Cognitive biases explain religious belief, paranormal belief, and belief in life's purpose

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ABSTRACT

Cognitive theories of religion have postulated several cognitive biases that predispose human minds towards religious belief. However, to date, these hypotheses have not been tested simultaneously and in relation to each other, using an individual difference approach. We used a path model to assess the extent to which several interacting cognitive tendencies, namely mentalizing, mind body dualism, teleological thinking, and anthropomorphism, as well as cultural exposure to religion, predict belief in God, paranormal beliefs and belief in life's purpose. Our model, based on two independent samples ($N = 492$ and $N = 920$) found that the previously known relationship between mentalizing and belief is mediated by individual differences in dualism, and to a lesser extent by teleological thinking. Anthropomorphism was unrelated to religious belief, but was related to paranormal belief. Cultural exposure to religion (mostly Christianity) was negatively related to anthropomorphism, and was unrelated to any of the other cognitive tendencies. These patterns were robust for both men and women, and across at least two ethnic identifications. The data were most consistent with a path model suggesting that mentalizing comes first, which leads to dualism and teleology, which in turn lead to religious, paranormal, and life's-purpose beliefs. Alternative theoretical models were tested but did not find empirical support.

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1. Introduction

Religion is an important part of the lives of billions of people around the world, and a cross culturally recurrent aspect of minds and cultures. Over the past decade, several theories have emphasized the natural basis of religious belief and experience, found in cognitive biases that are byproducts of brain functions (Atran & Norenzayan, 2004; Barrett, 2000, 2004; Bloom, 2007; Boyer, 2001, 2008; Kelemen, 2004). These theories converge on suggesting that belief in supernatural agents such as gods and spirits, and related phenomena, emerge from a set of inter-related cognitive biases, such as perceptions of agency and

mentalizing, mind-body dualism, and teleological intuitions. Equipped with these cognitive biases, human minds gravitate towards religious and religious-like beliefs and intuitions.

Despite the plausibility and influence of these theories, there has been limited empirical research directly testing the connection between specific cognitive biases and various religious beliefs. Moreover cognitive theories have not been formally modeled in a unifying conceptual framework that assesses how various cognitive biases, taken together and in relation to each other, explain religious belief. These were the main goals of the present study.

We took an individual difference approach to examine whether variation in religious and related beliefs could be explained by variation in several interrelated cognitive biases and intuitions that have been theorized to underlie religious belief. Previous work has found variation in religious belief to be related to a number of key individual

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differences, in conscientiousness and agreeableness dimensions of the Big Five (Piedmont, 2005; Saroglou, 2002; Saroglou & Munoz-Garcia, 2008), as well as in forgiveness (McCullough, Bono, & Root, 2005; McCullough & Worthington, 1999), and in self regulation (McCullough & Willoughby, 2009). Our approach is also grounded in an individual difference approach, but focuses on the role of cognitive biases in religious belief. Consistent with cognitive theories (Atran & Norenzayan, 2004; Barrett, 2000; Boyer, 2001), recent research has found that religious belief is rooted in intuitive processes and that conversely, religious disbelief can arise from analytic cognitive tendencies that block or override these intuitive processes. In one series of studies, Shenhav, Rand, and Greene (2012) found that individual differences in intuitive thinking predict more belief in God, controlling for several relevant demographic and psychological variables such as education level, relevant personality dimensions, and general intelligence. Pennycook, Cheyne, Seli, Koehler, and Fugelsang (2012) replicated and extended these individual difference findings, further showing that religious skepticism and skepticism about paranormal phenomena were less prevalent among intuitive thinkers, holding constant potentially confounding factors. In a series of experiments that agree with these mostly correlational findings, Gervais and Norenzayan (2012), as well as Shenhav et al. (2012) found that inducing analytic processing temporarily decreased religious belief. Taken together, these findings suggest that religious belief is anchored in intuitive cognitive biases, but they do not specifically pinpoint which particular intuitive processes are at the root of religious belief, and do not reveal the specific pathways by which these intuitive processes encourage religious belief. The present study addressed these gaps in current knowledge.

1.1. Overview of the present study

The cognitive tendencies we investigated were mentalizing, anthropomorphism, mind-body dualism and teleological thinking. Rather than investigating each cognitive tendency in isolation, an important strength of the current research was to built a path model to examine how these tendencies mutually interact to predict different but related types of belief, in particular, belief in God, paranormal belief, and belief in life's purpose. With this method, we examined several interrelated questions. (1) We tested for the hypothesized direction of these relationships – that these cognitive tendencies are theorized to lead to supernatural belief, and not the other way around. (2) We tested the underlying relationship between cognitive biases and beliefs, investigating whether the previously established path from mentalizing to belief in God (as well as other supernatural beliefs) goes through the other cognitive intuitions, namely teleology and mind-body dualism. (3) We tested whether these cognitive biases explain other supernatural beliefs, such as belief in paranormal phenomena and belief in life's purpose. (4) We included in our model a measure of cultural exposure to religion (operationalized as the proportion of religious adherents that lived in the same US county as the participant), to compare the relative effects of intuitive cognitive biases to effects due to cultural transmission of religious beliefs. (5) Finally, we tested the generalizability and robustness of our findings by testing our model in two large independent samples, and across ethnic and gender lines.

1.2. Cognitive theories of religious belief

1.2.1. Anthropomorphism

One of the oldest, and most well known cognitive theories locates the basis of religious belief in anthropomorphism (see Barrett, 2000, 2004; Feuerbach, 1957; Guthrie, 1980). One version of this theory states that believers conceptualize gods and other supernatural agents by projecting human-like mental states to them (discussed below under "Mentalizing"). Another version of this idea focuses on the human tendency to project human-like characteristics to all types of non-human things, from clouds to chairs and automobiles, to pets and gods (e.g. Barrett, 2004; Guthrie, 1993; Hume, 1779/1981). Guthrie and others argue that this tendency to detect humans everywhere leads to the belief that human-like beings exist everywhere, giving rise to, for example, animistic beliefs that the world is infused with gods, spirits, and ghosts (Guthrie, 1996). The theoretical logic behind this claim is that the costs and benefits of agency detection are asymmetric; seeing agents everywhere helps us avoid being surprised by a hidden agent. The cost to seeing agents where there are none is small compared to the cost of not seeing an agent that could potentially harm or kill us (Barrett, 2000, 2004; Guthrie, 1996).

Empirical work in psychology investigating anthropomorphism has taken a different perspective. Rather than showing that projecting human-like agency to the world is promiscuous and automatic, research has demonstrated this tendency to be selective (Waytz, Gray, Epley, & Wegner, 2010) and motivated (Epley, Waytz, Akalis, & Cacioppo, 2008). Studies have shown that people do not always see human minds in non-human entities and objects – they do so when they are lonely and want human companionship (Epley, Akalis, Waytz, & Cacioppo, 2008), or when an entity behaves unpredictably and its behavior cannot be reliably predicted using other conceptual frameworks (Waytz, Morewedge, et al., 2010). This research outlines, in particular, the potential situations in which we would see human minds in non-human entities; but the relationship between mind–perception and conceptualizations of God has only been explored in a small set of studies (e.g. Gray, Gray, & Wegner, 2007; Schjoedt, Stødkilde-Jørgensen, Geertz, & Roepstorff, 2009). In addition, there is now extensive evidence that there are dispositional differences in anthropomorphic tendencies, such that some people are chronically more likely to anthropomorphize than others (Waytz, Cacioppo, & Epley, 2010).

1.2.2. Dualism

Another hypothesized cognitive foundation of religious belief is mind-body dualism, which refers to the intuition that minds are separate from bodies (Bloom, 2005; Damasio, 1994). According to this theory, minds are seen as a non-physical substance that can be related to bodies, but not reliant on bodies, opening up the

possibility of minds existing without bodies. In a sense, the ability to think dualistically is a necessary condition for understanding concepts such as ghosts and spirits or any other disembodied supernatural agent (Bloom, 2007).

The idea that the mind and body are separate, as an intellectual concept, is most commonly attributed to Descartes, but according to Damasio (1994) it originates in the structure of the brain. One of the unique characteristics of human cognition is the ability to represent others' minds (Herrmann, Call, Hernández-Lloreda, Hare, & Tomasello, 2007). With this ability, it seems that even young children develop the intuition that what makes up a mind is subject to different rules and is independent of the physical body (Johnson & Wellman, 1982).

Until recently, the empirical evidence for dualistic intuitions was limited. Only a few empirical studies have looked at dualism and have only used children in western settings (Johnson, 1990; Kuhlmeier, Bloom, & Wynn, 2004; Lillard, 1996). A few recent studies have offered more support for dualism as a common human tendency, showing dualistic thinking in North American and Fijian children (Chudek, MacNamara, Birch, Bloom, & Henrich, submitted for publication), rural Madagascar (Astuti & Harris, 2008), and in Ancient Chinese texts (Slingerland & Chudek, 2011).

1.2.3. Teleology

A third cognitive hypothesis is that religious beliefs are rooted in teleology. Teleology is the tendency to see things in the world as having a purpose and having been made for that purpose (Kelemen, 1999; Kelemen & DiYanni, 2005). This tendency is theorized to be a byproduct of 'artifact cognition'. Part of our ability to understand artifacts is the capacity to see them as designed by agents with specific goals and motivations. This ability is sometimes referred to as 'promiscuous' when it is extended to things that were not made for any purpose. For example, children have the intuition that lions exist so that we can visit them at the zoo, clouds are for raining, and mountains are for climbing (Kelemen, 2004).

This tendency, commonly found in children (Kelemen, 1999), is suppressed among science-educated adults unless when they are under time pressure (Kelemen & Rosset, 2009; Kelemen, Rottman, & Seston, 2012). It is also exaggerated in people with Alzheimer's (Lombrozo, Kelemen, & Zaitchik, 2007). The tendency to see the world and things in the world as purposeful leads to the possibility of seeing one or more agents as having created the world. Therefore, promiscuous teleology makes us 'intuitive theists' (Kelemen, 2004; Kelemen & DiYanni, 2005).

1.2.4. Mentalizing

All of the above cognitive tendencies have a clear common feature: they require some mentalizing ability. There has been some speculation about the relationship between metalizing and religious belief (Atran, 2002; Atran & Norenzayan, 2004; Barrett, 2004; Bloom, 2005; Boyer, 2001), but limited empirical work has been conducted. Mentalizing or Theory of Mind is the tendency to infer and think about the mental states of others. The key idea is that to interact with person-like supernat-

ural beings, such as a personal God, spirits, ghosts, – a core feature of many religions – believers must try to understand their wishes, beliefs, and desires. Therefore, conceptualizing these beings requires mentalizing. Consistent with this, neuro-imaging studies found that among Christian believers in the US (Kapogiannis et al., 2009) and in Denmark (Schjoedt et al., 2009), thinking about or praying to God, activates brain regions associated with Theory of Mind.

A recent effort went further and investigated whether individual differences in mentalizing are associated with belief in a personal God (Norenzayan, Gervais, & Trzesniewski, 2012). If mentalizing is required for belief in a personal God, then poor mentalizing skills would be expected to render religious belief less intuitive, leading to lower levels of belief. Indeed, research shows that the autism spectrum, which is characterized by selective deficits in theory of mind, is associated with lower levels of mental state attributions to God (Gray, Jenkins, Heberlein, & Wegner, 2010). Consistent with this line of reasoning, individual differences in mentalizing predicted religious belief; moreover, the autism spectrum, as expected, inversely predicted belief in God, and mentalizing was found to mediate this effect (Norenzayan et al., 2012). Finally, the commonly found tendency for women to be more religious than men was mediated by higher mentalizing tendencies in women.

Beyond this, very little work has been done on the relationship between religious belief and individual differences in mentalizing abilities. It seems clear that the ability to attribute human minds to non-human entities and objects, and the tendency to think of minds as separate from bodies both hinge on the ability to understand minds. Similarly, the ability to see minds is required to understand the motivation behind artifacts created by those minds. These cognitive tendencies, in turn, are expected to increase the odds of belief in mindful supernatural agents.

1.3. The role of cultural learning in religion

Of course, religious beliefs are not just an outcome of cognitive biases; they are also influenced by cultural learning, that is, growing up and living in a religious community increases the odds of being a believer, influences the particular religious beliefs one commits to, and explains the psychological impact of those beliefs (Cohen, 2009; Cohen & Hill, 2007; Gervais, Willard, Norenzayan, & Henrich, 2011). However, researchers in the cognitive science of religion have often argued that culture's role is limited and that cognitive biases are doing most of the work (Atran, 2002; Barrett, 2004, 2008; Bering, 2006, 2011; Bering, McLeod, & Shackelford, 2005). Therefore, we included a variable that reflects cultural exposure to religion (proportion of religious adherents in the participant's local community) to investigate the relative contributions of cognitive and cultural influences on religious belief, with the important caveat that only one cultural variable was considered, limiting our ability to make strong inferences about cultural learning processes in religious beliefs.

1.4. Religious belief

We measured belief in the conventional personal God found in the Abrahamic religions and two related types of beliefs: paranormal belief and belief in life's purpose. Unlike the culturally endorsed belief in God, paranormal beliefs such as beliefs in extra-sensory perception and UFOs are less influenced by institutionalized religion. Belief that life has a purpose is interesting because it may betray some underlying teleological intuition, and it has been argued that even atheists cannot shake the intuition that there is a transcendental intentionality or purpose underlying human life (Bering, 2002, 2003). At the same time, it is a belief that is reinforced by Christian beliefs, for example, Protestant ideology (Weinstein & Cleanthous, 1996). We measured this construct to examine to what extent this belief is related to belief in God, and to what extent it is related to cognitive biases above and beyond any relationship to belief in God.

To recapitulate, the present study tested a conceptual model that predicts belief in religious agents, in paranormal events, and in life's purpose from individual level tendencies towards certain cognitive biases as well as cultural exposure to religion. Given that mentalizing appears to underlie the other cognitive biases, we tested a model that starts with mentalizing, leading to anthropomorphism, mind-body dualism, and teleology, which in turn leads to belief in religious agents, in paranormal events and in life's purpose. Given that there is scant empirical research about this topic, we were interested to know exactly which pathways from cognitive biases to the different beliefs would emerge. We also tested several alternative models against the data, including a reverse causation account that would argue that religious beliefs encourage cognitive biases, rather than the other way around.

2. Method

2.1. Participants

We used two samples to allow us to test for replicability, robustness, and generalizability. Sample 1 consisted of 492 undergraduate psychology students at a large Canadian university with a religiously and ethnically diverse population. Sample 2 consisted of 920 adult Americans collected though Amazon's Mechanical Turk (see Table 1).

In both samples, the survey was hosted by the Survey Monkey website and was completed by the participants on a computer. The survey completed on Mechanical Turk contained slightly fewer questions (due to the removal of a second anthropomorphism measure) than the student sample. We took steps to ensure data quality (Buhrmester, Kwang, & Gosling, 2011). For example, four nonsense questions were placed throughout the survey to ensure that our participants were paying attention. Participants who failed to answer any of these four questions correctly were removed before analysis (as a result, 13 participants were removed from the student sample and 95 from the Mechanical Turk sample).

Table 1
Demographic characteristics of participants.

Demographic dimension	Canadian student sample	American adult sample
Age		
Minimum (years)	18	18
Maximum (years)	41	81
Mean (years)	20.5	34.7
Gender		
Male (%)	23	34
Female (%)	77	66
Religious affiliation		
Christian (%)	30.8	50.3
Buddhist (%)	6.2	1.8
Sikh (%)	2.8	0.3
Muslim (%)	2.2	0.7
Jewish (%)	1.6	2.0
Spiritual but not religious (%)	0.8	13.3
Other religious (%)	0.2	0.3
Not religious (%)	53.8	30.0
Ethnicity		
Caucasian (%)	28.3	81.6
Asian (%)	68.4	5.7
Hispanic (%)	0.7	4.7
African origin (%)	0.2	4.5
Other (%)	2.4	3.4

3. Materials

3.1. Predictor variables

3.1.1. Anthropomorphic tendencies

We employed the previously validated "Individual Differences in Anthropomorphism Quotient" (IDAQ) to measure anthropomorphism (Waytz, Cacioppo, et al., 2010). This scale measures the tendency to project human like mental states such as consciousness, free will and emotions to machines, nature and animals (e.g., To what extent does the ocean have consciousness? To what extent do cows have intentions?). We also used a second measure of anthropomorphism in our student sample, by having participants rate natural scenes such as mountains and volcanoes using anthropomorphic (conscious, angry) or non-anthropomorphic (large, high) concepts (see Norenzayan, Hansen, & Cady, 2008) (Student sample α = .92). We did not include this measure in the adult sample because the results from the two different anthropomorphism measures produced identical results (measures combined α = .89).

3.1.2. Dualism

We measured dualism with Stanovich's (1989) "Dualism Scale". This scale was chosen because it has no content that could be interpreted as overtly religious in nature (e.g., "The 'self' I introspect about controls both the mind and the brain" and "Mental processes are the result of activity in my nervous system(R)". The single item question dealing with afterlife beliefs was removed from the scale. We used a subset of 10 dualism items in the student sample, but returned to the complete scale in the adult

sample to get a more reliable measure (Student sample α = .68; Adult sample α = .83).

3.1.3. Teleology

There is no existing scale to measure individual differences in teleological intuitions. Therefore, we used a series of statements created by Kelemen and Rosset (2009) to test adult teleological tendencies in experimental tasks (e.g., Earthworms tunnel underground to aerate the soil; The sun makes light so that plants can photosynthesize). These statements were originally used to examine the influence of time pressure on teleological thinking. Levels of agreement were recorded using a seven point Likert scale (Student sample α = .91; Adult sample α = .86).

3.1.4. Mentalizing

We used the "Empathy Quotient" to measure mentalizing (Baron-Cohen & Wheelwright, 2004). We chose this measure because it has been used extensively to detect individual differences in adult mentalizing tendencies, including perspective taking, interest in others' beliefs and desires, and understanding emotions (e.g., I often find it difficult to judge if someone is rude or polite (R); I am good at predicting how someone will feel.). This measure is well suited to assess aspects of mentalizing most likely to be related to the belief in God, as has been shown before (e.g., Norenzayan et al., 2012). Other adult mentalizing tasks based on false belief or beliefs different from one's own (see Apperly, Back, Samson, & France, 2008; Birch & Bloom, 2007) are less relevant to supernatural beings, because gods are less likely to have false beliefs (Knight, Sousa, Barrett, & Atran, 2004) and people seem to attribute beliefs to God that they themselves hold (Epley, Converse, Delbosc, Monteleone, & Cacioppo, 2009).

3.2. Outcome variables

3.2.1. Belief in God

We measured belief in God using three questions (I believe in God, I believe in a divine being who is involved in my life, there is no god or higher power in the universe) (Student sample α = .85; Adult sample α = .93). These three items have good construct validity, as they correlate highly with other measures of religious belief, such as Intuitive belief in God (r(916) = .84, p < .001) (see Gervais & Norenzayan, 2012) and the "Spiritual Well Being Scale" (r(916) = .86, p < .001) (Bufford, Paloutzian, & Ellison, 1991).

3.2.2. Life's purpose

We created a 3-item measure to assess this construct, with one reverse-scored item (Things in my life happen for a reason; There is a discernable purpose to the events of my life; Many things that happen to me are random or coincidental.) (Student sample α = .74; Adult sample α = .78). These items were chosen to reflect the type of intentionally-driven purpose that has been discussed previously in the cognitive science of religion literature (see Bering, 2002, 2003). In addition, we created this 3-item scale rather than using existing scales (Crumbaugh, 1968) so as to avoid conflating belief in life's purpose with

deficits in meaning and depressive or suicidal tendencies (e.g., "With regard to suicide, I have: thought of it seriously as a way out (1) — never given it a second thought (7).") Both Belief in God and Life's Purpose were measured on an 8 point Likert scale.

3.2.3. Paranormal belief

We adapted the paranormal belief scale (Tobacyk, 2004). We removed the religiosity and the extraordinary creatures subscales before administering the scale to our participants. The religiosity subscale was removed because it offered confounds with our belief in God measure, and the extraordinary creatures subscale was removed because it was based on largely culturally bound creatures (e.g., the Loch Ness monster and the Yeti) which may have been unfamiliar to our participants, and because these creatures may or may not be seen as being supernatural. They are only 'extraordinary' because they do not exist, not because they have any supernatural powers or relevance (e.g., Some individuals are able to levitate (lift) objects through mental forces; Astrology is a way to accurately predict the future.) (Student sample α = .93; Adult sample α = .95).

3.2.4. Cultural exposure to religion

In our adult American sample, but not our student sample, we compiled information about the percentage of religious adherents in each person's local area. We did this by collecting postal codes from each participant and matching them with county-level religious adherence from a large database of religious variables (www.thearda.com). It has been argued that an individual's claimed church attendance is often inflated, and actual attendance data gives estimates lower than US national estimates based on self-report attendance (Brenner, 2011; Hadaway, Marler, & Chaves, 1993; Hout & Greeley, 1987). To overcome this issue, we relied on a non-self-report measure of church adherence supplied by churches in each county. Adherence numbers are made up of church members and their children, and those who regularly attend services. Other work has similarly used church attendance records as a reliable, though imperfect estimate of attendance (see Finke & Stark, 2005). We chose this measure because membership in a church could be considered a credible display of religious commitment (Henrich, 2009). In turn, exposure to such displays is theorized to cause greater levels of belief.

4. Results

4.1. Rationale for statistical analyses

The theorized path model was fit to the data using the statistical program EQS (Bentler, 2006). A path model was used because it allows us to test all the hypothesized relationships simultaneously, and thus model each relationship while accounting for the variance and covariance associated with all other relationships (see Ullman & Bentler, 2012). This method allows us to test specific relationships between multiple independent variables and dependent by including some paths and excluding others (e.g. excluding the direct relationship between mentalizing

and belief in God) without running multiple tests that could inflate type-I error. An expected covariance matrix is created from the model and compared to the covariance matrix of the raw data. All straight lines in the model represent direct predictions (regression coefficients), whereas the curved arrows are correlations between the residuals of these relationships. These arrows represent the remaining relationships between the variables that are not represented in our theoretical structure. All models were tested using a X^2 test of fit. This test is the most conservative test of fit, in that it assumes that the model can account for all variance in the sample. A non-significant test means the model fits the data by demonstrating that the residual difference between the variance accounted for by the model and the total variance in the sample does not differ significantly from zero. Models fit estimates were obtained by full information maximum likelihood estimations (FIML; see Bentler, 2006; Enders, 2001) to deal with a small amount of missing data. The Yuan–Bentler robust chi-square test (Yuan & Bentler, 2000) was used to deal with some non-normality in the data (normalized estimate = 4.45).

4.2. Sample 1

The model fit the data (Yuan–Bentler X^2(4, N = 492) = 6.80, p = .15; CFI = .99; RMSEA = .04; See Fig. 1). The model we predicted accounted for the relationships found in the data, suggesting that the cognitive biases do predict religious belief, paranormal belief and life's purpose. Correlations and standard deviations for this sample can be found in Table 2. When assessing individual paths, several paths were found to not be significant. These non-significant paths mostly came from the mentalizing measure. Despite being non-significant, these paths mediate the direct relationship between mentalizing and religiosity and are required for model fit. As mentalizing is a key part of our model, we chose to leave it in the model and re-tested this with an adult sample (sample 2; means and standard deviations for both samples can be found in Table 3).

When comparing these two samples, we note that although the means for mentalizing between the two samples are not significantly different (Mdiff = .48, t(1113.24) = 1.05, p = .29), the variance of the student sample was significantly lower than that of the adult sample (F(1406) = 12.66, p < .001). It is also worth noting that within the student sample, our Asian population scored significantly lower on this measure than our Caucasian participants (Mdiff = 4.12, t(478) = 5.45, p < .001). This low variance among psychology students on this measure may make it difficult to detect an effect that is actually present, especially if the variance we are getting is in part due to how different ethnic groups answer these questions and not related to our variables of interest.

Based on this difference between Asian (n = 335) and Caucasian (n = 146) students on our mentalizing measure, we decided to conduct a two-groups test to verify that the pattern of our findings was the same in both groups. This model fit even after constraining all error variances and covariances, and all regression paths to be equal in each group (Sattora–Bentler X^2(30) = 14.64, p = .99), suggesting that the model does not fit differently in our two ethno-cultural groups, which in turn suggests that our model generalized across these two ethno-cultural groups.

Given influential theories that place the origin of religious belief in anthropomorphism, it was surprising that the path from anthropomorphism to belief in God was non-significant. One might wonder whether this null result is a reflection of any problems with the IDAQ – a particular measure of anthropomorphism (Waytz, Morewedge, et al., 2010). Given that this is a validated scale with good predictive power, we find this unlikely. However, in order to rule out this possibility, we fit this model a second time using the alternative, task-based visual measure of anthropomorphism (Norenzayan et al., 2008), with a moderate-to-high correlation with the IDAQ r(490) = .47, p < .001. We found similar fit results that confirmed the previous findings with the IDAQ (Yuan–Bentler X^2(4, N = 492) = 6.19, p = .19; CFI = .99; RMSEA = .03) (see Fig. 2), suggesting that the null finding regarding anthropomorphism is not an artifact of the particular measure we used. We are not
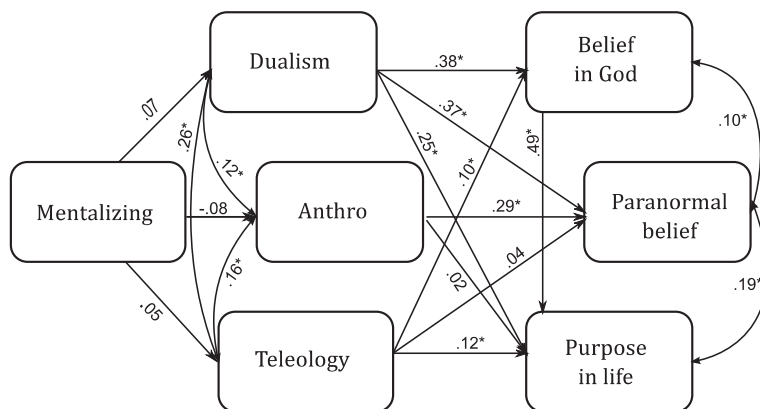

Fig. 1. Student sample using the IDAQ scale as a measure of anthropomorphism (Yuan–Bentler X^2(4, N = 492) = 6.71, p = .15; CFI = .99; RMSEA = .04). $^*p$ < .05.

Table 2
Correlation matrix, student Canadian sample; $N = 492$ (reliabilities in the diagonal).

	Mentalizing	Dualism	Teleology	Anthro	Anthro pic	God	Paranormal	Purpose
Mentalizing	(.87)							
Dualism	.07	(.68)						
Teleology	.05	.26[**]	(.91)					
Anthro	−.08	.15[*]	.15[*]	(.86)				
Anthro pic	−.08	.27[**]	.27[**]	.47[**]	(.92)			
God belief	.10[†]	.41[**]	.20[**]	.10[†]	.14[*]	(.85)		
Paranormal	−.03	.43[**]	.18[**]	.36[**]	.44[**]	.31[**]	(.93)	
Purpose	.11[†]	.49[**]	.29[**]	.13[†]	.19[**]	.62[**]	.37[**]	(.74)
SD	7.82	.80	1.23	1.3	1.44	1.78	1.11	1.50

Scale alphas on diagonal. All p-values calculated with a Bonferroni correction.
[†] $p < .10$.
[*] $p < .05$.
[**] $p \leqslant .01$.

Table 3
Mean and standard deviations for both samples.

Measure	Student sample		Adult sample	
	Mean	SD	Mean	SD
Mentalizing	22.62	7.82	22.14	8.90
Anthropomorphism	3.79	1.33	3.37	1.23
Dualism	3.83	.81	3.83	.75
Teleology	4.34	1.23	4.90	1.11
God belief	4.86	2.11	5.55	2.62
Paranormal belief	3.05	1.11	2.99	1.31
Purpose	4.85	1.55	5.04	1.67

the first to question the theorized relationship between anthropomorphism and belief in God (see Bulbulia, 2004; Lisdorf, 2007; McKay & Dennett, 2010; Weingarten & Chisholm, 2009). Still, this is only a preliminary finding on this topic.

4.3. Sample 2

The model proposed with sample 1 was fit to data in sample 2, and was found to fit (Yuan–Bentler X^2(4, $N = 920$) = 8.25, $p = .08$; CFI = .99; RMSEA = .034) (see Fig. 3). Correlations and standard deviations for this sample can be found in Table 4.

It has been noted that that females are, on average, more religious than males (Walter & Davie, 1998). Consistent with this, in our sample, females scored significantly higher than males on all outcome variables (see Table 5). Because of this, we wished to see if this model is equivalent in both genders. This was not tested in the student sample because the large ratio of females to males caused the model to not be identified. Using a two group model in our larger adult sample (308 males, 609 females, 2 missing), we found that the model fit even after constraining all error variances and covariances, and all regression paths to be equal in each group (Yuan–Bentler X^2(30) = 16.61, $p = .98$). This suggests that the path model had similar explanatory power in both men and women, despite the fact that on average women scored higher than men on religious variables, supporting previous findings (Norenzayan et al., 2012; Roth & Kroll, 2007; Stark, 2002).

Finally, we tested for the effect of cultural learning on religious belief. We added the percentage of religious adherents living in a person's county as an additional predictor variable (based on postal codes provided by participants). As expected, living in an area with greater religious attendance increased the odds of believing in God, largely independently of the influence of the cognitive biases. The only exception was anthropomorphism. We needed
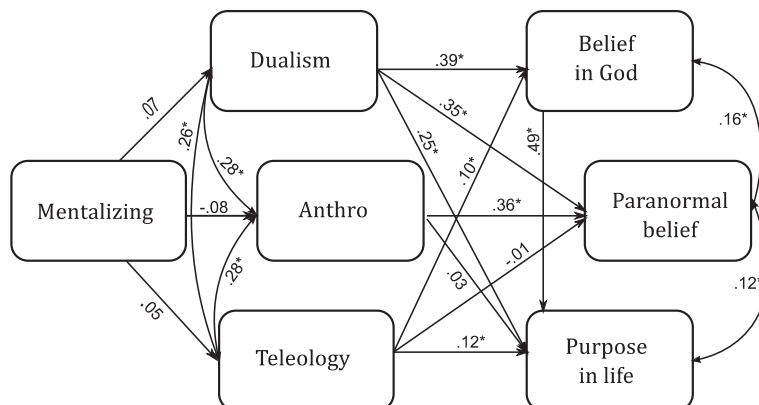

Fig. 2. Student sample with anthropomorphic pictures measure (Yuan–Bentler X^2(4, $N = 492$) = 6.19, $p = .19$; CFI = .99; RMSEA = .03). [*]$p < .05$.
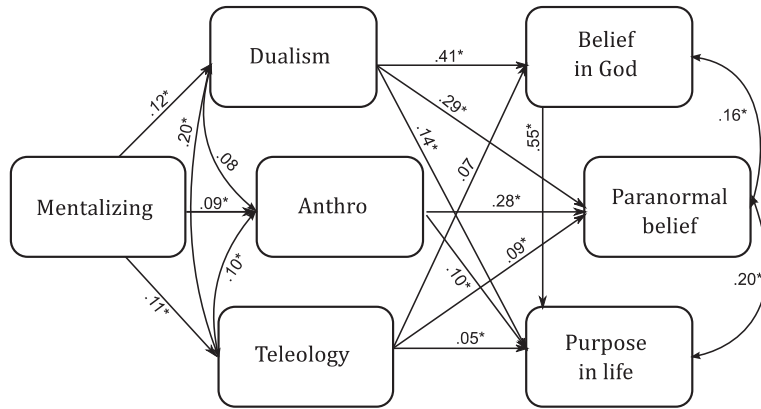
Fig. 3. Adult American sample (Yuan–Bentler X^2(4, N = 920) = 8.25, p = .08; CFI = .99; RMSEA = .03). $^*p$ < .05.

Table 4
Correlation matrix, adult American sample; N = 920 (reliabilities in the diagonal).

	Mentalizing	Dualism	Teleology	Anthro	God	Paranormal	Purpose	Adherents
Mentalizing	(.90)							
Dualism	.12[*]	(.83)						
Teleology	.15[**]	.22[**]	(.86)					
Anthro	.09	.09	.11[*]	(.85)				
God belief	.10[*]	.42[**]	.12[**]	.05	(.93)			
Paranormal	.12[**]	.33[**]	.19[**]	.31[**]	.29[**]	(.94)		
Purpose	.14[**]	.39[**]	.18[**]	.14[**]	.62[**]	.33[**]	(.78)	
Adherents	−.01	.04	.001	−.08	.10[*]	−.04	.04	–
SD	8.89	.76	1.12	1.23	2.62	1.31	1.67	16.44

Scale alphas on diagonal. All p-values calculated with a Bonferroni correction.
[*] p < .05.
[**] $p \leqslant .01$.

Table 5
Male and female mean differences, adult sample.

	Anthro	Teleology	Dualism	Mentalizing	Paranorm	Purpose	Religiosity
Male	3.14	4.70	3.68	19.09	2.63	4.58	4.61
Female	3.48	5.00	3.90	23.67	3.18	5.27	5.31
t-test	t(915) = 4.01, p < .001	t(915) = 3.79, p < .001	t(915) = 4.09, p < .001	t(914) = 7.59, p < .001	t(915) = 6.03, p < .001	t(914) = 5.99, p < .001	t(914) = 4.45, p < .001

to include a path from the proportion of religious adherence to anthropomorphism (a negative relationship) ($\lambda = -.09$, p < .05) for the model to fit (Yuan–Bentler X^2(9) = 10.80, p = .29; CFI = .99; RMSEA = .02) (see Fig. 4).

4.4. Preliminary summary

To summarize thus far, we found that individual differences in mentalizing tendencies encouraged mind–body dualism, teleology, and anthropomorphism (albeit, weakly); dualism, and to a lesser extent teleology in turn led to belief in God, belief in paranormal events, and belief in life having an underlying and possibly transcendental purpose. Although the relationships between mentalizing and the other cognitive biases are significant in the adult sample but not the students one, theoretical predictions

and previous research leads us to conclude this is likely to be a sample issue rather then an issue with the model. This is further supported by a significant difference in the variance of this measure between the two samples. Anthropomorphic tendencies failed to predict belief in God, but predicted paranormal belief, and to a much lesser extent, belief that life has a purpose. This model was robust to ethno-cultural variation present in our sample, and emerged in both men and women. However so far we have not addressed alternative possible models that could explain the data. We now turn to several such plausible alternatives and examine whether they better explain our results than the current model under consideration. We did this using the adult American sample that had a large sample size, allowing for statistical power to test alternative competing models.
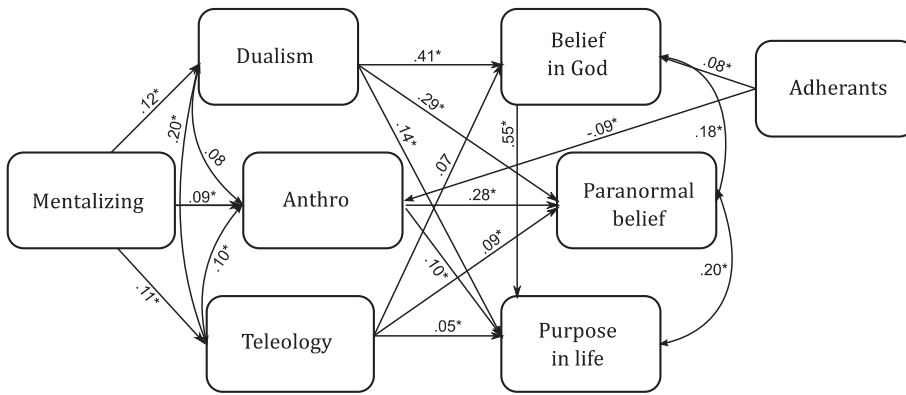
Fig. 4. Adult American sample, with the percentage of religious adherents in local area (county level) as an additional variable (Yuan–Bentler $X^2(9)$ = 10.80, p = .29; CFI = .99; RMSEA = .02). $^*p$ < .05.

5. Alternative models

5.1. Reverse causation

An obvious criticism of any cognitive hypothesis of religious belief is reverse causation: religious engagement may intensify cognitive tendencies, rather than the other way around. In this latter view, people are prone to anthropomorphizing the world, seeing minds as separate from bodies, and engaging in teleological thinking, because of their prior religious beliefs. We tested this reverse-causation hypothesis by reversing the model. We tested whether Belief in God, Life's Purpose and paranormal belief could be encouraged by mentalizing, and in turn leading to teleological thinking, anthropomorphism and dualism. This model did not fit the data (Yuan–Bentler $X^2(4)$ = 21.38, p < .001, CFI = .99, RMSEA = .07) (see Fig. 5). Similarly, if we switch belief in God to lead to all other variables, that model did not fit the data either, even after enough errors are correlated (based on the largest residuals) to match the original model's degrees of freedom (Yuan–Bentler $X^2(4)$ = 21.68, p < .001, CFI = .98, RMSEA = .07).

5.2. Additional paths

We tested whether mentalizing contributes to religious belief directly. In other words, we explicitly tested the idea that the relationship of mentalizing to the outcome measures is mediated by its relationship to dualism, anthropomorphism and teleology. A chi-squared difference test was conducted after adding in a direct path from mentalizing to belief in God. However, the model fit was not significantly improved ($X^2(1)$ = 1.90, p = .17). The model fit did not improve when adding a direct path between mentalizing and life's purpose ($X^2(1)$ = 3.25, p = .07) nor when both extra paths were added together ($X^2(2)$ = 5.06, p = .08). These analyses suggest that dualism and teleology indeed mediate the path from mentalizing to religious belief.

5.3. Purpose causing belief

It might be argued that believing in life's purpose comes first, which then encourages people to seek God. This alternative was also tested but did not receive support. Switching the direction of the relationship between life's purpose and belief in God to make purpose predict belief in God
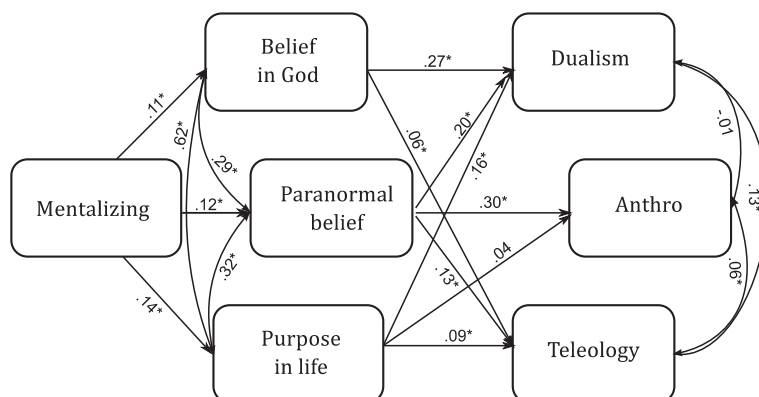

Fig. 5. Reverse Causation model, adult American sample (Yuan–Bentler $X^2(4)$ = 21.38, p < .001, CFI = .99, RMSEA = .07).

causes the model to no longer fit the data (Yuan–Bentler $X^2(4) = 11.38$, $p = .02$, CFI = .99, RMSEA = .06).

6. Discussion

This research contributes to our current understanding of the cognitive tendencies that underlie supernatural belief in several important ways. First, our analysis suggests that the relationships are directional, going from cognitive biases to beliefs and not the other way around. The addition of the religious adherence measure adds to this directionality argument. The proportion of religious adherents in an individual's county predicted belief in God, but it did not predict greater levels of dualism or teleology, implying that cognitive biases and cultural learning independently (and probably interactively) contribute to religious belief – they are not mutually exclusive explanations. Interestingly, the proportion of religious adherents in one's community predicted anthropomorphism negatively, suggesting that high rates of Christianity in a community might actually suppress anthropomorphic tendencies in individuals. Neither of these relationships is particularly strong and should be treated with caution. Moreover, this cultural measure has its limitations. It does not account, for example, for those who have recently moved to an area, and therefore have not had much of a chance to interact with their local neighborhood, nor does it account for how much a person interacts with the religious adherents in their county. Still, we do find a relationship in the direction we would predict from cultural explanations (Gervais et al., 2011; Henrich, 2009). Greater exposure to religious attendance predicts more belief in God.

6.1. Dualism as a key intuition underlying religious beliefs

Of the cognitive biases we included in this model, dualism emerged as the strongest predictor of all three beliefs in both samples. We found a significant relationship to life's purpose, even beyond the indirect relationship through religious belief. Dualism is, theoretically, a necessary condition to believe in any disembodied supernatural being (Bloom, 2005, 2007). This includes gods, ghosts, spirits, and the soul. The more people see minds and bodies as separate, the more likely they are to think about and believe in these types of beings. The relationship between dualism and life's purpose is less straightforward. It is possible that the belief that the mind is separate from the body allows people to see minds, and therefore intention, everywhere (see Bering, 2002, 2003). Dualism may also infuse life with greater meaning to the extent that it encourages the belief that a part of one's self is not identical with the body, and therefore may continue after death.

6.2. The role of anthropomorphism

Anthropomorphism, operationalized as the tendency to project human-like attributes to non-human entities, was not related to belief in God in our model. In our adult sample, it was not related to belief in God even in a zero-order correlation. This may be surprising given theories that argue that anthropomorphism and hyperactive agency detection are an underlying feature of all supernatural belief (Barrett, 2000, 2004, 2008; Guthrie, 1993, 1996). It is less surprising when one considers that the religious conviction of most of our sample is Christian or living in a majority-Christian culture. In Christianity, and in Abrahamic religions in general, God is anthropomorphized in the important sense that God has human-like mental characteristics. God does not fit into the template of animism in the Christian tradition; he is super-human, not human-like. He is a mega-mind without the frailty of a human body and without basic human needs, like hunger, or feelings (Gray et al., 2007). Perhaps more importantly, the negative relationship between the proportion of local religious adherents and anthropomorphism suggests that Christian believers may actually suppress the tendency to anthropomorphize the world. This is possibly due to the prohibition of animistic tendencies in Christian (and more broadly, Abrahamic) folk theology, in which attributing human-like mental states to non-humans, such as seeing spirits in mountains or trees, goes contrary to religious teachings, and in some instances is considered idolatry.

Despite the lack of any relationship between anthropomorphism and belief in God, anthropomorphism still played an important role in other types of beliefs. Anthropomorphism predicted paranormal belief. Paranormal beliefs may be more influenced by individual differences in this dimension because they are less strongly regulated by religious institutions (at least in the West). For North Americans, belief in astrology and ESP are not culturally sanctioned the way that belief in God is. Rarely are people ousted from their family and community for questioning the accuracy of divination, or the plausibility of astral projection. It is possible that these types of beliefs are closer to our supernatural intuitions about the world. People may naturally be superstitious and prone to believing in some supernatural concepts, but may not passionately commit to God without additional cultural support (Gervais et al., 2011).

6.3. Teleology

Teleology was a predictor of all three beliefs, but it was the weakest one. Though not all the paths from teleology are significant, they are all necessary for model fit. There are several possible reasons for why these links are so weak. It may be that teleology, as an over-extension of artifact cognition, really does not influence supernatural beliefs all that much, or it could be that our measure of this trait did not quite capture all that we intended it to. It is hard to rule this second option out, as this measure has not been validated as an individual difference construct. Nevertheless, our results are consistent with recent findings (Kelemen et al., 2012), showing that teleological thinking is related to belief in God, and belief in spiritual Gaia-type beliefs in Mother Nature. At this point, no hard conclusions can be made on the role of teleology, other than that our measure does appear to be capturing

at least some of the variance in religious and paranormal belief.

6.4. Life's purpose and belief in God

The sense that there is some underlying purpose to life has been argued to be a residual of supernatural belief among the non-religious. Though many people have managed to stop believing in God, the sense that there is some purposeful intentionality behind life remains entrenched (Bering, 2002, 2003; Slingerland, 2008). Our results do not contradict this claim, but suggest a somewhat more complex picture. Although our cognitive biases remain predictors of purpose above and beyond the variance predicted by belief in God, belief in God remains the strongest predictor. Further, the model no longer passed the test of fit when we reversed this relationship to have belief in purpose lead to belief in God. This suggests that much of the variance in belief in life's purpose, is coming from belief in God. The remaining relationships with our cognitive biases could be seen as an intuition towards purpose above and beyond what is encouraged by belief in God, or it could be something left over from growing up in a largely Protestant Christian culture. This interesting question could be answered by going beyond a Christian sample. Regardless, it does not seem to be the case that purpose is another sort of intuition that leads to belief in a supernatural power. Rather, belief in God appears to lead to a greater sense that there is a purpose to life.

6.5. Limitations and future directions

The quest for what explains religious belief and disbelief is an important and understudied area of psychological research. Our findings provide empirical support for the idea that naturally emerging cognitive tendencies predispose human minds towards religious beliefs. A particular strength of our findings is that we assessed the interactions of a converging set of cognitive biases in a single theoretical model that explained several types of supernatural beliefs. Yet, there are several limitations to the current findings. Our results are correlational, and although based on path analyses that assessed alternative models (including reverse causation) that found them to be lacking, we cannot conclusively claim causality without further experimental work. Additionally, we relied on mostly self-report measures of cognitive biases that have their limitations. These measures yielded good results, but future research can further advance this work by using non-self-report measures. Moreover, more work needs to be done to determine both what cognitive traits lead to belief as well as how belief is culturally transmitted, within a community and through generations. To really appreciate the complexity of this question, we must recognize that all supernatural beliefs are not identical and may not develop in the same way. Christianity, like other world religions, has a long cultural tradition behind it and upholding it. To truly comprehend what causes supernatural beliefs it is important to examine beliefs, or even superstitions, that have less institutional force behind them as well as full-fledged religious belief.

Acknowledgement

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