can be palliative, as well as many that have culturally evolved for entirely different reasons (such as cooperation; Henrich et al., 2006). The authors allude to a need for order as one such component (although there are likely others), showing that any abstract way of affirming that there is a master plan, not just through organized religion, can alleviate error-related anxiety. This implies that what makes modern religions special is not their ability to psychologically minimize anxiety in a unique way, but that they are one instance of culturally-evolved technologies that happen to do this very successfully.

There are likely other psychological strategies for producing this effect that bear very little resemblance to religion. For instance, religious affirmation increases following uncertainty threats (McGregor, Nash, & Prentice, 2010), showing that it can be used to minimize uncertainty concerns, but research has shown that many other strategies have similar effects, such as reinforcing normative values (McGregor, Nail, Marigold, & So-Jin, 2005), system justification (Jost, Glaser, Kruglanski, & Sulloway, 2003), or even conspiracy theories (Whitson & Galinsky, 2008). Understanding the basic qualities of a belief that are useful in minimizing anxiety will be an important direction for future research. Studying this effect across religions and cultures will likely yield valuable insight, as the authors suggest, but this should be combined with research focused on the minimum necessary components of a belief system that are sufficient to reduce anxiety. For instance, the finding reported in the target article that North Americans are soothed by knowing there is an unknowable master plan may have more to do with the unique concerns of modern western culture specifically rather than humans universally. The more we understand about the minimum criteria needed to guide the mind into feeling calmer than it otherwise would, the clearer the story of religion and the importance of the palliative component will become. This paper makes a strong case for the palliative quality of religion, and as we learn more about the basic criteria for producing this palliative, we will learn more about the origins and evolution of religion.

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The need to believe in conflicting propositions

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Introduction

Inzlicht, Tullett, and Good (IT&G) defend a “motivated meaning-making hypothesis” for religion in which religiosity functions to reduce anxiety by affording a sense of control and order. They show that religious belief and zeal are associated with reduced activity in the anterior cingulate cortex (ACC) as religious subjects commit Stroop errors. While we remain skeptical whether such errors offer ecologically valid anxieties, we nevertheless believe that the authors’ experimental work is important. In this commentary we present an alternative interpretation of the authors’ findings.

ACC function and conflict processing

The authors correctly notice that the ACC is involved in multiple cognitive functions, especially in emotional, social-cognitive, and executive processes (Bush, Luu, & Posner, 2000; Fan, Flombaum, McCandliss, Thomas, & Posner, 2003; Fan, Hof, Guise, Fossella, & Posner, 2008). They interpret ACC activity (error-related negativity, or ERN) in the Stroop task as evidence of a neural “distress signal,” emphasizing the ACC’s affective role in cognition. This interpretation supports their hypothesis “that religion protects against distress and anxiety.” The functional significance of ERN, however, remains controversial. Whereas affective models of ERN signals have been proposed by some neuroscientists (Luu & Pederson, 2004), the ERN has also been modeled as the functional correlate of error detection

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(Holroyd & Coles, 2002), and conflict monitoring (Carter, Botvinick, & Cohen, 1999; Carter et al., 1998).

The authors reject an interpretation in which the diminished activation in religious subjects results from a decrease of attention. They reject this interpretation because believers showed improved task performance, which is inconsistent with attention reduction. Reduced ACC activity in Stroop tasks, however, does not necessarily indicate a general decrease of attention but rather a specific decrease of attention to error detection or conflict monitoring. For example, hypnosis research has shown that highly susceptible subjects can reduce ACC activity while simultaneously improving Stroop performance if their attention to conflicting information is reduced by hypnotic suggestions to ignore the meaning of the color words (Raz, Fan, & Posner, 2005; Raz, Shapiro, Fan, & Posner, 2002). We prefer a cognitive model in which the authors' results simply indicate inattention to conflict monitoring, rather than a production of meaning or coherence.

Religion and epistemic coherency

This interpretation avoids the problematic suggestion that the foremost role of religion is to provide epistemic coherence, which is at odds with the observation that believers easily adopt conflicting propositions in their religious world views (Schjoedt, 2007). Paradoxically, the ability to ignore conflicts between beliefs may render religion a more efficient system for coping and anxiety reduction. For instance, consider the notions of free will and determinism which exist in most religious systems. In coping with accidents believers may find comfort in notions of fate, predestination, or God's mysterious ways (determinism) rather than in the idea of free will because free will may imply that events could have been different. Yet free will may be preferred whenever the believer has the means to actively meet a challenge, for example by studying, rather than by leaving academic outcomes in God's hands. Believers who are unable to suppress attention to one of these propositions – free will or determinism – when the other proposition is in use will not be able to optimally cope with the relevant challenge.

From this perspective strong believers may learn to habitually suppress epistemic conflicts to better “harvest the fruits” of religion. This inattention hypothesis is consistent with IT&G's intriguing data.

How do believers acquire this ability?

The interpretation that religiosity attenuates conflict processing raises the question of how believers might acquire this ability. An intriguing prospective answer comes from the social neuroscience of religion. In a recent fMRI experiment investigating neural responses under assumptions about a religious authority, Schjoedt and colleagues found that believers who listened to prayers by a charismatic authority down-regulated their frontal executive network including the dorsolateral prefrontal cortex and the ACC (Schjoedt, Stodkilde-Jorgensen, Geertz, Lund, & Roepstorff, 2011). Such participants were subsequently more likely to report experiences of God's presence during the prayer. Intriguingly, hypnosis research shows comparable neural effects as patients become susceptible to suggestions by the hypnotist and down-regulate attention to conflicting information (Egner & Raz, 2007; Gruzelier, Gray, & Horn, 2002; Jamieson & Sheehan, 2004). Such modulations are dependent

on the patients' beliefs about the efficacy of hypnosis as well as patients' trust in the competences of the hypnotist (Kirsch, 1985; Spanos, 1996). If the analogy to hypnosis proves useful, then a strong belief in God may combine with trust in religious authorities to down-regulate attention to conflicting information. Trust in the knowledge and powers of religious authorities may reduce the need for individuals to struggle with inherently unsolvable problems. For example, believers who undergo epistemic crises may reduce anxiety by assuming that religious experts have the answers. If this interpretation has merit, the learning of conflict suppression would derive at least in part from structured social interactions mediated by cultural assumptions and contexts of trust. We have shown elsewhere how this ability can be understood in an evolutionary framework to facilitate cooperation under risk even in large-scale societies (Bulbulia & Schjoedt, 2010).

Summary

We applaud IT&G's search for a more rigorous social cognitive neuroscience of religion. Indeed, our neurocognitive model is not so different from theirs. However, rather than defending any specific model, our point has been to show that there remains a wide scope for alternative hypotheses, even for the apparently simple question of how ACC activity relates to religious traits.

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Religions, meaning making, and basic needs

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Introduction

This comment is not so much concerned with criticism of the research as with the framing of the study in relation to discussions of meaning making in psychology and the conceptualization of religion in the humanities and social sciences. Specifically, we advocate a building block approach to the study of religion that allows us to consider components, such as meaning making processes, which are not inherently “sacred” or “religious,” but that people mix and match to create religions and spiritualities.

Religion versus religions

The emphasis in the paper is on religion used in the singular. Rather than attempt to characterize the abstract noun “religion,” we think it makes more sense to view religions and spiritualities as disparate wholes made up of parts. Methodologically, we need to begin by attempting “to characterize the elementary phenomena from which any religion results, and then characterize the system produced by their union” (Durkheim, 1995, pp. 33–34). Durkheim characterized religions as consisting of two basic parts – beliefs and practices – having to do with the sacred, that is, things set apart from the ordinary or everyday. The three lines of research identified by the authors – hyperactive agency detection; prosociality, costly signaling, and the evolution of large groups; and meaning making – are yet more basic processes. We can consider each line of research as contributing to our understanding of a basic building block that people use to form and structure beliefs and practices and sometimes further assemble into the larger systems we call religions (Taves, 2009, 2010). Thus, we can relate hyperactive agency detection to the identification of things (animate and inanimate) that people believe possess non-ordinary powers, ranging from amulets to deities. We can relate costly signaling not only to the formation of groups, but more specifically to the formation of groups that embrace alternative, non-ordinary conceptions of reality that operate according to their own rules and conceptions of time and space, from athletic and video games, on the one hand, to the otherworlds of religions and science fiction, on the other. Finally, we can relate meaning making to processes of rationalization that not only create order, but also

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establish rank and value, leading in some cases to claims of ultimate meaning and value. In view of this general framework, we want to highlight the considerable literature on meaning making extant in psychology and sociology that can assist in framing the discussion more broadly and reflect on the underlying needs that inform each of these building blocks.

Meaning making

The psychological literature on meaning making is much more extensive than the authors suggest, perhaps due to page constraints. Following the far-reaching existential treatise *The will to meaning* by Frankl (1969), the first real social psychological treatment of meaning making was by Baumeister (1991). He explained that it is meaning that connotes anything with respect to, implied by, or related to anything else, and that it is these associations that make for synthesis and continuity among elements. He summarized the point by saying meaning “connects things” (p. 16). Park and Folkman (1997) extended this idea into the concept of global meaning systems in a landmark review article that elaborated the concept of meaning systems in the context of coping. Then, following Wong and Fry’s (1998) edited volume on the search for meaning, Park (2005) published the first comprehensive chapter on religion and meaning, concurrent with the companion publication of the *Journal of Social Issues* issue on religion as a meaning system (Silberman, 2005). Park and McNamara (2006) connected meaning making to neurological functioning. Park’s (2010) comprehensive review of research on meaning systems in the *Psychological Bulletin* stands as a landmark summary of work on the topic.

Within sociology, Weber (1946) made the problem of senselessness central to his understanding of religions. The target paper helps us to understand why senselessness is such a problem: it generates distress (uncertainty and anxiety). Distress (at least extreme distress) presumably decreases individual functioning and thus effects individual survival. The authors’ thus stress the “salutary properties” of religion as a buffer against distress. Weber’s work, however, allows us to consider the effects of such buffering from a more comprehensive vantage point. His work highlights the close relationship between meaning making as a process of making things coherent (rationalization) and as a process of valuation (ranking and ordering) and, thus, in identifying ultimate goals and directing action toward them. Conceived in this way meaning making, thus, points to the possibility of extreme actions undertaken in the name of religion, such as martyrdom, that do not have survival value for the individual. Nonetheless, martyrdom may have benefits for the group to which the martyr belongs. In signaling the costly sacrifices that individuals are willing to make to uphold the ultimate values and goals of the group, martyrs may contribute to the survival of the group as a group. Given that what one group construes as martyrdom another may construe as terrorism, we want to stress that the “palliative” or “salutary” effects of the quest for coherence on the anxiety of individuals may lead to outcomes that many would consider negative. Non-anxious individuals can do many things in the service of “coherent” goals. In contrast to the singularly positive assessment of “religion” in the target article, we want to distinguish between the salutary effects that religious beliefs and practices may

have on distress and the effects of “religion,” which are not only various, but also dependent on point of view.

Basic needs

A sociological approach to meaning making would also suggest that intellectual elites are the ones most obsessed with coherence, e.g., scientists, academics, and, within religious traditions, theologians. Most people and most intellectuals in their off hours get by with relatively modest, pragmatic levels of coherence. This reinforces the point that people mix and match these building blocks rather than necessarily giving precedence to any one of the three over the others. Moreover, just as we can understand the quest for meaning as a response to basic needs such as the buffering of distress and the orientation of goal-directed action, we can also apply this perspective to human engagement with non-ordinary powers and realities. The tendency to over-attribute agency in the context of threat detection can be viewed in the larger framework of detecting and evaluating the powers at play and the resources at hand in threatening situations. Objects or agents to which persons attribute non-ordinary powers are not necessarily threats or signs of danger; they may also be resources, that is, means of overcoming danger, whether in the form of “magical” objects or “supernatural” beings. The tendency to create and signal our allegiance to groups committed to non-ordinary realities may be, as Bellah (2011) argues, rooted in the mammalian need to go “off-line” when it’s safe to do so, whether in the context of sleep, dreams, or play. Seemingly non-functional activities may in fact reflect underlying biological needs, while at the same time serving to encourage prosocial behavior, develop skills, and imagine alternatives. In sum, we can conceive of religions as wholes made up of parts that are themselves composed of more basic building blocks that respond to a variety of basic human needs, including responding to threat or danger, replenishing the organism “offline,” and mitigating distress.

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From “is” to “ought”: the naturalistic fallacy in the psychology of religion

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A couple of issues plague the rigorous scientific study of the psychology of religion. These include the occasionally adversarial tone of the debate between religious believers and non-believers, and the neglect or misinterpretation of empirical findings.

Along these lines, Inzlicht, Tullett, and Good (IT&G) noted recently that modern writers such as Dawkins (2006) tend to highlight the absence of a truth-value of religion and, in doing so, overlook the fact that religious beliefs can have positive effects on adherents. Others have come up with similar observations (see, e.g., De Botton, 2011). These authors should be commended for emphasizing this point. Furthermore, the IT&G paper is important because it contributes potentially important specific insights into how exactly religious adherence may be beneficial to believers. And the authors do so while adopting a motivational meaning-making approach.

IT&G quite rightfully point to the often-observed facts that (1) religion is widespread throughout the world and (2) believers tend to be healthier and show other beneficial effects. I agree with these authors that this suggests that adherence to religious beliefs serves important psychological functions. However, in focusing on this issue, the authors ignore the negative effects of adherence to religious beliefs. For example, in Study 1 of their paper they measure religiosity with zealous items such as “I would support a war that defended my religious beliefs.” I argue that is precisely the adherence to these sorts of beliefs that causes a lot of societal unrest and violence (e.g. 9/11). At a bare minimum, the negative impact of strong adherence to religious beliefs should be noted as well.

I propose that the negative impacts of religious beliefs are often ignored because it is easy to commit to a naturalistic fallacy when adopting a functional approach to explaining the psychological importance of these beliefs. A common error that is often made when studying what *is* going on in the world is to deduce from the observation of recurring and reliable facts that they *should* be the case (Hume, 1951; Kohlberg, 1971). This effect is also found in evaluating societal arrangements: you see that certain arrangements in society serve important functions and then incorrectly infer that these arrangements must be how society *should* be organized (Gaucher, Kay, Peach, Zanna, & Spencer, 2007). I argue that the same applies to the psychology of religion: you see that religious beliefs serve some important psychological functions for the individuals who adhere to those beliefs and then you are inclined to deduce that these beliefs should have some kernel of truth in them otherwise they could not fulfill these important functions. As a result you ignore the

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negative aspects of those beliefs and focus on the positive effects only, which is what IT&G do.

Toward a research agenda for the psychology of religion

When studying the fascinating interface of religion and psychology my recommendation would be to adhere to the following five items as starting points of inquiry:

Empirical evidence obtained thus far does not suggest there is a God or that there are multiple gods. This makes the empirical basis for religion weak (Popper, 1959).

Treat people who nevertheless adhere to religious beliefs with respect. Thus, non-believers should not shout from the rooftops that believers are WRONG (cf. Dawkins, 2006). Similarly, believers should treat non-believers with the utmost respect.

Science is not value free, so indicate your personal standpoint on religion when studying this issue. This will allow readers of your work to better interpret your writings on this topic.¹

The fact that religion is widespread and that adherence to religious beliefs can have beneficial effects on believers suggests that religious beliefs serve important psychological functions. Psychological models such as a motivated meaning perspective (IT&G), or related models focusing on how people cope with existential uncertainties (e.g., Fromm, 1942; Towler, 1984; Van den Bos, Van Ameijde, & Van Gorp, 2006), can help us to understand why this is the case and what these functions are.

Do not study the psychology of religion by committing the naturalistic fallacy (cf. De Botton, 2011). The notion that adherence to religious beliefs may fulfill important psychological functions among believers does not make these beliefs right.

Note

1. I am an atheist.

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RESPONSE**Existential neuroscience: a proximate explanation of religion as flexible meaning and palliative**

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The cognitive science of religion has made great strides in the past decade (e.g., Boyer, 2008), with more and better research from many disciplines asking basic questions about why religions exist, persist, thrive, and heal. The journal that is publishing these very words, *Religion, Brain & Behavior*, is testament to the accelerating nature of this interdisciplinary movement, as is the breadth and quality of the commentaries that our target article generated. We are grateful that these commentaries have forced us not only to think deeply about the ideas contained therein, but also to elaborate upon our own model.

Rather than addressing each reply in turn, we built our response around the major themes that emerged. Overall, there was consensus satisfaction with our basic neuroscience findings linking religious belief with brain-based error-related distress. There was less satisfaction, however, with the way we broadly interpreted these data. Paying heed to the most frequent questions and ideas put forth by the commentators, we organized our response as follows: we (1) discuss our use of the term “meaning,” (2) contrast the kind of proximate explanations provided by the motivated meaning model with ultimate explanations provided by evolutionary models, (3) provide evidence for why flexible meaning systems like religion may be better palliatives than scrutable meaning systems like science, and (4) suggest that an affective interpretation of anterior cingulate cortex (ACC) activity accounts for more data than a purely cognitive explanation, but also note that both explanations might be functionally isomorphic. We end by mapping out the kinds of future studies that we are now planning and that were inspired by the valuable commentaries.

What do we mean by meaning?

We define meaning as “the perceived coherence between beliefs, salient goals, and perceptions of the environment.” In other words, we define meaning as consistency between mental representations, which is a definition based on the structure and not the content of beliefs. In so doing, our work follows directly from the seminal research on cognitive dissonance theory (Festinger, 1957; Harmon-Jones & Harmon-Jones, 2008) that has inspired the multiple and related ways that people have defined meaning in the field (Baumeister, 1991; Silberman, 2005; Park, 2010; Taves & Paloutzian, this article). Baumeister and MacKenzie criticize this structural definition, which we find odd given that our own definition was (indirectly) inspired by

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Baumeister's (1991) – “meaning is shared mental representations of possible relationships among things, events, and relationships . . . meaning *connects* things” (p. 15).

We would like to add to the definition of meaning we provided in our target article by giving it a function. In our view, meaning is more than abstract connections of the mind; meaning has a real function and consequence – it allows people to act in their environments (Tullett et al., in press). Inspired by the action-based model of dissonance (Harmon-Jones & Harmon-Jones, 2008) and the model of reactive approach motivation (McGregor, Nash, Mann, & Phills, 2010), we suggest that meaning is required for action. As such, we define meaning as coherence between beliefs, salient goals, and perceptions of the environment that provides a foundation for our interactions with the world (Tullett et al., in press). Without this coherence, our actions would be ineffective, random, and disconnected from our surroundings. This is conceptually similar to Taves and Paloutzian's suggestion that meaning-making not only makes things cohere, but also allows for a process of valuation; a process for the identification and execution of important goals.

An implicit part of our definition of meaning is that people rarely notice when it's present; instead, they notice when there is a lack of meaning – when things are inconsistent. For example, no one thinks twice about getting wet in the rain; people's sense of meaning, however, would be threatened if they did not get wet despite being in the rain. So meaning comes to the fore when there is a lack of it. People focus on the absence of meaning because it is accompanied by an aversive affective state. Like cognitive dissonance (Elliot & Devine, 1994; Cooper, Zanna, & Taves, 1978), threats to meaning do not feel good; “they are characterized by a psychologically uncomfortable state that motivates [people] to reduce the source” of threat (Harmon-Jones & Harmon-Jones, 2008).

Religion offers meaning in one of two ways. First, it provides a coherent framework for understanding one's environment and interpreting specific events from one's life (Baumeister & MacKenzie). In so doing it acts like a blueprint for action and the setting of important goals. Second, when things go wrong, or when meaning is threatened (e.g., when a loved one dies), religion acts like a palliative that eases attendant feelings of anxiety. Religion, that is, allows people to transcend the inconsistencies, uncertainties, and cruelties of the real world (Burris, Harmon-Jones, & Tarpley, 1997). As such, it acts as a bulwark against the stresses and anxieties of everyday life. Importantly, religion offers a meaning system that is flexible; it can accommodate many varieties of meaning-threats because the order it offers is often inscrutable, only knowable to a super-natural, all-knowing, and all-powerful God.

Disentangling proximate and ultimate explanations

One of the important endeavors undertaken by psychologists is to establish the psychological needs of human beings – the things that motivate people to behave in one way versus another. Given the question “Why do people need X?” two broad categories of answers are potentially possible. The first type of answer involves an attempt to establish the way in which the needed thing can alleviate unpleasant states. If, for instance, someone answered the question “why do people need to eat?” the explanation might be something like “people need to eat because eating gets rid of their hunger.” An alternative and orthogonal type of answer focuses on the way in which the needed thing can serve an adaptive function. With respect to the need to eat, this type of answer might be something like “people need to eat because

otherwise they will not consume the proteins, fats, carbohydrates, and nutrients that allow them to survive and reproduce.” These two types of answers – termed proximate and ultimate, respectively – constitute two separate approaches to understanding psychological needs, and distinguishing between them is essential to avoiding confusion and wasted effort in the human behavioral sciences (Mayr, 1963; Scott-Phillips, Dickins, & West, 2011; Tinbergen, 1963).

In our target article, we propose that religion is functional in that it serves a need for meaning. Our explanation for why people need meaning is a proximate one: meaning is something that, when lacking, generates a negative state that people are motivated to resolve. In the case of meaning, we posit that this negative state is characterized by feelings of anxiety and uncertainty, and that this state creates a motivational drive to restore meaning. What is important to note about this explanation is that it makes no claims about the adaptive value or evolutionary importance of meaning or religion – accounts that do make these claims are providing ultimate explanations that tackle the notion of “need” from a different level of analysis.

In several of the thoughtful commentaries on our target article, the costly signaling model of religion was proposed as an alternative account to our own model of religion as motivated meaning-making. In some instances the explanations provided by these two accounts may be in real conflict, in which case further research might do well to pit the two possibilities against each other in experimental investigations. There are other instances, however, where we feel the conflict between the two models may be more illusory than real.

According to Alcorta, religion is comforting because it reduces anxiety by fostering feelings of trust and security. In her words, “[religious] frameworks reduce personal anxiety by allowing us to predict the motives and behaviors of others and optimally pattern our own individual behaviors and choices”. First, it should be noted that this hypothesis does not *necessarily* follow from the ultimate hypothesis that religion is adaptive because it encourages trust and cooperation. The adaptive significance (or insignificance) of religion may bear no resemblance to the proximate motives that drive people to believe (just as people may not be proximately motivated by survival and reproduction when they decide to eat a hamburger). Nevertheless, Alcorta proposes a proximate hypothesis about the function of religion that differs from our own, and thus it makes sense to debate which is the stronger explanation. Future research that compares feelings of security and a sense of meaning as mediators of the link between religiosity and reduced anxiety could shed light on this debate.

In the commentary by Bulbulia and Schjoedt, however, the authors suggest that our model is weakened by the fact that “motivated meaning is unlikely to be a basic evolutionary function.” They propose that the costly signaling theory is a stronger explanation because it does a better job of accounting for things like the association between religion and social norms. Here, there has been a basic misunderstanding about the kind of explanation that we are proposing, and the kind of explanation that is offered by costly signaling theory. At its heart, costly signaling theory is an ultimate explanation of religion; it seeks to explain why religion offers fitness benefits to its adherents. The motivated meaning-making account instead offers a proximate explanation of why people are motivated to turn to religion – because it quells their anxiety – and is thus not in conflict with costly signaling theory at this level.

Raising another potential source of confusion in discussions of religion, van den Bos cautions against committing the naturalistic fallacy; that is, he warns that we cannot assume religion is good simply because it is widespread or “natural.” It is

certainly not our intent to argue that religious belief should be encouraged (or discouraged) and we recognize that there are some forms of religious belief that have the potential to be quite harmful. Pointing out that there are benefits to religion, however, does not amount to arguing that people should be religious. Thus, we see no inconsistency in agreeing with van den Bos: “The notion that adherence to religious beliefs may fulfill important psychological functions among believers does not make these beliefs right.”

In addition to van den Bos’s well-taken suggestions, Alcorta makes an important clarification when she notes that our model provides an account of “how” religion works (a proximate explanation), while the costly signaling model does a better job of explaining “why” religion works (an ultimate explanation). As Harmon-Jones and Harmon-Jones point out, “the need to manage anxiety may provide the proximate motivation for religion, whereas prosociality and group cohesion via costly signaling may be important distal, adaptive functions of the resulting religious behavior.” We maintain that while ultimate explanations can shed light on fascinating issues surrounding the evolutionary history of religion, there is ample room for scientific curiosity and discovery surrounding the proximate mechanics that motivate people to believe.

The benefits of inscrutable meaning

Commentators questioned whether there is anything particularly unique about religion as a motivated meaning system. Preston, for example, argues that science is an alternative system that may fulfill many of the same functions as religion, namely, a coherent framework of answers and explanations that directs people towards the pursuit of specific goals and reduces uncertainty and distress in its adherents. Similarly, Haque, Shenav, and Rand suggest that individuals’ need to create and sustain meaning can be satisfied by any type of ideology, whether supernatural or secular. Randles, as well, points out that the affirmation of religious beliefs may be just one of many “cultural tools” that have evolved in order for humans to quell anxiety. We agree that many other systems can reduce anxiety through the creation of order, explanation, and perceived control, and have said as much in our past work (Inzlicht, McGregor, Hirsh, & Nash, 2009; Inzlicht & Tullett, 2010). However, we suspect that religion may be a particularly powerful and adaptive system of meaning because it confers anxiolytic benefits across a wide variety of situations. That is, religion is more broad-based than most other types of ideologies, and its palliative effects likely function in a greater number of domains than other systems of meaning such as science.

There are some aspects of human experience to which non-religious ideological frameworks do not speak. For example, while religion can reduce the fear of death, it is unlikely that non-religious ideologies can offer relief in this domain. Using a terror management paradigm, for example, Jonas and Fischer (2006) demonstrated that individuals whose religious orientation was characterized by a sincere and deeply internalized belief system reacted to primes of their own mortality with less worldview defense and lower death-thought accessibility, suggesting that religion buffers the experience of terror associated with death.

The power of religious ideology can also be seen when one considers that even individuals who reject organized religion may make use of religious/supernatural ideas when they think about the purpose of life and/or what happens after death (Bering, 2011). For example, Bering (2002) found that, when asked to make

inferences about the physical and cognitive states of dead characters in hypothetical vignettes, participants who believed that consciousness ends at death sometimes characterized dead people as possessing emotions, desires, and knowledge. Indeed, there is evidence that both believers and atheists are susceptible to teleological reasoning – that is, assuming that everything happens according to a “master plan” (Bering 2011; Schrock, 2010).

Given that non-believers may utilize religious/supernatural concepts to think about issues of death and purpose, it is possible that scientific ideologies may not offer adequate epistemic structures for these domains of life. Or perhaps it would be more accurate to postulate that, under conditions of acute stress in which issues surrounding the purpose and meaning of life are salient, invoking a religious ideology may be more comforting than invoking a scientific ideology. Bering (2006), for example, recounts the story of how, the day after his mother’s death, upon hearing her wind chimes start to sound outside her window he (an avowed atheist) automatically thought: “That’s her! She’s telling us not to worry!” (p. 148). Indeed, these kinds of thoughts may occur even in non-believers because when bad things happen, it may be more comforting to think about a supernatural master plan and afterlife than a rational scientific ideology in which tragedy is the result of randomness or natural processes, and death is simply the end of consciousness.

Some reviewers questioned whether religion is a beneficial meaning-making system given the inconsistencies inherent in religious ideologies. Schjoedt and Bulbulia, for example, raise the point that it is problematic to assume religion’s most important role is epistemic coherence, given that “believers easily adopt conflicting propositions in their religious world-views.” Johnson, Ball, Brewer, and Cohen similarly note that “religion doesn’t always make sense.” We agree that there are conflicting principles within religious systems; however, we do not think that these inconsistencies necessarily negate religion’s ability to confer epistemic coherence. Believers in every type of ideology encounter epistemological inconsistencies and uncertainties, whether it is the Christian who observes the suffering inflicted by a natural disaster, the communist who perceives the unequal distribution of wealth in nations such as Cuba and China, or the scientist who takes note of research findings that support opposite conclusions about the same phenomenon. Religion, however, has a critical, unique “escape valve” that allows adherents to encompass any number of inconsistencies within their beliefs. Namely, religion provides an inscrutable meaning system, wherein *God works in mysterious ways* (to use theistic terms; see Tullett, Inzlicht, & Kay, 2011). If a believer notes that God said X and Y (which are inconsistent with each other), he or she will be unlikely to conclude that God is wrong. Rather, the response of the devout may be to utilize the “God works in mysterious ways” escape valve, which should reduce anxiety by providing complete epistemic coherence.

Conversely, if a scientist observes that the data say X and Y (which are inconsistent), he or she may conclude that there has been an error made somewhere along the line, since X and Y were determined by fallible humans. This type of explanation may be less effective at reducing feelings of inconsistency and attendant anxiety than the inscrutable order explanation provided by religion. As pointed out by Harmon-Jones and Harmon-Jones (also see Burris et al., 1997), an often-overlooked manner in which people reduce the distress caused by inconsistency is through the process of transcendence, which involves “reconciling of dissonant cognitions under a superordinate principle” (Burris et al., 1997, p. 20). We suggest that the superordinate principle of inscrutable order dictated by a higher power may

be very effective at reducing the negative emotions caused by inconsistency, and provides believers with “all-inclusive” epistemic coherence. The same cannot be said for secular beliefs.

The ERN: affective and cognitive explanations

While most commentators agreed with our affective explanation of the error-related-negativity (ERN) – where we suggest that this evoked brain potential indicates error-related distress – some dissented. Specifically, Schjoedt and Bulbulia preferred a cognitive model where a lower ERN indicates not less affect in response to errors, but less attention to the errors themselves. Similarly, Bulbulia and Schjoedt “lack confidence” in our interpretation, question whether cognitive reaction time tasks like the Stroop produce the kinds of distress that are relevant to a palliative model of religion, and instead prefer a cognitive explanation where the ERN indicates inattention to conflict and error.

We respectfully disagree with this alternative explanation. It would not be possible for us to cover the now overwhelming evidence that the ERN is related to negative affect and motivation, so we refer the interested reader to a recent and comprehensive treatment by Weinberg, Riesel, & Hajcak (in press). This paper is a contemporary antidote to the increasingly insufficient account supported by Schjoedt and Bulbulia.

Here, we focus on a few key points to support the ever more accepted view of the ERN as an affective signal. First, errors (even on the Stroop) are aversive. The ERN, as the name implies, is time-locked to errors, and errors are not affectively neutral events. Rather, errors are distressing because of the negative consequences typically associated with them. Errors on reaction time tests like the Stroop, for example, prompt increased skin conductance, greater heart rate deceleration, greater pupil dilation, and larger startle reflexes compared to correct responses (Critchley et al., 2003; Hajcak & Foti, 2008; Hajcak, McDonald, & Simons, 2003a). Second, individual differences in negative affect moderate the amplitude of the ERN. Indeed, studies have repeatedly observed enhanced ERN amplitudes in patients with anxiety and major depressive disorders (Chiu & Deldin, 2007; Gehring, Himle, & Nisenson, 2000). Similarly, healthy participants with higher trait negative affect consistently exhibit a larger ERN than those with lower trait negative affect (Hajcak, McDonald, & Simons, 2003b, 2004). In contrast, participants with low trait negative affect or those with high life satisfaction show lower ERNs (Larson, Good, & Fair, 2010). Finally, people who have suffered lesions to their anterior cingulate cortex, the hypothesized neural generator of the ERN, do not show deficits in attentional control (Critchley et al., 2003; Fellows & Farah, 2005), but instead show a profile of flat emotional responses (Critchley et al., 2003). The ERN, in sum, is related to negative affect. And, given the evidence that the ERN (and its neural generator) is dissociated from attentional control (Fellows & Farah, 2005; Inzlicht, Tullett, & Good, this issue; Weinberg et al., in press), it is hard to argue that the lower ERN observed among religious believers merely reflects “inattention” (Bulbulia & Schjoedt).

While the literature strongly suggests an affective interpretation of the ERN, we are quick to note that affective and cognitive interpretations might be functionally indistinguishable (Yeung, 2004). Whether the ERN reflects negative affect or attention, the function of the ERN might be the same – to orient people to uncertainty and conflict in order to defend against such aversive events (Hajcak &

Foti, 2008; Weinberg et al., in press). Religions, we propose, protect against such defensive responding and as such bring about salutary benefits to its adherents.

Future directions

We end our response by listing the future studies these commentaries have inspired. Johnson and her colleagues rightly note that a number of basic goals motivate the human animal, with an epistemological goal being only one of them. They then suggest that religion may serve to both satisfy and inhibit some of the goals. We find this idea fascinating and believe that examining the various motivational antecedents and consequences of religions will serve to provide a more complete picture of religion than a reliance on cognition alone. As mentioned above, Alcorta suggests that religion may affect the ERN because it fosters feelings of trust and security. Similarly, Baumeister and MacKenzie state that religion meets the need to belong, and one implication of this is that it is this sense of belonging that reduces error-related distress. Although these proximate hypotheses about religion are different from our own, we also suspect that they can complement the motivated meaning model and we look forward to examining the interplay of these two hypotheses. Randles offers a very interesting hypothesis when he wonders if religion's palliative qualities are selectively deployed. Is it the case, Randles wonders, that religion is a blunt palliative? Or does it mainly offer relief during times of stress and duress? These are good questions. Finally, Harmon-Jones and Harmon-Jones try to turn our results on their head when they wonder if religious people ever show greater (not lesser) error-related distress. They suspect that "behavioral violations of a religious belief (e.g., "sinning") might instead cause greater ACC activity in religious than non-religious individuals." This is a fascinating idea and we suspect that Harmon-Jones and Harmon-Jones are correct. In fact, partially inspired by these comments, we have already begun testing this idea on a large sample of Mormons, asking if after they are primed with the notion of a punishing God they will show heightened ERNs to a religious transgression (e.g., drinking alcohol).

We are grateful for the commentaries because they have forced us to sharpen our own motivated meaning model of religion. Moreover, we are grateful because they have supplied us (and others) with testable hypotheses that promise to push the scientific investigation of religion forward. We hope that the discussion that has been started here will inspire new and inventive research, and will foster an ever growing scientific interest in religious belief and other non-scientific epistemologies.

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