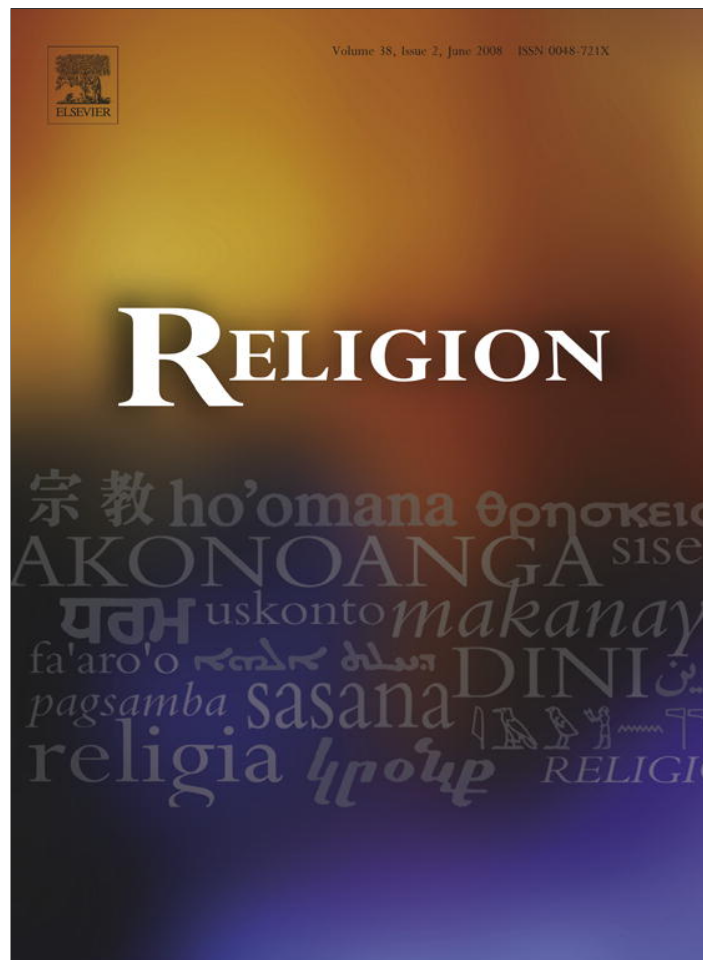


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ELSEVIER

Religion 38 (2008) 141–156

RELIGION

www.elsevier.com/locate/religion

Adaptation, evolution, and religion

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Abstract

Neo-Darwinian theories of religion include both nonadaptationist and adaptationist versions. Nonadaptationist versions contend that the mental architecture of the brain is wired for religious thinking but that religious concepts have piggybacked on other cognitive adaptations, especially those for agency detection. Religious concepts are not evolved biological adaptations but rather by-products of more general cognitive structures that are adaptations. Adaptationist versions concentrate on the benefits provided by religion, such as increased social cohesion and the individual benefits that stem from it, such as better physical and mental health and greater longevity. After clarifying the meaning of the terms “adaptation” and “adaptationism,” this article presents four lines of evidence in favor of the adaptationist position: (1) in the ancestral environment the role of the shaman was nearly universal and was primarily devoted to the crucial human goals of curing illness and protecting and finding vital resources; (2) religion generally has positive effects on both physical and mental health; (3) religions tend to be pro-natalist and more religious people tend to leave more offspring than less religious or nonreligious people; (4) the major world religions that evolved in the first millennium BCE during a period of major social chaos and disruption emphasized an omnipotent, transcendent God of love and mercy who offered salvation in a heavenly after-life and released individuals from earthly suffering. None of these facts demonstrate conclusively that cognitive modules specifically oriented to supernatural agents evolved by natural selection, but they are highly suggestive and make a good inferential case.

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Keywords: evolution; adaptation; by-product; shamanism; reproductive success; health

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doi:10.1016/j.religion.2008.01.003

In recent years there has been much important work on the biological foundations of religion by evolutionary and cognitive anthropologists and evolutionary psychologists (for example, Boyer, 2001; Atran, 2002; Atran and Norenzayan, 2004; Whitehouse, 2004; Kirkpatrick, 2005; Liénard and Boyer, 2006; Boyer and Liénard, 2006). The most influential of these works argue that religion is a by-product of other cognitive structures, which are themselves adaptations, whereas others argue that religious beliefs and rituals evolved as part of the human mental architecture because they were adaptive in one or more ways. After summarizing these approaches, this paper examines the concepts of “adaptation” and “adaptationism” and then proceeds to make a case for the adaptationist position. It does so by pointing to four lines of evidence showing that religion is adaptive. The adaptiveness of a social institution or practice does not prove that it evolved as an adaptation, but it does make a good inferential case.

I define religion simply as *beliefs and rituals associated with and focused around postulated supernatural beings and forces*, and begin by looking at those theorists who see religious thinking as a nonadaptive cognitive by-product.

By-product approaches to religion

The two leading by-product theorists, Pascal Boyer (2001) and Scott Atran (2002), reject such traditional theories of religion as: religion explains the otherwise unexplainable; religion reduces anxiety and provides comfort; or religion integrates society. These theories, they argue, are at best partial explanations and fail as *general explanations* of religion. For example, religious explanations are often more puzzling than illuminating and they often create more anxiety than they reduce. Moreover, salvation or release from suffering has not been a preoccupation of most religions in most societies across time and space, and in many societies mortality is not considered unbearable and death does not make existence seem pointless. Also, conventional explanations fail to tell us why there is such a wide range of supernatural agents.

According to Boyer and Atran, the key feature of religious concepts is that they involve *counterintuitive* beliefs in supernatural agents, and these agents are for the most part structured by our natural intuitions concerning *agency*. Humans have cognitive adaptations for agency in the sense that they recognize that persons and animals have goals and pursue various means to reach them. They cause things to happen. However, humans have a very strong tendency to extend their natural intuitions about agency beyond persons and animals to many features of nature, such as the sun, moon, or wind. They seem to have a bias to assume that, if the wind blows, it is because there is some agent that is causing it to blow, and to blow for some reason or purpose.

One of humans' most important cognitive modules is therefore an *agency-detection module*, and this module is biased toward overdetection. Because of our evolutionary heritage, we need to be able to detect both predators and prey, and it is far better to overdetect than to underdetect because the costs of not detecting agents when they are around are much greater than the costs of detecting them when they are not around. In the ancestral environment, it was highly adaptive for humans to know what animals or other humans might be around and capable of doing them harm.

For by-product theory, in the evolution of the human brain there was no specific evolutionary selection for religious concepts. Thus there is no special religious center in the brain, no network of neurons that is specialized for handling thoughts about supernatural entities. Religious

concepts have piggybacked on the extremely adaptive evolutionary imperative to look out for predators, whether dangerous beasts or dangerously manipulative and deceptive humans. It is this cognitive module that generates universal cognitions involving supernatural demons, ghouls, goblins, vampires, and the like.

Lee Kirkpatrick (2005) offers another type of by-product theory, applying John Bowlby's classic attachment theory to explain certain features of religious belief and behavior. For Kirkpatrick, many religious notions are extensions or generalizations of the parent–child bond. Supernatural agents are seen as protectors from harm in much the same way that parents are. Kirkpatrick points out that people in modern societies often turn to religion in times of psychological distress and crisis, such as personal catastrophes, serious illness or injury, and death and grieving. He notes that much of Christian scripture, for example, reveals the importance of God in providing “a shield” or “strength”.

Kirkpatrick stresses that God or gods are primarily *substitute attachment figures* for natural attachment figures, i.e., fathers, mothers, and other close kin. The feeling of a relationship with God or gods is most likely to be activated, therefore, when an individual's sense of security, safety, and freedom from anxiety falls below a certain threshold as a result of natural attachments being inadequate to life's challenges. Thus, children who fail to develop adequate attachments to parents should be more likely than other children to develop an attachment to God. Kirkpatrick calls this the *compensation hypothesis*.

Like Boyer and Atran, Kirkpatrick contends that there is no specifically religious module (or set of modules) in the brain and that religious beliefs are by-products of cognitive modules for agency detection. Kirkpatrick points out that, although religion seems to function in important ways to provide a sense of security, reduce anxiety, and improve physical and mental health, *these are not the currency of Darwinian selectionist thinking*. That currency, as we very well know, is *reproductive success*. As Kirkpatrick correctly notes, evolution by natural selection is not about increasing an organism's happiness but about increasing the representation of its genes in present and future generations.

Adaptationist approaches

An intriguing adaptationist argument for religious ritual has been developed by Richard Sosis (2003). Following up on William Irons' (2001) suggestion that religious rituals are “hard to fake” indicators of commitment, Sosis uses costly signaling theory to explain why religious rituals are so important in all religions. According to Sosis, ritual is the primary mechanism through which religious communities maintain beliefs among their members. Since relaxed rituals are not especially costly to perform, they are “easy to fake,” and this makes such communities easily invaded by free-riders who seek to reap the benefits of religious membership while paying low costs. Demanding rituals, on the other hand, are costly and thus much more difficult to fake.

When religious communities ask their members (including prospective members) to pay such costs, they are in essence asking them for clear signs of commitment. Continued participation in costly rituals actually serves to create or intensify religious belief. At the same time, strong believers come to evaluate ritual performances as less costly than those whose beliefs are weaker. For strong believers, ritual performance is seen as less of a burden, and, moreover, the

opportunity costs of engaging in other behaviors are lower. They thus receive a large payoff in religious group membership, whereas those who cannot muster a sufficient level of belief and commitment tend to drop out. Thus, in enhancing belief and commitment, costly, hard to fake rituals contribute to interpersonal trust and social cohesion.

Alcorta and Sosis (2005) argue that the key benefit of religion is that it enhances group cooperation, and this in turn has individual fitness benefits. They are fully aware of the arguments of thinkers like Boyer and Atran, and actually seem to agree with many of them. They agree that religion is all about counterintuitive beliefs and rituals, and that religious systems engage mental modules regarding agency. However, they do not think that this precludes these counterintuitive beliefs from being adaptive. A major means of determining whether something is an adaptation or a by-product is to look for clear evidence of complex design. Alcorta and Sosis believe they can see such evidence in several features of religion. Religious beliefs seem to go well beyond cognitive modules for agency detection. Natural category agents possess information, but that information is always limited and sometimes unreliable. Supernatural agents, by contrast, are perceived to be *full access strategic agents* (Boyer, 2001), or agents that “possess knowledge of socially strategic information, having unlimited perceptual access to socially maligned behaviors that occur in private and therefore outside the perceptual boundaries of everyday human agents” (Alcorta and Sosis, 2005, p. 327).

Alcorta and Sosis agree with the by-product theorists that there is no specifically religious module in the brain, saying that “the assertion that the cognitive and emotional mechanisms that produce religious behaviors did not evolve for such purposes [is] a position we are in agreement with” (Sosis and Alcorta, 2004, p. 749). Religion has indeed been hitching a ride on other cognitive mechanisms. However, for them these mechanisms are not agency detection, but rather ritualized communication. The capacity for ritualized communication is an evolved adaptation in humans and in many other animal species, but the specifically *religious* nature of rituals is uniquely human and is a response to socioecological conditions (Alcorta and Sosis, 2006). As these conditions change, the nature of rituals (and corresponding beliefs) also changes.

Alcorta and Sosis are at pains to stress that religion is not a “functionless by-product,” and claim that this is one of the main differences between their position and that of the by-product theorists. However, by-product theorists do not assume that all elements of religion are functionless; on the contrary, both Boyer and Atran have stressed that a central element of religion is its invocation in dealing with existential anxiety, and Kirkpatrick sees gods as providing beneficial psychological consequences in the form of attachments.

Since Alcorta and Sosis do not envision the brain as having any specifically religious architecture, their adaptationism might be regarded as something of a halfway point between the by-product theorists and other adaptationists, who do invoke a “religious neuroanatomy and neurophysiology”. Harris and McNamara (2008) are adaptationists in this sense. They identify three criteria whereby a trait can be considered an adaptation: it is a cultural universal, is acquired effortlessly, and has an “associated biology,” i.e., a known set of genetic, anatomical, or physiological systems. They point out that the first two criteria are easily met. Religion has been found everywhere at all times, and children acquire religious beliefs with extraordinary ease. The third criterion is more difficult to meet, but Harris and McNamara point to research showing that religiosity appears to be moderately to highly heritable (they suggest a heritability coefficient of 0.28 to 0.72); to neuroimaging studies indicating that parts of the brain high in the frequency of

dopamine receptors, especially the prefrontal cortex, seem to be associated with religious experience; and to pharmacological studies showing that the DRD4 gene correlates positively with different measures of religiosity.

Brain neurochemistry is also invoked in the adaptationist positions of Michael Winkelman (1990, 2000) and James McClenon (2002). In the earliest religions the key practitioner was a part-time religious specialist known as a *shaman*, whose activities and their possible biological basis have been studied in considerable detail by these two social scientists. According to Winkelman, the shaman has been found throughout the world and is universal in hunter-gatherer societies. The shaman performed a variety of activities: healing and curing of illness, divination, protecting and finding game animals, communicating with the dead, recovering lost souls, and protecting people from evil spirits and the practitioners of malevolent magic. Shamans also went on “soul flights” and “vision quests”. Winkelman (2000, p. 71) contends that the striking similarities among shamanistic practices all over the world

... cannot be explained by diffusion. The fundamental similarities across time, space, and cultures in the phenomena of shamanism indicates that these traditions develop from a common psychobiological basis. The cross-cultural distribution of fundamental aspects of shamanism reflects an underlying psychobiological basis and its adaptive consequences. These universal and cross-cultural characteristics of shamans reflect biosocial and neurophenomenological structures that constitute the primordial basis for religion.

Like Winkelman, McClenon points out that shamanic healing rituals are strikingly similar all over the world. They typically involve a great deal of rhythmic repetition, especially chanting, singing, drumming, and dancing, which are able to induce altered states of consciousness and “anomalous experiences”. Such altered states can produce high levels of relaxation and benefits for physical and psychological health. McClenon points to research indicating the existence of a so-called “shamanic syndrome,” which is “characterized by hypnotizability, dissociative ability, propensity for anomalous experience, fantasy proneness, temporal-lobe lability (measured by EEG), and thinness of cognitive boundaries” (McClenon, 2002, p. 134).

Deconstructing adaptationism

Thus far we have discussed by-product versus adaptationist approaches to religion without delving into the concepts of “adaptation” or “adaptationism” themselves. Let me begin by making a simple distinction between calling a trait *an adaptation* and calling it *adaptive*. Perhaps the most common definition of an adaptation is that it is a trait that has arisen by natural selection because it promotes the survival and reproductive success of the organisms containing it (cf. Buss et al., 1998). Because the trait promotes both survival and reproduction, it is therefore said to be adaptive. The concepts of adaptation and adaptive are therefore joined in a single larger meaning. However, they do not always need to be, and sometimes cannot be. Some qualifications are therefore essential. As Timothy Shanahan (2004) has pointed out, to characterize something as an adaptation is to say something about its *origin* or *causal history*, but to call something adaptive is to characterize its *current usefulness*. Shanahan uses the simple example of the human appendix. The appendix is presumably an adaptation, which is to say that at some point in human

evolutionary history it arose by means of natural selection. However, to the very best of our current biomedical knowledge, it is not an adaptive organ because it can easily be removed without the organism in question suffering in any way. In other words, it arose as an adaptation but no longer is.

Similarly, it is possible to say that a trait is adaptive without it ever having been an adaptation. For one thing, not every trait arises by natural selection. Some traits become fixed in a population by means of genetic drift, and others develop because they are part of the basic body plan of an organism, thus “hitching a ride” on other traits that are, presumably, adaptations. And there is a third possibility, which is that a trait is adaptive and arose by natural selection, but its current adaptive function is not the basis for it having arisen as an adaptation by natural selection. Feathers, for example, arose as adaptations that had the adaptive function of providing warmth; only later were they reengineered by natural selection to have a different adaptive function, that of forming themselves into wings and tail feathers for the purpose of flight. Gould and Vrba (1982) and Gould (1991) have coined a special term for this last type of function: an *exaptation*.

What, then, is *adaptationism* as a scientific approach or strategy? It can be defined as the claim that the characteristics of organisms arise as adaptations by means of natural selection and persist because they fulfill adaptive functions. There are a number of complex conceptual problems here, but because space is short I shall restrict myself to the simple distinction, drawn originally by Peter Godfrey-Smith (1999, 2001) and taken up by Shanahan (2004), between *empirical adaptationism* and *methodological adaptationism*. Empirical adaptationism is the claim that natural selection is such a powerful evolutionary force that most of the characteristics of organisms have arisen by natural selection and thus are adaptations. Methodological adaptationism, by contrast, is not a claim about what we will actually find when we study the traits of organisms, but rather a strategic or methodological guidepost which tells us to proceed *as if* all or nearly all traits have arisen as adaptations by natural selection. Methodological adaptationism assumes that *the majority of traits* are likely to be adaptations, but it does not predetermine the matter. It simply tells us: start with the assumption that something is an adaptation, and then investigate it and see what you find.

Armed with methodological adaptationism, investigators can proceed in a variety of ways. Buss et al. (1998, p. 536) note that the “hallmarks of adaptation are features that define *special design* — complexity, economy, efficiency, reliability, precision, and functionality,” and Andrews et al. (2002, p. 497) indicate that a trait that is an adaptation should, in particular, “exhibit specificity and proficiency when in its evolutionary environment”. The eye, for example, is understood to be an adaptation because it has evolved independently in some 40 separate biological lineages and is a complex structure that reveals elaborate special design. Andrews et al. (2002) point out that the most important criterion for determining whether a trait is an adaptation is just this evidence of special design. Therefore, investigators would most likely begin by looking for such evidence. Other criteria for determining adaptation identified by Andrews et al. (2002) include “beneficial effects” and “fitness maximization”. A trait may be considered an adaptation if members of a species with the trait lead longer and healthier lives, and if they outreproduce individuals not possessing the trait.

It is my impression that in the history of evolutionary biology *methodological adaptationism* has been the default assumption and that by following it evolutionists have in fact discovered to their reasonable satisfaction that most biological traits are empirical adaptations. As is by now well

known, both methodological and empirical adaptationism have been severely challenged by Gould and Lewontin (1979) in their classic article on spandrels and so-called Panglossian adaptationism. In this article the authors maintain that many biological traits are not adaptations but rather products of the constraints imposed by the body plans of organisms. Adaptationism, they claim, often produces nothing more than “just so stories”. But this is, I think, very much a minority point of view. Few evolutionary biologists have accepted Gould and Lewontin’s strong conclusions (although they often concede that their arguments can serve as useful cautions against uncritical acceptance of adaptationism). Be that as it may, Kirkpatrick (2005), despite otherwise very cogent arguments, seems to be endorsing the kind of position advocated by Gould and Lewontin when he contends that by-product theory rather than adaptationism should be the default assumption in the evolutionary study of religion. I am at a loss to understand this claim, which has almost no warrant in the entire history of evolutionary biology or evolutionary psychology. At any rate, in the study of religion I urge us to be methodological adaptationists, not because I am sure that religion is an adaptation, but because this investigatory strategy has proved its worth in the past and thus deserves to be continued.

Is there, then, evidence for *empirical* adaptationism in the study of religion? Can we find evidence of special design in the many features of religion? Atran (2002) contends that, unlike such mental capacities as language, religious beliefs generally do not reveal any unambiguous evidence of special design. However, this may be unduly pessimistic. As Andrews et al. (2002) point out, if something shows evidence of specificity and proficiency in its evolutionary environment, this is suggestive of special design. We can therefore look at the nature of religious belief and ritual in the human ancestral environment. If there are strikingly similar beliefs and rituals in societies that typify this environment, then an inference of adaptation seems warranted. In addition, we can employ two of the other criteria suggested by Andrews et al. (2002), beneficial effects and fitness maximization. Does religious belief and ritual lead people to lead longer, healthier lives and to leave more offspring? A final way, at least for the purposes of this paper, would be to look at the evolution of major new religions and their success in attracting adherents. These religions can be probed for their principal concerns and the kinds of motives that people have for attaching themselves to them.

I begin by looking at the nature of religion in the human ancestral environment, which seems to provide evidence of special design.

Evidence that religion is an adaptation: religion in the ancestral environment

We noted earlier in referring to Winkelman’s work that the oldest religious practitioners are shamans. In the religions of the hunting and gathering ancestral environment, the shaman was usually the *only* religious practitioner, for which reason Anthony Wallace (1966) has called these religions *shamanic* religions. The key shamanic ritual was the curing ceremony, an event that Winkelman (2000, p. 61) describes as of “unparalleled importance in hunter-gatherer societies”. In this ceremony the shaman (Winkelman, 2000, pp. 61–62)

... brought the local community into interaction with the spirit world in a ritual charged with fear, awe, and other powerful emotional experiences [T]he shaman enacted struggles and

battles of animals and spirits, summoning spirit allies while beating drums, singing, chanting, and dancing violently and excitedly. Finally the shaman collapsed exhausted and, through magical flight, entered into the spirit world, ascending to the upper world and descending to the lower one to communicate with the spirits and to obtain their cooperation.

Shamanic practices assume the existence of a world populated by a wide variety of spirits that affect all aspects of human life. The shaman is able to control these spirits, which are in fact the vehicle through which he is able to accomplish his goals. Shamanic curing assumes that illness is the result of people having lost their souls or being under the influence of ghosts, spirits, witches, or malevolent acts performed by other shamans. Shamans appear to undergo altered states of consciousness that are trance-induced. Trances are induced by means of hallucinogens or opiates and other drugs; by hunger, thirst, the loss of sleep, or other forms of sensory deprivation; by extreme forms of sensory stimulation; or by various psychophysiological sensitivities that may result from nervous system imbalances.

Winkelman (2000) argues that shamanism is universal among hunter-gatherers because it is a product of a fundamental human neurophysiology interacting with the ecological conditions of the hunter-gatherer mode of subsistence. Winkelman (2000, pp. 77–78; emphasis added) explains:

Shamanistic traditions have arisen throughout the world because of the interaction of *innate structures of the human brain-mind* with the ecological and social conditions of hunter-gatherer societies. This is possible because this ASC [Altered State of Consciousness] basic to selection, training, and professional activities occurs spontaneously under a wide variety of circumstances. These ASC experiences can be induced naturally as a consequence of injury, extreme fatigue, near starvation, ingestion of hallucinogens, perceptions of natural phenomena, bioelectric discharges, or as a consequence of a wide variety of deliberate procedures that induce these conditions Consequently, shamanism was reinvented or rediscovered in diverse cultures as a result of those experiences and because the experiences *provide important adaptive capabilities*. These are illustrated in a functional relationship of ASC to shamanistic activities. This is derived from their *usefulness in meeting challenges to survival, including healing* through ASC-induced stress reduction and other physiological changes that enhance systemic integration of the information-processing strata of the brain The functional relationships of ASC to the shamanistic abilities of healing and divination derive from their *psychophysiological effects on biological processes* and social psychology. The uniformities in these practices worldwide are a result of the interaction of the *psychobiological mental potentials* with similar social conditions and *human needs*

The shaman's role in the evolution of human consciousness derives from *adaptive potentials* of ASC, animistic beliefs, visionary perceptions, soul flight, and death-rebirth experience. These *universal adaptations to biocognitive potentials* derived from systemic integration of brain functions. *Their biological structuring makes them neurognostic structures*, reflecting their biological contribution to the bases of knowing. The neurognostic structures provide experiences that *facilitate adaptation* to the operational environment.

Note that Winkelman (2000) stresses that shamanistic activities all over the world are not the result of cultural diffusion, but rather of rediscovery and reinvention. The striking similarities in shamanistic activities provide grounds for assuming that they have a common biological basis,

as Winkelman clearly points out. He contends that the critical “physiological mechanisms underlying ASCs and integrative forms of consciousness are found in activation of the paleomammalian brain, specifically the hippocampal-septal circuits, the hypothalamus, and related areas that regulate emotions and the balance in the autonomic nervous system” (Winkelman, 2000, p. 128).

In shamanic healing rituals, the ASCs that shamans induce in their clients are remarkably effective in producing results in the absence of anything remotely resembling modern medicine. Generally the rituals are most effective in producing results in illnesses that have at least a partial psychological basis. The ASCs produce their effects primarily through improving physiological relaxation and reducing tension and anxiety, both of which have positive effects on overall immune system function. Relaxation responses derive from the fact that the induction of ASCs creates a state of dominance of the parasympathetic nervous system. Remarkably, Winkelman’s conclusions, as we will see in the next section, dovetail exceptionally well with the findings of scientific research concerning the positive effects of religiosity on the physical and psychological health of people in modern industrial societies. As he notes, the “relaxation response has preventive and therapeutic value in diseases characterized by increased sympathetic nervous system activity, particularly in lowering of blood pressure, control of hypertension, treatment of heart disease, and reduction of premature ventricular contractions” (Winkelman, 2000, p. 195). Shamans were, in effect, the first physicians or psychotherapists.

These facts suggest adaptation. The fact that shamans also play an important subsistence role in finding or protecting game likewise suggests adaptation. Moreover, shamans do not disappear with the transition to agricultural societies. They persist, at least in the slightly altered forms that Winkelman (2000) calls shaman/healers, healers, sorcerer/witches, and mediums. These new types of practitioners are not all that different, however; they engage in many of the same activities as the shaman, the most crucial of which is healing. Such practitioners continue to be found even in societies where ecclesiastical religions with formal religious doctrines and full-time priesthoods have developed. Indeed, even in affluent industrial societies a religious practitioner strikingly reminiscent of the ancient shaman is found in the form of the “faith healer”.

A similar analysis of shamanism has been provided by James McClenon (2002). McClenon suggests that the ASCs that shamans induce in their clients are in essence hypnotic trances, a point endorsed by Winkelman (2000). McClenon cites research showing that approximately 15 percent of persons in various societies are highly susceptible to hypnosis. In the ancestral environment, shamans themselves would have been among such people, and they had greatest success with other highly susceptible individuals. Since these individuals received greater health benefits from shamanistic activity than less susceptible individuals, they would have had greater reproductive success, and thus genes for hypnotic suggestibility and spiritual belief would have spread throughout populations. In addition to the kinds of psychological and physiological effects pointed to by Winkelman (2000), McClenon (2002) notes that pregnant women who are highly hypnotizable have fewer childbirth complications than other women. Since stress also reduces the likelihood of impregnation, more hypnotizable women would have higher fertility, with the genes for hypnotizability thus spreading in the gene pool. Here are, McClenon suggests, the first seeds of religion, which were planted and began to sprout at least as early as 30,000 years ago. And it is from these early shamanic seeds that later religions have developed (cf. Lewis-Williams, 2002).

Evidence that religion is an adaptation: religion and health

A great deal of research has been conducted on the relationship between religiosity and both physical and mental health. Reynolds and Tanner (1995) have reviewed some older studies. Comstock and Partridge (1972) showed that, for the United States in the 1960s, persons attending church once a week or more had approximately 50 percent lower rates of mortality from cardiovascular disease, emphysema, and suicide, and a 75 percent lower rate of mortality from cirrhosis of the liver, compared to less frequent attenders. A much older study (Stussi, 1873–1875) showed that members of the English and Welsh Protestant clergy in the nineteenth century had substantially lower mortality rates than the general male population, especially in the reproductive years between 25 and 45.

More recently, Hummer et al. (1999), in a study of US adults, found that persons who never attended church were nearly twice as likely to die in a follow-up period as persons who attended church weekly. They found that this translated into 7.6 fewer years of life expectancy at age 20 (for blacks, life expectancy at age 20 was shortened by 13.7 years). And recent work by McConnell and Boyatzis (2002) found that the more religious their cardiac patients were, the more they improved.

The most comprehensive survey of studies on religiosity and physical and mental health is that of Koenig et al. (2001), who looked at literally hundreds of studies. In terms of physical health, 75 percent of 16 studies found lower heart disease and cardiovascular mortality among persons assessed as more religious. The authors examined 16 studies of the relationship between religiosity and blood pressure; 14, or 88 percent, found lower blood pressure (especially diastolic blood pressure) among the more religious. In terms of longevity, 39 of 52 studies, or 75 percent, reported that more religious people lived longer, and only 1 study reported a shorter lifespan for the more religious. In terms of mental health, the authors examined 93 studies of religiosity and depression and found that 65 percent reported significant correlations between religiosity and lower levels of depression, with only 5 percent reporting higher levels of depression among the more religious. Similarly, out of 68 studies of suicide, 84 percent found lower suicide rates among the more religious, and none of these studies found higher rates of suicide among the more religious. Of 69 studies of anxiety, 35 (51 percent) found that the more religious reported lower anxiety levels compared to 10 studies (14 percent) reporting higher levels of anxiety. The authors also surveyed studies that related religiosity to alcohol and drug abuse. The vast majority of 86 studies of alcohol abuse (88 percent) and 52 studies of drug abuse (92 percent) reported significantly lower levels of these addictions among the more religious.

The role of religion in promoting physical health seems to be that it alleviates “existential stress”; it decreases anxiety and uncertainty and gives people a greater sense of control in a difficult world. It has become very well established by mental health professionals that stress, especially prolonged stress, has a debilitating effect on bodily functioning. Prolonged stress leads to an increase in the body’s endogenous steroids, which negatively affects the body’s immune system. Stress also increases circulating levels of epinephrine and norepinephrine, which if prolonged leads to damage of the coronary and cerebral arteries (Koenig et al., 2001). Thus religiosity, by providing important coping mechanisms, seems to promote better physical health by also promoting better mental health.

Evidence that religion is an adaptation: religion and reproductive success

As Kirkpatrick has reminded us, it is reproductive success rather than health and longevity that is the most appropriate currency for identifying a genuine Darwinian adaptation, but it is almost inconceivable that people in better health would not also have higher reproductive success. People in better health would be more likely to find mates, and to find good mates, than people in poor health, and thus to reproduce at higher rates. This would be true in all types of societies. And even if the reproductive difference is marginal, we know very well that even tiny differences in reproductive success can have major evolutionary consequences over many generations.

Moreover, there is direct evidence that religion does promote reproductive success. All of the major world religions have been pro-natalist to some extent, and many religions have encouraged sexual intercourse between married couples during the wife's most fertile period (Reynolds and Tanner, 1995). Catholicism has long opposed birth control and is very "pro-life". Mormonism, one of the world's fastest growing religions, is also very pro-life, and Mormon fertility is often astonishingly high, with even well educated, upper-middle-class Mormons sometimes having completed family sizes of 4–6 children. Reynolds and Tanner (1983) have taken a somewhat more nuanced view, contending that religions have favored either an r-selected or a K-selected reproductive strategy depending upon the environmental circumstances in which each strategy would be most apt to promote inclusive fitness. They summarize their argument as follows (Reynolds and Tanner, 1995, pp. 38–39):

In environments where levels of disease and frequency of natural disasters were high, where poverty was great, expectation of life low, infant mortality rate high, and confidence in the future poor, then religious attitudes to child-bearing were pro-natalist: that is, religions fostered the view that it was altogether a good thing for parents to have many children. We found this kind of religious attitude to be prevalent in many Moslem countries, in Hindu India, and in rural African societies. In such cases, religions were ... acting adaptively, because in promoting pro-natalist ideas they were ensuring the survival into maturity of at least a few children who would then be able to support their parents and continue the family line down the generations. Conversely, we showed that in environments where disease levels and frequency of natural disasters were lower, where affluence prevailed, expectation of life was high, infant mortality rate low, and people's confidence in the future strong, then religious attitudes to childbearing were anti-natalist: religions did not emphasize the production of large numbers of offspring by parents. This attitude we found to be characteristic of modern Westernized countries, whose primary religion is Christianity. Once again, ... this was adaptive because such ideas would tend to reduce family size and this would be in keeping with the high cost of rearing and educating even a small number of children.

In fact, Reynolds and Tanner conclude that religions are "handbooks of parental investment".

Religion is also a major source of opposition to infanticide and abortion. Most of the major world religions have tolerated these practices only under very special circumstances, and have usually been strongly opposed to them. Islam has forcefully condemned both, as has Orthodox Judaism. Catholics and Protestant evangelicals are also among the strongest anti-abortion advocates in the contemporary United States, and, of course, evangelical Protestants are among the leading pro-family groups in the United States.

There is also empirical research linking individual religiosity to higher fertility. Using data from the European Value Survey conducted in 2000, Frejka and Westoff (2006) studied the fertility of women aged 18–44 in the United States and Europe. They found a significant contribution of religiosity to fertility. In the United States, women who attended religious services more than once a week had an average fertility of 1.65 children compared to 1.18 for women who never attended services. In terms of religious belief, women who regarded religion as very important in their lives had a fertility of 1.61 compared to women who regarded religion as unimportant, whose fertility was 1.04. For Western Europe, women who attended church more than once a week had an average fertility of 2.66 compared to 1.10 for women who never attended. Western European women who regarded religion as very important in their lives had an average fertility of 2.07 compared to 1.15 for women who regarded religion as unimportant. With respect to southern Europe, women who attended services more than once a week had an average fertility of 1.38 compared to women who never attended, whose fertility averaged 0.58. And southern European women who regarded religion as very important averaged 1.25 children compared to 0.67 for women who regarded it as unimportant.

In a study of ten western European countries during the period 1981–2004 carried out by Eric Kaufmann (2006) and summarized on the Internet, he claims to have found that, after a woman's age and marital status, the strongest predictor of her number of offspring was her religiosity. Saul Singer (2006) reports that in contemporary Israel the average fertility rate per Jewish woman is 2.7; among Orthodox Jewish women in the United States the fertility rate is 3.3 children, and among even more devoutly religious American Orthodox Haredim the rate is 6.6. These are much higher rates than the rate found among other American Jews, which is only 1.86. Only one study was uncovered that did not support the religiosity–fertility relationship (Mistry, 1999). In this study of the fertility of Muslim women in India, it was found that married women aged 40–49 who were high in religiosity had an average of 6.16 children ever born, compared to 7.31 children ever born to women of moderate religiosity.

Most recently, Michael Blume (2007) has studied over 10,000 individuals whose religious affiliations and fertility levels were obtained in the 2000 Swiss census. The highest completed fertility rates were found among Hindu, Muslim, and Jewish women (2.79, 2.44, and 2.06, respectively), the lowest rate among women with no religious affiliation (1.11). Members of fundamentalist Protestant sects also had relatively high fertility (average around 2.0).

Note also that in many earlier religions religion and fertility were often linked. Numerous figurines have been found in many preliterate societies that represent fertility goddesses or spirits. Fertility cults have been common in a wide range of religions. Sir James Frazer (1922), for example, called attention nearly a century ago to the ancient Roman goddess Diana, who was worshiped as a goddess of childbirth and was thought to bestow offspring on women and men. Other fertility goddesses have included Hathor in ancient Egypt, Aphrodite in ancient Greece, Freyja among the ancient Teutons, and Brigit among the ancient Celts. Frazer also pointed out the widespread practice of *theogony*, or beliefs and rituals involving the marriage of gods and their ensuing reproduction.

Evidence that religion is an adaptation: the religions of love and mercy

Throughout much of the world for thousands of years in complex chiefdoms and archaic states there prevailed ecclesiastical religions based on pantheons of highly specialized gods. Each city or

city-state could have its own god, individuals could choose a god from several, or individuals could worship several gods for different reasons and purposes. But during the period that Karl Jaspers (1953) has called *the Axial Age*, which can be dated from about 600 BCE until 1 CE, there emerged very different religions based on a single omnipotent God that was the exclusive object of worship. Unlike the earlier gods, this God was outside the world, i.e., was *transcendent*. These new world religions emphasized *God's love and mercy* (Jaspers, 1962; Harris, 1977; Stark, 1996; Armstrong, 2006) and *worldly salvation*, which for Max Weber (1978 [1923]) took the form of a *release from suffering*.

Why should the emphases on God's love and mercy and the desire for salvation have become such critical features of religion, and what was it that people wanted to be saved from? What was happening around 600 BCE that would have changed or intensified people's religious needs? Elsewhere (Sanderson, 2008) I have identified two dramatic social changes during this time that seem to have increased the scale of human misery and suffering. One was a dramatic increase in warfare; the other was rapidly expanding urbanization. Here is where I think Kirkpatrick's attachment theory becomes highly relevant. War is a tremendously socially disruptive and psychologically anxiety-producing phenomenon. It is not hard to see how a dramatic increase in the scale of war and the number of people being killed as a result would create new needs for security and comfort. Increasing urbanization was also tremendously socially disruptive. One of the main things that was being disrupted was *people's attachments to kin and to other social intimates*. People were increasingly living in a world of strangers. People turn to God, Kirkpatrick says, as a substitute attachment figure, especially when there has been some sort of disruption in their attachments to parents, and God functions psychologically as a safe haven and secure base.

The themes of the major world religions, then, and the social conditions under which these new religions emerged, are exceptionally indicative of the adaptive functions of religion and are another major line of evidence for the adaptationist position. These religions were founded by prophets, who were individuals with special religious insights that may have resembled the insights of shamans. Prophets were, in effect, transformed shamans who arose to ply their trade under radically new social, economic, and political circumstances.

Conclusions

This paper has reviewed evidence suggesting that religion manifests important characteristics of adaptive design. Four points in particular stand out:

1. The primary type of religious specialist that prevailed in the human ancestral environment, the shaman, devoted himself above all to two of the most fundamental of all human practical concerns, namely, good health and the availability of crucial resources. Despite the social transformations that have occurred in the nature of religion in long-term social evolution (Roberts and Sanderson, 2005), this type of religious practitioner has never completely disappeared. Shamanism has been invented and reinvented many times and the activities of shamans are strikingly similar wherever they are found. Moreover, shamanistic rituals seem to be rooted in universal human brain mechanisms.

2. Empirical research in modern societies consistently shows that people with higher levels of religious belief and practice are in better physical and mental health. Religion is adaptive in alleviating stress, which has ensuing salutary effects on bodily functioning.
3. Religion tends to be strongly pro-natalist. The major world religions support family life and procreation, and the devoutly religious generally have more offspring (often many more) than the less religious or the nonreligious.
4. Today's major world religions all evolved in the second half of the first millennium BCE, and these religions were notable as religions of love and mercy. They offered both other-worldly benefits (salvation from the misery and suffering of the world) and this-worldly benefits (for example, attention to human suffering, nursing of the sick, concern for the poor and downtrodden).

Atran and Boyer say that we cannot explain religion as an anxiety-reduction system because religion often creates anxiety. Atran (2002) argues specifically against Kirkpatrick's attachment theory on the grounds that many gods and spirits are the source of evil rather than love and protection. This is indeed true, but parents, who are the attachment figures *par excellence*, are themselves often the source of punishment and anxiety, yet this does not falsify Bowlby's attachment theory.

The mistake in arguments like this is the implicit assumption that a trait must be optimally designed in order to be an adaptation. Many biologically adaptive traits in many species are far from optimally designed because evolution never starts with a clean slate. It is always working with preexisting structures and must make do with what is available. It would be like saying that the shape and dimensions of the human pelvis are not adaptations because the birth canal is narrow and infants and their mothers often die in childbirth. Evolutionary advantage frequently involves tradeoffs, and thus the key question is whether a trait or structure yields more benefits than costs. As long as a religion's supernatural entities provide more love and nurturance than fear and punishment, that religion is operating adaptively.

This paper cannot settle the question of whether religion is a biological adaptation or a by-product of other cognitive adaptations. None of the four lines of evidence discussed above can, by themselves, clinch an adaptationist argument. However, when all four are considered together, I think a very strong case is made. Yet even if it is eventually shown that religion is not an evolved biological adaptation in the human species, it nevertheless is adaptive in the sense that it has beneficial consequences and is sought by individuals for those consequences. Even some of the by-product theorists acknowledge that this is the case, since they recognize that religions all over the world are often linked to matters of existential anxiety.¹

¹ Consider some of the remarks Atran made in an interview he gave in 2003 to *Discover Magazine*. The interviewer asked Atran why he has referred to religion as an "evolutionary riddle". Atran's response was the familiar "religion increases anxiety as well as relieves it" and "it explains events but is also unable to explain them". When the interviewer asked if religion is such a riddle why has it survived in so many cultures, Atran's response was "*because humans are faced with problems they can't solve*". Atran also claimed that science will never replace religion "*because it doesn't solve any of the problems that religion solves*". He even claimed that "*there is no society that survives more than a generation or two that isn't religiously based*". "People want a personal God", Atran claimed, "*for obvious reasons, to solve personal problems*" (Glausiuz, 2003, p. 4; emphasis added) (and see Atran and Norenzayan, 2004, pp. 726–728). Therefore, even though Atran insists that religion is a by-product, it is not, to use Buss et al's. (1998) phrase, a "functionless by-product". It is, rather, a "functional by-product". That seems like an awfully odd kind of by-product to me.

In conclusion, I take the adaptationist position that there really is a “religious module” – a bundle of highly specialized neurons and neuronal connections built by a set of genes – in the brain. But this does not mean that all of the features of religious belief and practice are evolved adaptations. Some features of religions are in all likelihood by-products rather than adaptations. Evil supernatural beings, which seem to exist in all religions, probably *are* by-products, especially of the cognitive module devoted to the detection of malevolent agency in other humans.

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