

# Where Do Gods Come From?

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Religiosity—belief in supernatural beings—is culturally universal, thus quite likely part of universal human nature. How can evolutionary psychology explain it? I survey one extant theory of religiosity as an evolutionary byproduct of a cognitive bias, variously known as the animistic bias or the agency-detector mechanism, and present a new theory that proposes religiosity may be a tertiary adaptation that was selected because of its effect on secondary adaptations such as subjective well-being and the sense of meaning and purpose in life, which in turn facilitated primary adaptations to maximize survival and reproductive success. Although more studies are necessary to adjudicate between these two explanations, both theories suggest that religiosity is deeply evolutionarily familiar. The Savanna-IQ Interaction Hypothesis suggests that more intelligent individuals may be less religious than less intelligent individuals.

*Keywords:* error management theory, higher-order adaptations, meaning/purpose in life, positive mood offset, religiosity

Religion<sup>1</sup> is a cultural universal. There has not been any human society known to science in which inhabitants do not worship some form of supernatural beings (Brown, 1991). Out of more than 1,500 distinct cultures throughout the world described in *The Encyclopedia of World Cultures* (Levinson, 1991–1995), only 19 entries contain any references to atheism. All 19 cultures without an exception are in former Communist societies (Abkhazians in Georgia, Ajarians in Georgia, Albanians, Bulgarians, Chuvash in Russia, Czechs, Germans in Russia [but not in Germany], Gypsies in Russia, Itelmen in Russia, Kalmyks in Russia, Karakalpaks in Russia, Koreans in Russia [but not in Korea], Latvians, Nganasan in Russia, Nivkh in Russia, Poles, Turkmens, Ukrainian peasants, Vietnamese). There are no cultures described in *The Encyclopedia* as containing any significant segment of atheists that are not former a Communist society.

The cultural universality of religion poses a puzzle for evolutionary psychology. When a given pattern of cognition or behavior is culturally universal, it is highly likely (though, strictly speaking, not logically necessary) that it is part of universal human nature and that humans have been evolutionarily selected to think or behave in such a way (Buss, 1989). However, it is not immediately obvious how and why religiosity may be evolutionarily adaptive. How would a belief in supernatural beings aid survival and reproduction? Although religious individuals, at least in the United States, tend to have higher fertility (Hayford & Morgan, 2008; Zhang, 2008), it has not been obvious, until now, how and why religiosity may increase reproductive success (see below).

In this article, I survey two—one old and one new—evolutionary psychological explanations for religiosity. An older theory contends that the universal human tendency to believe in supernatural beings evolved as an evolutionary byproduct of the adaptation to overinfer agency as a means of error management. A newer theory suggests that religiosity may have evolved as a tertiary adaptation, which facilitates the operation of secondary adaptations—subjective well-being and meaningful/purposeful life—which in turn aid the operation of primary adaptations that increase the chances of survival and reproductive success.

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<sup>1</sup> Before I can explore the evolutionary origins of religion, I must first clearly define my terms. The term *religion*, both in academic and general writing, tends to refer to three related yet separate entities: *religious beliefs* or *religiosity* (intraindividual cognitive processes inside the brain, such as a belief in supernatural beings), *religious practices* (individual and inter-individual social behavior, such as rituals and prayers), and *religious organizations* (supraindividual collectivities gathered mostly for the purpose of collective religious practices, such as churches, synagogues, and other denominations). Psychologists mostly study religious beliefs (Allport, 1950; James, 1985/1902), anthropologists usually focus on religious beliefs and practices (Durkheim, 1965/1915; Evans-Pritchard, 1956), and sociologists and economists tend to concentrate on religious practices and organizations (Greeley, 1972; Iannaccone, 1994). In this article, I focus *exclusively* on the evolutionary psychological origins of *religious beliefs* and *religiosity*. Wilson (2002) provides an excellent evolutionary perspective on religious organizations and how different religious groups and societies evolved as superorganisms over history.

I also focus exclusively on general theories of religiosity that explicate the cognitive processes that either facilitate or inhibit belief in supernatural beings. These theories are meant to apply to all humans (and, potentially, individuals of other species) equally. Neither of the theories presented refers to rare and exceptional individuals, such as religious leaders and founders. The general theories of religiosity offer no explanation for the behavior of such exceptional individuals, which, by definition, general theories of behavior cannot explain.

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## Religiosity as a Byproduct

Religiosity may be a byproduct of other evolved psychological mechanisms, variously known as the “animistic bias” (Guthrie, 1993) or the “agency-detector mechanism” (Atran, 2002), in a cognitive bias known as error management (Haselton & Buss, 2000; Haselton & Nettle, 2006). Now what in God’s name does that mean?

Imagine you are our ancestor, living as a hunter-gatherer on the African savanna 100,000 years ago, and you encounter some *ambiguous situation*. For example, you heard some rustling noises nearby at night. Or you were walking in the forest, and a large fruit falling from a tree branch hit you on the head and hurt you. Now what is going on?

Given that the situation is inherently ambiguous, there is really no way for you to know for sure, but you can make an inference. You can either attribute the phenomenon to impersonal, inanimate, and unintentional forces (e.g., wind blowing gently to make the rustling noises among the bushes and leaves, or a mature and ripe fruit falling by the force of gravity and hitting you on the head by coincidence) or attribute the same phenomenon to personal, animate, and intentional forces (e.g., a predator hiding in the dark and getting ready to attack you as soon as you fall asleep, or an enemy hiding in the tree branches and throwing fruits at your head to hurt you). The question is, which is it?<sup>2</sup>

As you can see in the  $2 \times 2$  table in Figure 1, there are four possible outcomes. In the two diagonal cases, you have made the correct inference. You inferred that the cause of the ambiguous situation was personal, animate, intentional, and it was; or you inferred that the cause of it was impersonal, inanimate, unintentional, and it was. There are no negative consequences if you make the correct inference.

Given the insufficient information you have, however, you cannot always make the correct inference. Sometimes you make mistakes in your judgment. In the two off-diagonal cases, you have made incorrect inferences. If you inferred that the cause was personal, animate, and intentional, whereas the true cause was impersonal, inanimate, and unintentional, you have made the “Type I” error of false positive (or “false alarm”). You thought the danger was there, when it was not. Conversely, if you inferred that the cause was impersonal, inanimate, unintentional, whereas the true cause was personal, animate, and intentional, you have made the “Type II” error of false negative (or “miss”). You didn’t think there was danger, when there was.

		True state of nature	
		Personal, animate, intentional	Impersonal, inanimate, unintentional
Inference	Personal, animate, intentional	Correct inference	False positive (Type I) error Consequence = paranoia
	Impersonal, inanimate, unintentional	False negative (Type II) error Consequence = potential death	Correct inference

Figure 1. Error management theory applied to religiosity. See the online article for the color version of this figure.

All errors in inference have negative consequences, but these two types of errors—Type I error of false positive and Type II error of false negative—have very different negative consequences. The consequence of Type I error is that you become paranoid. You are always looking around and behind your back for predators and enemies that do not exist. The consequence of Type II error is that you are dead, killed by a predator or an enemy when you least expect them. Obviously, it is better, evolutionarily or otherwise, to be paranoid than dead, so evolution should have designed an inference system that *overinfers* personal, animate, and intentional forces even when none exist. Evolutionary processes should select for a bias in the inference system that minimizes the chances of making Type II errors.

Here’s the catch. An inference system cannot simultaneously decrease the chances of making Type I errors and the chances of making Type II errors. Any inference system that decreases the probability of making Type I errors must *necessarily* increase the probability of making Type II errors, and any inference system that decreases the probability of making Type II errors must *necessarily* increase the probability of making Type I errors. So if the human mind has been selected to minimize the probability of making Type II errors, so that they would be less likely to be caught off guard and attacked by predators and enemies that they assumed didn’t exist, then the human mind must necessarily make a large number of Type I errors. You cannot be paranoid and oblivious (or relaxed) at the same time. The more paranoid you are, then, necessarily, the less oblivious you are. The more oblivious (or relaxed) you are, then, necessarily, the less paranoid you are. In the face of potentially dangerous yet ambiguous situation, which our ancestors must have encountered repeatedly, the human mind is designed to be more paranoid and less oblivious.

This problem is known in engineering as *the smoke detector principle* (Nesse, 2001). A smoke detector is an inference system, designed, not by evolution by natural and sexual selection as the human mind is, but by human engineers. Just like the human mind’s inference system, smoke detectors can make errors of inference. It can sound the alarm, “thinking” that there is fire, when there isn’t (Type I error of false positive), or it can remain silent, “thinking” there is no fire, when there is (Type II error of false negative). As the  $2 \times 2$  table in Figure 2 shows, the consequence of Type I error is that you are woken up in the middle of the night by the fire alarm, when there is no fire. The consequence of Type II error is that you sleep through the fire and are potentially burned to death.

As annoying as it is to be repeatedly woken up by false alarm at three o’clock in the morning, the annoyance, even repeated annoyance, is a small price to pay compared with what could happen

<sup>2</sup> The error management theory conceives of both the true state of nature and inference as strictly dichotomous. The true cause of the ambiguous stimulus is *either* personal, animate and intentional, *or* impersonal, inanimate and unintentional. An individual’s inference for the cause of the ambiguous stimulus is *either* personal, animate and intentional, *or* impersonal, inanimate and unintentional. The theory does not conceive of any “gray area” between the dichotomous possibilities. However, some religious scholars and authorities (including the current official doctrine of the Roman Catholic Church) suggest that an observed phenomenon in nature, such as evolution, can begin with a supernatural intention and intervention but then follow the laws of nature once it starts. This is a topic that I am neither qualified nor interested to discuss.

		True state of nature	
		Fire	No fire
Inference	Fire!	Correct inference	False positive (Type I) error Consequence = woken up in the middle of the night
	No fire	False negative (Type II) error Consequence = potential death	Correct inference

Figure 2. The smoke detector principle. See the online article for the color version of this figure.

if the smoke detector makes one fatal Type II error of not sounding the alarm when there is fire. So engineers deliberately design smoke detectors to make a large number of Type I errors of sounding alarm when there is no fire, to make sure that it would never ever make a single fatal Type II error of remaining silent when there is fire. Smoke detectors are therefore intentionally designed to be extremely sensitive to any potential smoke or fire. Just like the human mind, smoke detectors are designed to be “paranoid.”

This evolutionary psychological theory therefore suggests that the human inference system may have been designed by evolution to operate like a smoke detector. It may be designed to make as few Type II errors as possible, and, as a necessary and unavoidable design feature, to make many Type I errors. This theory suggests that the evolutionary origins of religious beliefs in supernatural forces may have come from such an innate cognitive bias to commit Type I errors rather than Type II errors, and thus to overinfer personal, animate, intentional forces behind otherwise perfectly natural phenomena. This tendency underlies the “animistic bias” (Guthrie, 1993) or the “agency-detector mechanism” (Atran, 2002). These tendencies happen because evolution employs the same “smoke detector principle” that engineers use, to minimize, not the total *number* of errors the inference system makes, but the total *cost* of such errors.

You see a bush on fire. It could have been caused by an impersonal, inanimate, and unintentional force (lightning striking the bush and setting it on fire). Or it could have been caused by a personal, animate, and intentional force (God trying to communicate with you). The “animistic bias” or “agency-detector mechanism” predisposes you to opt for the latter explanation rather than the former. It predisposes you to see the hands of God (an animistic and intentional agent) at work behind otherwise natural, physical phenomena whose exact causes are unknown.

In this view, religiosity—the human capacity for belief in supernatural beings—is not an adaptation per se. It is instead a *byproduct* of the animistic bias or the agency-detector mechanism, the tendency to be paranoid, which *is* an adaptation that evolved for the purpose of saving your life. Humans did not evolve to be religious; they evolved to be paranoid. And humans are religious, in this view, because they are paranoid.<sup>3</sup>

A recent fMRI study in Finland (Riekk, Lindeman, & Raij, 2014) supports this explanation for the evolutionary origin of religiosity. Believers in supernatural beings are more likely to

attribute intentions to random movements of geometric figures than nonbelievers are. Precisely as predicted by the evolutionary psychological explanation of religiosity as a byproduct, believers activate the theory of mind module in their brain when they view 2D animations of geometric objects and believe that such figures move intentionally. Similarly, Crowell and Dole (1957) find that more intelligent college students are less animistic in their thinking than their less intelligent classmates. Given that (as discussed below) less intelligent individuals are more religious than more intelligent individuals (Kanazawa, 2010a; Zuckerman, Silberman, & Hall, 2013), Crowell and Dole’s findings also support the religiosity-as-byproduct explanation. These findings suggest that religiosity may have its origin in the overinference of intentions and overapplication of theory of mind to otherwise random or natural phenomena.

### Religiosity as a Tertiary Adaptation

Two separate teams of positive psychologists have recently and independently proposed an entirely different explanation for religiosity as a universal human trait. These theories suggest that religiosity might have evolved as a tertiary adaptation, which promotes and facilitates the operation of secondary adaptations, which in turn aid the execution of primary adaptations that humans have been selected to possess to survive and achieve reproductive success.

In their attempt to explain the positive mood offset—the ubiquitous phenomenon where most individuals are in a mildly positive mood most of the time—Diener, Kanazawa, Suh, and Oishi (in press) suggest that humans may have been selected to be mildly happy under normal circumstances, in the absence of stimuli that produce negative moods, because happier individuals are more likely to execute their primary adaptations. For example, happier individuals are more likely to seek and maintain beneficial social relationships, get married and stay married, have better health, live longer, have more children, and invest more in grandchildren. Positive mood offset may therefore have been selected, and most people are mildly happy most of the time as a result, because it promotes adaptive behavior and allows individuals to execute their primary adaptations more efficiently.

Similarly, Heintzelman and King (2014) suggest that “life is pretty meaningful” and most individuals perceive meaning and purpose in their lives because it is a necessity for survival in the sense that individuals who experience meaning and purpose in their lives are more likely to engage in adaptive behavior.

Pairing pleasure with adaptive behaviors is evolution’s way of getting us to do the things we must do to survive. . . . In this sense, this experience we call meaning in life might well help to solve adaptive

<sup>3</sup> This, of course, is the modern variant of “Pascal’s wager.” The 17th-century French philosopher Blaise Pascal (1623–1662) argued that, given that one cannot truly know for sure whether God exists, it is nonetheless rational to believe in God. If one does not believe in God when He indeed exists (Type II error of false negative), one must spend eternity in hell and damnation. In contrast, if one believes in God when he actually does not exist (Type I error of false positive), one only wastes a minimal amount of time and effort spent on religious services. The cost of committing Type II error is much greater than the cost of committing Type I error, so one should rationally believe in God.

problems, directing attention and behavior toward survival-relevant ends. (Heintzelman & King, 2014, p. 570)

Both Diener et al. (in press) and Heintzelman and King (2014) therefore suggest that positive mood offset and meaning and purpose in life may have evolved as *secondary* adaptations which facilitate the execution of *primary* adaptations that promote survival and reproductive success.

There is by now abundant evidence that religious individuals experience higher levels of subjective well-being and meaning and purpose in life. For example, individuals with stronger religious faith experience greater life satisfaction (Ellison, 1991) and religious beliefs and behavior improve mental health (James & Wells, 2003). The frequency of personal prayer is positively associated with psychological well-being both among students (Maltby, Lewis, & Day, 1999) and in a community sample (Maltby, Lewis, & Day, 2008). Religiosity is positively associated with subjective well-being both in the U.S. and throughout the world, especially in more religious nations (Diener, Tay, & Myers, 2011). The effect of religiosity on happiness may be greater among political conservatives than among political liberals (Bixter, 2015).

Similarly, more religious Americans experience greater meaning and purpose in life (Cranney, 2013; Stroope, Draper, & Whitehead, 2013). Religiosity increases meaning in life both in the U.S. and in all regions of the world (Diener et al., 2011). In fact, religiosity increases meaning in life so much that residents of poorer nations have greater sense of meaning in life than residents of wealthier nations simply because they are more religious (Oishi & Diener, 2014). It is therefore possible to suggest that religiosity may function as a *tertiary* adaptation, which facilitates the *secondary* adaptations of subjective well-being and meaning/purpose in life, which in turn aid and promote the more efficient execution of *primary* adaptations that have evolved to increase the chances of survival and reproductive success.

There is one crucial difference between primary adaptations and higher-order (secondary and tertiary) adaptations. All primary adaptations—physical or psychological—are domain-specific (Tooby & Cosmides, 1992). They are designed to solve adaptive problems, and all adaptive problems occur in specific domains of life, such as social exchange, interpersonal relations, mate selection, and parenting. There are no domain-general primary adaptations, because there were no domain-general adaptive problems throughout human evolutionary history. All adaptive problems occurred in specific domains of life, and called for specifically designed solutions in the form of domain-specific primary adaptations (Williams, 1996).

In sharp contrast, higher-order adaptations are domain-general, because they do not solve domain-specific adaptive problems directly. Instead, they help solve adaptive problems *indirectly*, by facilitating the execution of primary adaptations that do solve domain-specific problems. General physical health may be an example of a secondary (physical) adaptation. Health (the absence of debilitating physical ailment) does not by itself solve any adaptive problem, but healthy individuals are better able to execute many of their primary adaptations more efficiently. Healthy individuals are better able than less healthy individuals to seek and obtain food, maintain their social relationships with friends and allies, select and keep mates, engage in sexual intercourse more frequently, and reproduce and invest in their offspring. The ben-

eficial effects of health on survival and reproduction are not direct or domain-specific, but instead indirect and domain-general, by facilitating the more efficient execution of primary adaptations in specific domains.

Nevertheless, if the existence of secondary adaptations is statistically associated with more efficient execution of primary adaptations, and thus greater chances of survival and reproductive success, over the course of human evolution, then individuals should be statistically more likely to possess secondary adaptations because of their indirect effects on survival and reproductive success. Similarly, if the existence of tertiary adaptations is statistically associated with a greater likelihood of possessing secondary adaptations, then individuals should be statistically more likely to possess tertiary adaptations for their indirect effect on survival and reproductive success *through secondary adaptations*. However, the statistical associations should become weaker as the higher-order adaptations become more removed from the primary adaptations, as they all gain their effects on survival and reproductive success through their statistical associations with the ultimate evolutionary outcomes of survival and reproductive success. The more removed higher-order adaptations are from primary adaptations (the higher the order), the weaker their effects on survival and reproductive success become and the weaker the forces for their selection during evolution.

If religiosity—belief in gods and supernatural beings—increases happiness and meaning/purpose in life, and *if* happiness and meaning/purpose in life facilitate adaptive behavior such that happier individuals with a greater sense of meaning and purpose in life live longer and achieve greater reproductive success (Diener et al., in press; Heintzelman & King, 2014), then religiosity can be a tertiary adaptation, which may be selected because the secondary adaptations of happiness (positive mood offset) and meaning/purpose in life are selected for their effects on adaptive behavior. Religiosity may be evolutionarily selected among humans for its *indirect* effect on survival and reproductive success through its effect on subjective well-being and meaning/purpose in life.

There is indeed substantial epidemiological evidence to show that more religious individuals stay healthier and live longer (Hall, 2006; Hill & Pargament, 2003; McCullough, Hoyt, Larson, Koenig, & Thoresen, 2000; Miller & Thoresen, 2003; Powell, Shahabi, & Thoresen, 2003; Seeman, Dubin, & Seeman, 2003). There is also some demographic evidence that, at least in the United States, religiosity increases fertility *regardless* of the religious denomination (Hayford & Morgan, 2008; Zhang, 2008). So it is not at all unreasonable to suggest that religiosity may have been evolutionarily selected for its indirect effect on survival and reproductive success.

### Potential Objections to the New Theory of Religiosity as a Tertiary Adaptation

There are a couple of potential objections to the new theory presented above, which explains the evolution of religiosity as a tertiary adaptation.

First, some evolutionary biologists are very strict about the use of the term “adaptation” and believe that it should be invoked very sparingly, only when a very narrow set of conditions are met (Williams, 1996). The critics might argue that the concept of secondary and tertiary adaptations introduced here do not meet

such stringent requirements, especially since, as mentioned above, it lacks one key defining feature of (primary) adaptations: domain specificity.

In response to such a criticism, it is not necessary that the theory refer to subjective well-being and meaningful/purposeful life as secondary *adaptations* or religiosity as a tertiary *adaptation*. What is important is not the terminology, but the proposed causal mechanism that can potentially explain the evolution of religiosity as a universal feature of the evolved human mind. The theory works just as well if it refers to subjective well-being and meaningful/purposeful life as “primary facilitating conditions” and religiosity as “secondary facilitating condition.” What is important is the statistical association between higher subjective well-being and meaning/purpose in life, on the one hand, and survival and reproductive success, on the other, *and* the statistical association between greater religiosity and higher subjective well-being and meaning/purpose in life. As long as such statistical associations reliably existed throughout most of human evolutionary history, then religiosity will evolve via proposed causal mechanisms and become part of universal human nature, regardless of the terminology used.

The key contention of the theory is that religiosity has been *evolutionarily selected* because of its *indirect* effect on survival and reproductive success. In evolutionary biology, traits that are evolutionarily selected for their functions are called adaptations, but the proposed theory and mechanism will work just as well if they are called otherwise.

Second, critics might argue that subjective well-being, meaning/purpose in life, and religiosity cannot be (higher-order) adaptations, because there are significant individual differences in all of them, whereas adaptations are species-typical and constant in all members of the species. The fact that some individuals experience higher levels of subjective well-being, meaning/purpose in life, and religiosity than others, the critics argue, means that they are not adaptations.

This criticism betrays profound misunderstanding of the nature of adaptations (Kanazawa, 2010b, pp. 283–284; Sosis, 2009, pp. 326–327). A trait could simultaneously be an evolved adaptation and exhibit significant individual differences. In fact, *most adaptations exhibit individual differences*. Full-time bipedalism is a

uniquely human adaptation, yet some individuals walk and run faster than others. The eye is a complex adaptation, yet some individuals have better vision than others. Language is an adaptation, yet some individuals learn to speak their native language at earlier ages and have greater linguistic facility than others.

Individual differences in the efficiency and execution of adaptations are what Tooby and Cosmides (1990) call random quantitative variation on a monomorphic design. “Because the elaborate functional design of individuals is largely monomorphic, our adaptations do not vary in their architecture from individual to individual (*except quantitatively*) [emphasis added]” (Tooby & Cosmides, 1990, p. 37). It is therefore possible (and usually likely) for a trait to be both universal and species-typical (exhibiting virtually no variation in the architecture in a cross-species comparison) *and* to manifest vast individual differences in quantitative performance among members of a single species. General intelligence may be an example of such an adaptation (Kanazawa, 2004, 2010b).

### Empirical Test of the Theory of Religiosity as a Tertiary Adaptation

More research is necessary before we can empirically adjudicate between the two evolutionary psychological theories of the origin of human religiosity, especially since the theory of religiosity as a tertiary adaptation is very new, based on the recent work of Diener et al. (in press) and Heintzelman and King (2014). Evidence of more religious (or less intelligent) individuals’ greater inference of agency behind natural phenomena and greater use of theory of mind toward inanimate objects, of the kind documented by Riecki et al. (2014) and Crowell and Dole (1957), would favor the religiosity-as-byproduct explanation. On the other hand, evidence of religious individuals’ greater chances of survival and reproductive success, of the kind documented by Hayford and Morgan (2008), Hall (2006), Hill and Pargament (2003), Miller and Thoresen (2003), McCullough et al. (2000), Powell et al. (2003), Seeman et al. (2003), and Zhang (2008), would favor the religiosity-as-tertiary-adaptation explanation.

Figure 3 represents the theory of religiosity as a tertiary adaptation in a causal diagram. As discussed above, the theory proposes that

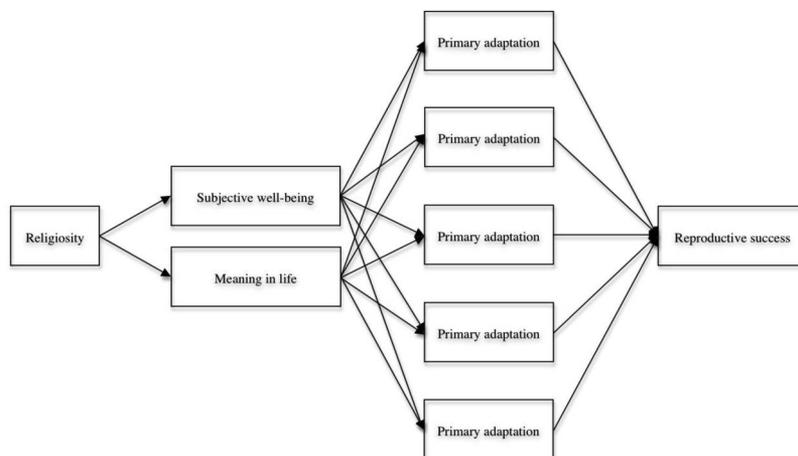


Figure 3. The theory of religiosity as a tertiary adaptation.

religiosity—belief in gods or supernatural beings—simultaneously increases subjective well-being and meaning in life, which in turn facilitate the efficient functioning of a large number of primary adaptations in various domains of life, all of which are evolutionarily designed to increase reproductive success via more efficient functioning of primary adaptations.

The effects of various primary adaptations (such as mate selection modules, parenting modules, cheater detection module, etc.) on reproductive success have been widely documented by a large number of evolutionary psychological studies, and lie outside of the primary focus of the current theory. An empirical testing of the theory begins by measuring respondents' religiosity at Time 1, their subjective well-being and meaning in life at Time 2, efficiency of the execution of various adaptations (measured, for example, by the number of sexual partners, frequency of sex, investment in offspring, number of friends and allies, etc.) at Time 3, and then their reproductive success (measured, most commonly, though not exclusively, by the number of children who reach sexual maturity) at Time 4. The theory predicts that there are significantly positive associations among all the measured variables, most importantly among religiosity, subjective well-being, meaning in life, and reproductive success. Further, the theory proposes that the association between religiosity and reproductive success, documented in Hayford and Morgan (2008) and Zhang (2008), is *entirely* mediated by subjective well-being and meaning in life. Religiosity should therefore have no significant effect on reproductive success, once subjective well-being and meaning in life are statistically controlled. The new theory of religiosity as a tertiary adaptation awaits rigorous empirical testing.

### Religiosity and Intelligence

Although the two theories have divergent empirical implications that must be tested in future research, they also make some common predictions. Both explanations suggest that religiosity is deeply evolutionarily familiar, being part of universal human nature, either as an evolutionary byproduct or a tertiary adaptation. If religiosity is evolutionarily familiar, and if humans are evolutionarily designed to believe in supernatural beings, then there should be a negative association between intelligence and religiosity.

The Savanna-IQ Interaction Hypothesis (Kanazawa, 2010a, 2010b, 2012) posits that, because general intelligence likely evolved as a domain-specific adaptation to solve evolutionarily novel problems that our ancestors did not routinely encounter (Kanazawa, 2004), more intelligent individuals are better able than less intelligent individuals to comprehend and deal with evolutionarily novel entities and situations, whereas intelligence has no effect on the human ability to recognize and comprehend evolutionarily familiar entities and situations. Some of the entities and situations that more intelligent individuals are better able to comprehend and deal with may form the basis of individual preferences and values, as it would be very difficult to prefer or value something that one does not truly comprehend. As a result, the Savanna-IQ Interaction Hypothesis predicts that more intelligent individuals are more likely than less intelligent individuals to acquire and espouse evolutionarily novel preferences and values that our ancestors did not have.

If religiosity is part of evolved human nature, and thus evolutionarily familiar, then atheism would be an evolutionarily novel

value. The Savanna-IQ Interaction Hypothesis would then predict that more intelligent individuals are more likely than less intelligent individuals to acquire and espouse atheism as a value.<sup>4</sup>

This indeed appears to be the case. Across all nations in the world, the average intelligence of the population is negatively associated with the level of religiosity (Kanazawa, 2009; Lynn, Harvey, & Nyborg, 2009). At the individual level, more intelligent children are more likely to grow up to be atheists than less intelligent children (Kanazawa, 2010a).

Figure 4 presents data from the National Longitudinal Study of Adolescent Health (Add Health). Add Health measures childhood intelligence at Age 16 with an abbreviated version of the Peabody Picture Vocabulary Test. Young adults (in their early 20s) who identify themselves as “very religious” have the average childhood IQ of 97.14 in junior high and high school. In contrast, young adults who identify themselves as “not at all religious” have the average childhood IQ of 103.04. And the negative association between childhood intelligence and adult religiosity is monotonic. Because these are means from a large sample of Americans ( $n = 15,197$ ), the difference of 6 IQ points separating the two extreme categories is very large and statistically significant ( $p < .000001$ ). Even though studies have shown that women are much more religious than men (Miller & Hoffmann, 1995; Miller & Stark, 2002), the Add Health data show that the effect of childhood intelligence on adult religiosity is twice as large as the effect of sex (standardized coefficient =  $-.1821$  vs.  $-.0910$ ). It is remarkable that childhood intelligence is a significant determinant of adult religiosity even when religion itself (whether the Add Health respondent is Catholic, Protestant, Jewish, or other, with “no religion” as the reference category) is statistically controlled (Kanazawa, 2010a).

The results presented above (and in Kanazawa, 2010a) are consistent with the recent meta-analysis of 63 studies, which shows that the mean of correlation between intelligence and the strength of religious beliefs is  $r = -.24$  (Zuckerman et al., 2013). The negative effect of childhood intelligence on adult religiosity is therefore well documented and indisputable. However, as mentioned above, it equally supports the religiosity-as-byproduct and religiosity-as-tertiary-adaptation explanations. It suggests that religiosity is deeply evolutionarily familiar and part of evolved human nature. Other lines of evidence will be necessary to adjudicate between the two theories of the evolution of religiosity presented above.

### Conclusion

In this article, I survey two evolutionary psychological explanations for the evolution of religiosity. There are many evolutionary psychological theories of religious behavior and religious organizations (Wilson, 2002; see Footnote 1), and there are many

<sup>4</sup> It is important to note that the Savanna-IQ Interaction Hypothesis does *not* claim that general intelligence is the only or a primary or even a major determinant of religiosity, merely that general intelligence has a statistically significant effect on acquiring and espousing evolutionarily novel values including atheism. There are undoubtedly many other determinants of individual differences in religiosity. For example, Miller (Miller & Hoffmann, 1995; Miller & Stark, 2002) has convincingly demonstrated that the sex difference in risk preference largely accounts for the sex difference in religiosity.

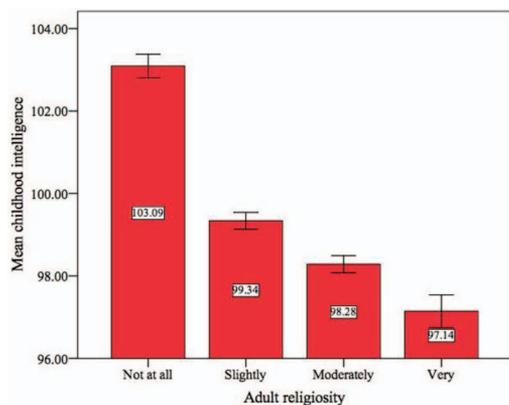


Figure 4. Association between childhood intelligence and adult religiosity (error bars represent one standard error). See the online article for the color version of this figure.

nonevolutionary theories of religiosity (see other contributions to this special issue). However, to the best of my knowledge, the two surveyed here are the only *evolutionary psychological theories of religiosity* that propose that religiosity increases reproductive success either directly (as an adaptation) or indirectly (as a byproduct). An extant theory suggests that religiosity may be a byproduct of an evolved cognitive bias to overinfer agency and intention behind otherwise natural or random phenomena (Atran, 2002; Guthrie, 1993; Haselton & Nettle, 2006). In this view, religiosity is itself not an adaptation, because it does not directly affect survival or reproductive success, but instead a byproduct of the adaptation—the animistic bias or the agency-detector mechanism—which does facilitate survival. Humans are designed to be paranoid, and they believe in god because they are paranoid.

A new theory proposes that religiosity may have evolved as a tertiary adaptation, which was selected because of its statistical association with two secondary adaptations—subjective well-being and meaning/purpose in life, which in turn were selected because of their effect on a variety of primary adaptations which aid survival and reproductive success. In this view, more religious individuals are simultaneously happier and experience greater sense of meaning and purpose in life, and individuals who are happier and experience greater sense of meaning and purpose in life are more likely to execute a large number of primary adaptations which facilitate survival and reproductive success (Diener et al., in press; Heintzelman & King, 2014). They are more likely to establish and maintain beneficial social relationships, get married and stay married, have more children, and invest in grandchildren.

Although future research is necessary to adjudicate between the two evolutionary psychological theories of the evolution of religiosity—especially since one of them is very new—both theories suggest that religiosity is part of evolved human nature and thus evolutionarily familiar. The Savanna-IQ Interaction Hypothesis suggests that more intelligent children are more likely to grow up to be atheists than less intelligent individuals are, and a large number of studies confirm this prediction. These findings, however, equally support the two theories surveyed here and do not help adjudicate between them.

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