

The God Allusion

Individual Variation in Agency Detection, Mentalizing and Schizotypy and Their Association with Religious Beliefs and Behaviors

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Published online: 29 March 2016

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Abstract It has previously been suggested that the historically and geographically widespread persistence of religious beliefs occurs because it is a by-product of normal cognitive processes, ones which first evolved to confer survival advantages in the social domain. If this theory holds, then it is likely that inter-individual variation in the same biases may predict corresponding variation in religious thoughts and behaviors. Using an online questionnaire, 298 participants answered questions regarding their tendency to detect agency, the degree to which they displayed schizotypal traits, their ability to understand the emotions and motivations of others (“mentalizing”), and their religious beliefs and behaviors. Path analysis suggests that mentalizing, agency detection, and schizotypal thinking were each independently related to religiosity. Furthermore, schizotypal thinking and agency detection were highly interrelated with one another, whereas mentalizing was not. Although the degree to which an individual engages with religious or spiritual beliefs will be influenced by their cultural and historical context, this paper helps to elucidate the interplay between various cognitive processes that might predispose some individuals but not others toward holding such beliefs in the first place.

Keywords Religious belief · Agency detection · Agency · Schizotypy · Theory of mind · Mentalizing · Empathy

Religious beliefs and practices are both historically and cross-culturally widespread, found in some form in every known human society (Norenzayan 2013). Currently at least 10,000 distinct religions exist, each with their own set of beliefs, rituals, and portrayals of

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supernatural beings (Barrett et al. 1998). Even individuals who do not partake in organized religion may identify with having “spiritual” beliefs that are considered religious in the widest sense (Saucier and Skrzypińska 2006). The apparent universality of religiosity implies that these diverse sets of distinctive beliefs might come quite naturally to humans, and that actually an atheistic mind-set is the oddity (Boyer 2008; McCauley 2000). Consequently, the prevalence of personal and institutionalized religious beliefs across both time and geography has led some researchers to examine the kinds of cognitive mechanisms that might both underlie, and help promulgate, this near-universal phenomenon.

An increasingly popular approach to explaining the pervasive existence of religious tendencies is the suggestion that such beliefs piggyback on everyday cognitive processes—processes that primarily evolved because they confer certain survival advantages (Atran and Norenzayan 2005; Barrett 2000; Bering 2002). For instance, religious beings in the form of gods or spiritual deities oftentimes combine nonhuman traits, such as omnipresence or the ability to fly, with humanlike properties, such as humanoid shapes, a physical presence, and mental states. Indeed, it may be these minimally counterintuitive amalgamations of normal human features and minimal violations of category characteristics that make such conceptual beings so attractive (Barrett 2000; Guthrie 1993; Shtulman 2008). Given that supernatural beings are considered to be agents with mind-states, it has been argued that belief in supernatural beings is likely to involve cognitive processes also relevant to dealing with social relationships with other humans, such as ascribing agency to others and reasoning about their mental states. In other words, the cognitive processes that help individuals function in the types of complex social environments typically found in the “real world,” where members of the network are dispersed and therefore not physically present all the time, can also be applied to imagined or “virtual” social interactions with supernatural entities even though they may never have a physical presence (Atran and Norenzayan 2005; Barrett 2000, 2007; Bering 2002; Guthrie 1980; Holt-Lunstad et al. 2010; Pearce 2014). Although cultural and personal context remain important, the general human predisposition to apply social cognitive processes beyond the sphere of face-to-face physical social interactions is likely to be a necessary precondition for many types of religious beliefs and cognitions to arise. Here, we build on previous work that has identified some of the specific social cognitive processes that may be associated with religious thinking, or religiosity, to examine whether individual variation in these cognitive abilities might be associated with corresponding individual variation in religiosity.

Three candidate cognitive processes, or biases, that have been posited to underlie the human tendency toward religious thinking are (a) attribution of agency and the ascription of humanlike mental states to nonhuman lifeforms or objects (a form of anthropomorphizing); (b) identifying and reasoning about the content of those mental states, or “mentalizing”; and (c) schizotypal personality traits associated with “odd” thinking and novel perceptual experiences (here referred to as “schizotypal thinking” and representing a subcomponent of schizotypy) (Atran and Norenzayan 2005; Barrett 2000; Bentall et al. 1989). The “cognitive science of religion” approach argues that humans are generally attracted to religious thought because these underlying biases predispose them to such thinking. Although these cognitive biases have been proposed to explain the existence of religious tendencies in general, the question of whether individuals who show greater levels of these biases would be *more* susceptible or responsive to religious thinking than individuals who display lower levels of these biases has not yet been tackled in depth. For instance, individuals (a) who are more

disposed to seeing agency in the natural world, (b) to ruminating on the mind-states of such “imagined” agents, and (c) who experience schizotypal cognitions and sensations may find religious concepts easier to intuit and accept than other individuals.

Humans are known to display considerable inter-individual variation in many cognitive abilities and traits, including those associated with sociality (Baron-Cohen et al. 2001; Stiller and Dunbar 2007; Willard and Norenzayan 2013). Inter-individual variation in many domains (such as personality traits or mating strategies) arises from a combination of genetic and environmental influences and is thought to be adaptive because differential fitness payoffs may accrue to various traits/strategies depending on their relative frequency in a population (e.g., Dall et al. 2004; Maynard Smith 1984; Włodarski et al. 2015). By examining such inter-individual variation in agency detection, mentalizing and schizotypal thinking and any corresponding variation in religiosity, the assumptions made by theories in the cognitive sciences of religion, namely that these cognitive thinking styles underlie religious thinking, can be empirically tested: individuals with stronger cognitive biases should be more likely to express greater religiosity. Moreover, by exploring these cognitive biases simultaneously, a clearer picture of both the relationship between these cognitive processes and their direct and indirect relationships with religiosity can be elucidated.

Agency Detection

The first cognitive bias thought to underlie religious beliefs is the tendency to detect agency, or “intentions,” in individuals and objects in the environment. Ascribing such agency aids in attributing purpose to external events—in the case of religion, purpose arising from the intentioned activities of supernatural agents (Michotte 1963). Agency detection may have arisen as an evolved survival strategy that allows for “erring on the side of caution” when presented with an ambiguous or unpredictable stimuli since the cost for failing to detect agents (e.g., a predator) may be much higher than for incorrectly assuming the presence of agents where none exist (Barrett 2000; Guthrie 1993). Attribution of agency can also be referred to as a specific type of anthropomorphism: attributing humanlike traits to nonhuman beings or objects, traits that include mental states.

In general, humans have such hyperactive agency detection tendencies that almost any object can be viewed as possessing humanlike traits, including animals, forces of nature, technological tools, and even the simplest of geometric shapes (Epley et al. 2007; Guthrie 1993). Studies have previously suggested that a link exists between religious thinking and agency detection by finding that religious individuals are more likely to detect faces in semi-ambiguous stimuli, irrespective of the actual presence of a face-like stimulus (Riecki et al. 2013). Interestingly, individuals are typically more likely to attribute psychological mind-state features, rather than human physical or biological features, to religious or fictive supernatural beings (Shtulman 2008).

Mentalizing

Although one of the outcomes of agency detection may be attribution of mental states to nonhuman entities, another necessary step underlying religious belief entails the

more involved ability to reason about the actual content of those mental states, referred to as *mentalizing* or Theory of Mind (Apperly 2012; Premack and Woodruff 1978). This ability allows an individual to understand that others may hold different beliefs, desires, and intentions than their own, and to reason about the content of such beliefs. One fundamental component of reasoning about the content of others' mind-states includes the ability to understand the emotional states of others, which is aided by the ability to put oneself in the place of another—that is, to *empathize*.

Identifying and understanding mental states (mentalizing) is a necessary prerequisite for the creation of the kinds of complex mental representations typically ascribed to supernatural beings and gods found in most religious belief systems (Barrett 2000; Dunbar 2003; Norenzayan et al. 2012). Indeed, studies that have looked at brain activations in individuals who are thinking about god or praying find activations in regions typically also associated with mentalizing (Kapogiannis et al. 2009; Schjoedt et al. 2009), and children begin to reason about the mental states of supernatural agents at around the same time as they develop the ability to reason about what other humans are thinking (around the age of four—though some studies have suggested that it may be present in some form in infants as young as 12–18 months (Frith and Frith 2003; Lane et al. 2010)). Further evidence that mentalizing may be a prerequisite for holding religious beliefs comes from research with individuals who show deficits in their ability to mentalize about the mental states of others—for example, individuals diagnosed with autism-spectrum disorders (Baron-Cohen et al. 1985; Korkmaz 2011). Several studies have shown that those on the autism spectrum are more likely to self-identify as atheist and are less likely to believe in god, with mentalizing abilities (as indexed by empathizing) thought to be a key mediating variable: the less individuals are able to empathize, the less likely they are to be religious (Caldwell-Harris et al. 2011; Norenzayan et al. 2012).

Schizotypal Thinking

As well as finding links between religiosity and agency attribution, and religiosity and mentalizing, previous research also supports a link between religiosity and schizotypal cognitions and sensations. Schizotypy is a set of traits found in nonclinical populations, including unusual perceptual experiences and cognitive disorganization (Bentall et al. 1989). In its extreme form (namely, the clinical diagnosis of schizophrenia), schizotypal traits have been associated with agency and perceptual misattribution—whereupon individuals wrongly attribute their own thoughts or perceptions to others, or attribute others' thoughts and perceptions to themselves (Dein and Littlewood 2011; Frith 1992). Research has found that individuals scoring highly on scales assessing various delusional tendencies are more likely to display hyper-religious behavior, or to become members of new religious movements (Peters et al. 1999; Previc 2006). Furthermore, some schizotypal traits found in normal populations have also been associated with certain religious tendencies, particularly among men (Diduca and Joseph 1997; Maltby and Day 2002).

The presence of these cognitive biases—namely, the tendency to detect agency, the ability to mentalize, and schizotypal thinking—is thought to be a necessary prerequisite for various types of religious thoughts and beliefs (religiosity). Individual variation in

these abilities has sometimes been found to be independently related to variation in religiosity. However, these cognitive biases have a lot in common, and they are all closely tied to general social cognition, and thus they may have strong associations not only to religiosity, but also with one another. The aim of the current study was to examine these cognitive processes and their implications for religiosity in parallel, looking at both their relative impact on religiosity as well the interrelationships between them. Only by examining the relationships between these cognitive abilities simultaneously can we begin to speculate about which of them might be the primary drivers of religiosity, and which may in fact just be different facets of common underlying cognitive processes.

Methods

Participant Recruitment

An online questionnaire was distributed to U.S.-based participants using the Mechanical Turk micro-task crowdsourcing platform. Participants were at least 18 years old and were informed that their responses were completely voluntary and anonymous. Participants provided informed consent and were remunerated the standard Mechanical Turk payment amount for their time. The study was approved by Oxford University's Research Ethics Committee (CUREC).

In total, 298 participants completed the survey, of whom 141 were male and 157 were female, ranging in age from 19 to 65 ($M = 37.1$, $SD = 11.9$). The most common self-reported "primary religious affiliations" were Atheist (22.1%), Catholic (16.8%), Agnostic (16.8%), Christian (Other) (14.8%), and Protestant (13.8%).

Questionnaire Design

Several standardized scales were used in the questionnaire to assess individuals' tendency to ascribe agency, their mentalizing abilities, presence of schizotypal traits, and their religious beliefs and practices.

To assess individual tendency to ascribe agency, the Individual Differences in Anthropomorphism Questionnaire (IDAQ; Waytz et al. 2010) was used. This psychometrically validated measure assesses an individual's tendency to ascribe free will, emotions, intentions, and consciousness (i.e., agency) to a variety of nonhuman objects, including animals, the natural environment, and technological items. Questions included "To what extent does a tree have free will?" with answers recorded on ten-point Likert-type scales ranging from "Not at all" to "Very Much."

A key component of mentalizing, or the ability to infer the content of the mental states of others, involves the ability to empathize with other individuals so as to better ascertain the content of their mental states (Baron-Cohen 2009; Baron-Cohen et al. 1985). To that end, a short version of the Empathy Quotient (EQ; Loewen et al. 2010; Wakabayashi et al. 2006) scale was used as a proxy measure of mentalizing abilities. This eight-item scale included questions such as "I am good at predicting how someone will feel" and "It is hard for me to see why some things upset people so much," with responses measured on a four-point Likert-type scale ranging from "Strongly Disagree"

to “Strongly Agree.” The EQ has been successfully used in past studies as a proxy for mentalizing and has been shown to have an independent association with religious beliefs (Norenzayan et al. 2012).

The presence of a relevant schizotypal thinking style was assessed using the Odd Beliefs/Magical Thinking and Unusual Perceptual Experiences subscales of the Schizotypal Personality Questionnaire (SPQ; Raine 1991). Questions included “*Can other people feel your feelings when they are not there?*” and “*Have you often mistaken objects or shadows for people, or noises for voices?*” with responses measured on a four-point scale: “Yes,” “Maybe,” “No,” “Unsure,” and with any “Yes” responses scoring one point on the standard scale. These particular subscales were used because they most closely assess cognitions related to misascription of mind-states and perceptual experiences between self and others, cognitions that have been shown in past research to be related to certain types of religious beliefs (Farias et al. 2005).

Religious beliefs were assessed using two established scales of religiosity. The Short Santa Clara Strength of Religious Faith Questionnaire (SCSRFQ; Plante et al. 2002) includes five items, such as “*My faith impacts many of my decisions,*” with responses collected on a four-point Likert-type scale ranging from “Strongly Disagree” to “Strongly Agree.” The Duke University Religion Index (DUREL; Koenig and Büssing 2010) contains five items, with three questions relating to religious beliefs (e.g., “*In my life, I experience the presence of the Divine*”) and measured on a five-point Likert-type scale ranging from “Definitely not true” to “Definitely True,” and two questions relating to frequency of religious practice and attendance (e.g., “*How often do you attend church/synagogue/mosque or any other religious meetings [outside of weddings/funeral services]?*”), with responses measured on a six-point Likert-type scale ranging from “Never” to “More than once a week.” Since responses to individual items across both scales were found to be very highly interrelated (Cronbach’s $\alpha = 0.96$), the mean of the responses to items on both scales was used to create a general “religiosity” score to be used in further analysis.

Questions were also asked about general demographic information, including age, sex, level of education, and primary religious affiliation.

Results

The correlations between each of the four variables of interest in this study are presented in Table 1. As can be seen, religiosity was significantly correlated with all three variables of interest—agency detection, mentalizing, and schizotypal thinking—as well as with sex (with females being significantly more religious than males). Schizotypal thinking and agency detection were also strongly positively correlated with each other, and females were found to be significantly better at mentalizing than males. The relationship between these variables and age was also examined; however, since no significant associations were found (all Pearson’s r values < 0.071 , all p values > 0.308), age was dropped from further analysis.

To examine the direct independent contributions of mentalizing, schizotypal thinking, and agency detection toward participants’ religiosity scores, the three predictor variables of interest, plus sex, were regressed onto religiosity in a linear regression analysis, the results of which are presented in Table 2. The regression analysis suggests

Table 1 Correlation matrix between mentalizing, schizotypal thinking, agency detection, and religiosity

	Sex	Mentalizing	Schizotypal Thinking	Agency Detection	Religiosity
Sex	1	.243**	.097	.082	.134*
Mentalizing		1	-.015	-.006	.175*
Schizotypal thinking			1	.505**	.256**
Agency detection				1	.240**
Religiosity					1

For sex, males =0, females =1; * $p < 0.01$, ** $p < 0.001$

that while both schizotypal thinking and mentalizing are predictors of religiosity, agency detection is not a significant predictor once the effects of schizotypal thinking and mentalizing are taken into account. Furthermore, this analysis suggests that when the effect of all the variables of interest on religiosity was taken into account at the same time, the independent effect of sex on religiosity was no longer significant. Since the subtraction of sex from this analysis was found to make no differences to the model fit ($\Delta r^2 < 0.001$) or the significance of the other predictor variables, sex was dropped as a predictor variable from further analysis.

In order to examine the relationships among mentalizing, schizotypal thinking, and agency detection tendencies in more detail, and their mediating effects on religiosity, a path analysis (using standardized scores) was conducted using the Ω nyx analysis package (version 0.9–729: von Oertzen et al. 2014). This analysis examines the relationships between each of these predictor variables, as well as their direct and mediated effects on religiosity, using Maximum Likelihood Estimation (MLE) of parameters. The results of the path analysis displayed in Fig. 1 and Table 3.

The path analysis model suggests that among the predictor variables, significant positive direct relationships exist between agency detection and religiosity, schizotypal thinking and religiosity, and mentalizing and religiosity. Additionally, a positive relationship exists between agency detection and schizotypal thinking, with schizotypal thinking and agency detection both having indirect effects via each other on religiosity.

Discussion

The findings presented here suggest that mentalizing, agency detection, and schizotypal thinking are independently related to how religious individuals report themselves to be.

Table 2 Regression of sex, mentalizing, schizotypal thinking, agency detection onto religiosity

	<i>B</i>	<i>SE B</i>	β
Constant	5.79	4.65	
Sex	0.92	1.60	.037
Mentalizing	0.29	0.11	.178*
Schizotypal thinking	0.74	0.26	.208*
Agency detection	0.05	0.03	.129

For sex, males =0, females =1;
 $r^2 = .121$, * $p < .01$

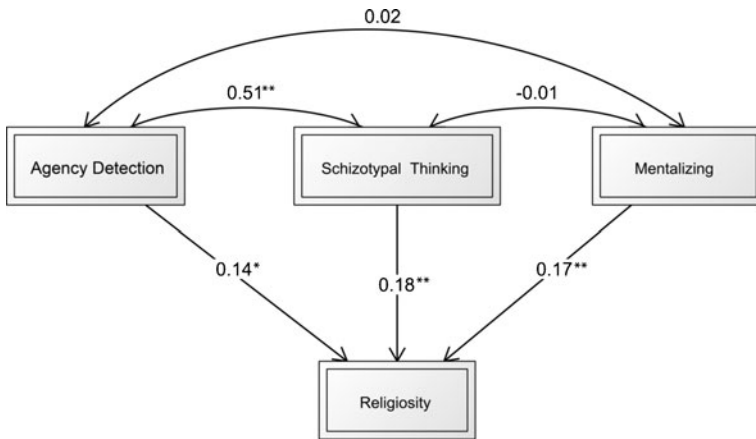


Fig 1 Path analysis of agency detection, schizotypal thinking, mentalizing, and religiosity. * $p < 0.01$, ** $p < 0.001$

Furthermore, as well as these direct relationships, the schizotypal pattern of thinking (as measured via subscales of the schizotypy scale) and agency ascription were also highly interrelated, meaning that they also have indirect relationships to religiosity via each other. Together, these results support the claim of Dein and Littlewood (2011) that there is a relationship between the schizotypal thinking style and religiosity as a consequence of the human tendency to detect agency. However, contra Dein and Littlewood, this relationship does not seem to be mediated by mentalizing ability. Instead, mentalizing ability seems to lie on a separate, independent path related to religiosity, as previously suggested by the finding that reduced mentalizing ability (as indexed by autistic-like thinking styles) is associated with reduced religiosity (Norenzayan et al. 2012).

Some initial sex differences were found in this study, with females being better at mentalizing than males, and more likely to be religious than males. These findings are in line with past research which has found not only that females are more likely to be religious than males (Walter and Davie 1998) but that this effect may be mediated by mentalizing ability (as assessed by empathizing) (Norenzayan et al. 2012) since females are sometimes found to show better mentalizing abilities than males (e.g., Baron-Cohen et al. 2001; Stiller and Dunbar 2007). However, when sex was examined in conjunction with the other variables of interest, the effect of sex on religiosity was negated, suggesting that mentalizing, schizotypal thinking, and agency detection are more relevant predictors

Table 3 Path analysis covariate estimates

	Estimate	SE	z	p
Agency detection – Religiosity	0.145	0.048	2.998	.003
Mentalizing – Agency detection	0.018	0.045	0.415	.678
Mentalizing – Schizotypal thinking	−0.014	0.043	−0.324	.746
Schizotypal thinking – Agency detection	0.514	0.049	10.487	.001
Mentalizing – Religiosity	0.171	0.040	4.264	.001
Schizotypy – Religiosity	0.184	0.047	3.875	.001

of religiosity. A possible explanation for the sex difference found in mentalizing ability revolves around the question of whether females are actually better than males at mentalizing abilities, or if this observations is a by-product of the methodology used. Sex differences in mentalizing only seem to crop up when self-report measures are used, and they disappear when more direct assessments of mentalizing are utilized (see Eisenberg and Lennon 1984), suggesting the possibility of demand characteristics driving self-report differences. If this is the case, then sex differences in real-world mentalizing ability might be nonexistent, calling into question the possibility that mentalizing mediates the relationship between sex and religious thinking.

Cognitive theories of religion have suggested that religious beliefs, and particularly beliefs related to the existence of supernatural agents, rely on several forms of cognition typically used in other social domains (Atran and Norenzayan 2005; Barrett 2000, 2007; Bering 2002; Boyer 1994; Guthrie 1980). In support of this supposition, research has suggested that religious and nonreligious people tend to anthropomorphize God during real-time inferential processing of information (Barrett and Keil 1996), and that a relationship exists between schizotypal thinking and an extrinsic religious orientation (Maltby and Day 2002), and between mentalizing abilities and religious belief (Norenzayan et al. 2012). This study's finding that individual variation in all three cognitive abilities is related to religious beliefs adds to this growing body of literature, but it also suggests that the causal pathways may be more complex than previously appreciated: agency detection and schizotypy were found to be closely interrelated, whereas mentalizing abilities showed no relationship with either agency detection or schizotypy.

The apparently separate pathways to religiosity from (a) agency detection and schizotypal thinking and (b) mentalizing arise because forms of agency detection likely involve deeply rooted biases that utilize low-level mental processing abilities—abilities possibly shared with other animals, whereas mentalizing involves higher-level cognitive processes involving greater activation of prefrontal cortices and evolutionarily recent social-decision-making circuits (Apperly 2012). Assessing the actual content of others' minds requires vastly more elaborate cognitive processes than basal "pattern recognition" cognitions involved in seeing faces in everyday objects (Dunbar 2003). The schizotypal thinking traits assessed here seem to be closely tied to agency detection, whereby individuals not only ascribe humanlike (cognitive) features to various items in their environment but also mistakenly ascribe agency to aspects of the environment—even in the absence of tangible environmental cues (as assessed by SPQ questions such as "Have you ever had the sense that some person or force is around you, even though you cannot see anyone?"). It may be that schizotypal thinking relies on similar low-level processes as agency detection and hence is similarly unrelated to "high-level" mentalizing activities, as suggested by the lack of relationship found here in the path analysis. However, the question remains whether any one of these three processes is a primary driver of religiosity, or whether all of these processes are required to support religious thinking.

The fact that the regression analysis in this study showed relationships between (a) schizotypal thinking and religiosity and (b) mentalizing and religiosity, but not between agency detection and religiosity, suggests that agency detection may in fact be a form of schizotypal thinking. It may be that the kind of misattribution of mental states found in some schizophrenic disorders also leads to greater levels of general agency detection,

and once the effect of schizotypal thinking is partialled out, then agency detection behaviors on their own are not significant predictors of religious cognition. This finding implies that looking at agency detection as the sole predictor of religiosity (e.g., Riekkii et al. 2013) may be misleading since it misses the important contribution of “unusual perceptual experiences” and “odd beliefs/magical thinking,” which might be the underlying cognitions leading to both agency detection and religious belief. Furthermore, the path analysis conducted here shows not only that agency detection is closely related to schizotypal thinking, but that it is a weaker independent predictor of religiosity than either schizotypal thinking or mentalizing.

Interestingly, mentalizing ability does not appear to be as closely related to either agency detection or schizotypal thinking as past literature implies. It makes intuitive sense that in ascribing a mental state to a nonhuman object, or mistakenly ascribing the presence of a mental state to an unusual perceptual experience (as in the case of schizotypal thinking), an individual might also need to infer something about the content of that mental state. After all, a mental state can hardly be said to exist if it has no content. However, the Empathy Quotient used to index mentalizing ability in this study examined the ability to *accurately* infer the mental and emotional states of other individuals throughout daily life (using such questions as “I often find it hard to judge if something is rude or polite”). It may be that while merely ascribing the presence of mental states or agency to a nonhuman object is an important underlying factor associated with religiosity, the ability to interpret and identify *what* those mental states might also be important, and may be a separate (more involved) cognitive process than either basic agency detection or schizotypal thinking.

Mentalizing likely involves higher-level processes that are quite distinct and a more involved form of cognition than simple agency detection. Cognitively demanding processes such as mentalizing, or Theory of Mind, seem to develop in humans at around the age of five, which is about the time that children also begin to reason about the mental states of various supernatural agents (Lane et al. 2010), whereas agency attribution (without understanding the content of mental states) occurs much earlier in development (Frith and Frith 2003). This suggests that religion may only have been possible once the ability to mentalize evolved in addition to basic agency attribution (or in the case of schizotypal thinking, misattribution). In other words, it is likely that religion depends not only on understanding that other individuals have minds, but also on ascertaining what those mind-states might be. Although basic agency detection may bias individuals to detect the presence of some form of agency, it may be this particular ability to assess the *content* of an agent’s mind that led to the formation of religious thinking, which in turn would be reinforced as individuals come to have a *shared* understanding of the intentions of the kinds of supernatural beings that form the basis of most forms of religion.

Although chimpanzees and orangutans show some indication of understanding that other individuals have minds, and perhaps even the contents of those minds (Cartmill and Byrne 2007; O’Connell and Dunbar 2003), it is likely that nonhuman primates do not possess “higher-order” mentalizing capabilities. Such capabilities would allow an individual to incorporate the mind-states of multiple individuals in a recursive fashion (e.g., “I think that he thinks that God has a purpose for us”) (Dunbar 2003, 2008; Launay et al. 2015), and it may this unique ability that is the prerequisite for the rise of the kinds of religions found throughout human cultures. Through being able to track the

mind-state of fellow individuals, as well as that of supernatural beings, and further realizing that others also hold mental representations of supernatural beings, “social” religions with shared belief systems can arise once enough individuals develop such capabilities. How these more complex social cognitive abilities—namely, higher-order mentalizing at multiple levels of recursion (keeping track of what others think about what others think about what others think)—fit into the model presented here remains to be investigated.

The nature of a cross-sectional study such as this one limits our ability to make causal inferences about the data. It may well be that differences in mentalizing ability, schizotypal thinking, and agency detection predispose an individual to religious thinking to differing degrees, but it is also possible that having more frequent religious thoughts and practices lead to improved mentalizing, more sensitivity to agency detection, and greater frequency of schizotypal thought. To examine the directionality of these effects, future experimental or intervention studies could attempt to manipulate these predictive traits, perhaps by providing training in mentalizing ability or in agency detection accuracy, and then measure the effects of such interventions on the frequency and intensity of various religious cognitions.

This study found that variation in the tendency to detect agency in the environment, variation in schizotypal thinking patterns, and the ability to understand the emotions and motivations of others (mentalizing) were all related to variation in religious beliefs and behaviors. Furthermore, schizotypal thinking and agency detection were found to be highly interrelated, whereas mentalizing ability was found to be relatively independent of these two cognitive systems. These results support previous conjectures that religiosity may rely on, and possibly be a by-product of, normal cognitive processes that likely evolved to solve challenges in the social domain. Although the degree to which an individual holds spiritual beliefs will most certainly be influenced by cultural and historical contexts, this paper also lends support to the notion that the human tendency toward religious thinking is associated, to some extent, with common cognitive biases.

Acknowledgments We thank our colleagues at the Social and Evolutionary Neuroscience Research Group (SENRG) for their valuable input, particularly Jacques Launay and Robin I. M. Dunbar. RW and EP are supported by a European Research Council Advanced Grant.

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