



BRILL

Numen 59 (2012) 564–613

NVMEN
brill.nl/nu

Religious Studies as a Life Science

Joseph Bulbulia^{a)} and Edward Slingerland^{b)}

a) Faculty of Humanities and Social Sciences, Victoria University of Wellington

P.O. Box 600, Wellington, 6140, New Zealand

joseph.bulbulia@vuw.ac.nz

b) Centre for the Study of Human Evolution, Cognition and Culture

Asian Centre, 403-1871 West Mall,

University of British Columbia, Vancouver, B.C. V6T 1Z2, Canada

edward.slingerland@gmail.com

Abstract

Religious studies assumes that religions are naturally occurring phenomena, yet what has scholarship uncovered about this fascinating dimension of the human condition? The manifold reports that classical scholars of religion have gathered extend knowledge, but such knowledge differs from that of scientific scholarship. Classical religious studies scholarship is expansive, but it is not cumulative and progressive. Bucking the expansionist trend, however, there are a small but growing number of researchers who approach religion using the methods and models of the life sciences. We use the biologist's distinction between "proximate" and "ultimate" explanations to review a sample of such research. While initial results in the biology of religion are promising, current limitations suggest the need for greater collaboration with classically trained scholars of religion. It might appear that scientists of religion and scholars of religion are strange bedfellows; however, progress in the scholarly study of religions rests on the extent to which members of each camp find a common intellectual fate.

Keywords

cooperation, cognition, culture, evolution, God, neuroscience

Philosophers debate the relevance of scientific discoveries for religious belief, but the question of whether the academic study of religion ought to be a science has received less attention. When scholars of religion consider it at all, most assume that scientific approaches are undesirable, incoherent, or even morally wrong. Elsewhere we have argued that

convincing justifications for these anti-science doctrines are lacking.¹ More problematically, insufficient attention has been paid to the sort of research that is relevant to any sober assessment of the issues.² Our purpose here is to present recent research in the biology of religion so that our audience may better judge its promise and perils.

We address two audiences. First, we address religious studies scholars. To this audience we argue for a more thoroughgoing integration of religious studies with the biological sciences. Among “biological sciences” we include cognitive science, social affective neuroscience, behavioral ecology, evolutionary psychology, evolutionary dynamics, behavioral genetics, and others. Our review only considers a small fraction of this research. Though our review is incomplete,³ we nevertheless hope that it will persuade our religious studies audience that cumulative knowledge is possible when religious studies is approached as a dimension of human biology.

Second, we address biologists of religion. Our message to this audience is the same: progress in the study of religion requires extensive collaboration between life scientists and classical scholars of religion.⁴ While preliminary results from the biology of religion are impressive, much of the science of religion is conducted by scholars who have only a casual acquaintance with religious facts. Such amateurism has led to unsupportable generalizations and lamentable exaggerations.⁵ These warts are obvious to classically-trained scholars of religion, who remain justifiably unimpressed. It is early days in evolutionary religious studies, however, and a more perfect union between scholars of religion and life scientists will help to avoid these errors. Where scholars of religion

¹) For criticisms and defences of science, see Cho and Squier 2008; Slingerland 2008.

²) For some recent exceptions, see Geertz 2010; Jensen 2003; Taves 2009.

³) For complementary review articles, see Alcorta and Sosis 2005; Boyer 2008; Bulbulia 2004a; Bulbulia and Schjoedt forthcoming; McCauley and Lawson 2007; McKay and Dennett 2010; Schjoedt 2009; Sosis 2009; Wiebe 2008; Wilson and Green 2011).

⁴) Among classical scholars of religion we include anthropologists, historians, philosophers, and other humanities scholars who investigate religion, not merely those located in religious studies departments.

⁵) For example, by Dawkins 2006; for discussion, see Stausberg 2010.

have initiated such collaborations, impressive gains to knowledge have followed.

Before presenting our review, we clarify basic terminology, and offer some initial justification for the idea that religious studies deserves to become a life science.

Religion and Evolutionary Biology

Defining Religion

As readers of this journal are well aware, religious studies lacks a widely accepted definition of the object of its study. Indeed, disagreements rage about whether the term “religion” even describes a coherent category (Smith 1998; Saler 2009; Stausberg 2010). Scholars who approach religion as a biological phenomenon, however, avoid verbal disputes by stipulating their meaning. They define “religion” to denote commitments and practices regarding a supernormal order.⁶ Humans typically, though not always, represent this order as harboring anthropomorphic powers — God/s or spirits. “Religious cognition” and “religiosity” are synonyms to name the processes of supernormal thoughts and actions. Biologists of religion think of religiosity as an assortment of psychological and behavioral traits, many and varied. Such traits, moreover, are variously distributed in human populations. The factors that express diverse religious traits — genetic, cultural, neural, and embodied — are also diverse. Little is known about religious traits and the factors that express and conserve them. Initial studies reveal rich complexity. Biologists of religion take it as their task to explain the mysteries of religion as among the mysteries of nature, ours.

⁶ We use the terms “supernormal” and “supernatural” interchangeably. It turns out that irrespective of culture and language, judgments tend to be consistent: divinities and heavens are judged to be categorically different from mortals and material objects (Boyer and Ramble 2001). Zeus is supernatural; Zsa Zsa Gabor, though extraordinary, is not.

Core Assumptions

The sub-disciplines of the life sciences are methodologically diverse. The working day of a molecular biologist differs from that of a marine biologist. A neuroscientist and a linguist might not understand each other's work. However, all research in the life sciences, and indeed all research in the sciences generally, is characterized by commitments to three basic principles:

- 1) Research should be grounded in testable hypotheses.
- 2) Conflicts between new findings and past findings, both within and between disciplines, must be resolved.
- 3) Scholars should minimize their ontological commitments.

We discuss each principle separately, before considering their relevance to the study of religions.

1) Hypothesis-Driven Research. Scientists seek testable hypotheses. Hypotheses are beliefs that make predictions: "If hypothesis A were true, what would it predict that hypothesis B would not?" Scientists present hypotheses neither as indubitable truths nor as subjective "interpretations." Rather, hypotheses are presented as explanatory proposals that may be put to the test. Much of science consists of putting such proposals to the test.

Hypothesis-driven research is grounded in experimental and statistical methodologies. These tools afford precise evaluations for hypotheses. Rarely are any experimental observations decisive in refuting (or "falsifying") a hypothesis. Rather, experimental observations cause confidence to rise or fall. The magnitude of this change in confidence varies. Over time, however, hypothesis-driven research leads to theoretical convergence. Debates rage, experiments are devised, and results eventually settle debates. Yet results also give rise to new questions, about which new hypotheses are offered. These hypotheses form a platform for novel research. Over time increasingly systematic understandings accumulate. Knowledge grows. There is a positive vector to this intellectual growth. We characterize this vector as "progressive," because growth in scientific knowledge is not merely expansive, it is directed. Scientific research does not merely add to known facts; it finds more

precise, integrated, and comprehensive understandings for known facts, as well as for new facts. Scientific practices are difficult. It is intellectually challenging to consider how one's beliefs may be tested by their predictions. Gathering facts relevant to such testing is also challenging. The reward of intellectual growth is, however, satisfying. Scientists should expect no end to such intellectual growth. Nature's complexity has proven, and will likely forever remain, elusive to science. The satisfaction of intellectual growth does not require or imply its eventual termination.⁷

2) Integration. The commitment to theoretical consistency within and among the sub-disciplines of science is sometimes called “conceptual integration” or simply “integration” (Cosmides and Tooby 1992). Integration generalizes from a basic principle of rationality, which states that one can be held accountable for the implications of one's beliefs. A toy example: If Alice believes that Adelaide is in Australia, and that Australia is south of the equator, then Alice can be held accountable to the inference that Adelaide is south of the equator. The principle of consistency also applies to behavior. If Bob believes that one should maximize happiness, and that complimenting Cathy on her dress will make her happy, then Bob can be held accountable, all other things being equal, for complimenting Cathy. Integration applies this basic principle of consistency in thoughts and behaviors to the conduct of scholarship. Within every scholarly community, old understandings must be reconciled with new findings. Reconciliation applies across the sub-disciplines that study nature. Our theories and models of the world must remain, in principle, harmonious with the others. Where inconsistencies arise, they must be repaired, either by adjusting one of the incongruent ideas or by rejecting both of them. Among the values that guide integration are those of parsimony, simplicity, maximal predictive power, and minimal modification of past knowledge (Harman

⁷ To emphasize the incompleteness of scientific understanding, we prefer the term “model” to “theory” when describing the precipitates of scientific research. Scientific models of the world improve through practices of hypothesis formulation and testing. For coherent, post-objectivist defences of scientific inquiry as a progressive discipline, see Laudan 1996 and Haack 2003.

2000). The goal of integration is an intellectual ideal. There is no guarantee that researchers who disagree will find a common ground. Among those who practice hypothesis-driven research, however, agreements do tend to follow. Despite the claims of postmodern critics of science, enduring scientific antinomies are in fact rather rare.

3) Methodological Naturalism. Scientific communities assign a near-zero probability to any theory that is committed to causation of the kind that plain interpretations of supernatural doctrines imply, what we call supernatural causation (see Saler 2009; Slingerland and Bulbulia 2011). Methodological naturalism is monistic in the sense that it rejects that the universe is divided into separate realms of *Geist* (spirit or mind) and *Natur* (physical nature), each realm with its own proper methods of inquiry (Slingerland 2008). Rather, scientific research finds an appropriate characterization in Robert McCauley's dictum, "explanatory pluralism but ontological seamlessness" (McCauley 2007; 2011).

Assigning a negligible probability to metaphysical dualism does not exclude the desirability of interpretive practices. It rather excludes the idea of inaccessible substrates for ghosts. Rejection of the inaccessible ghost doctrine is not arbitrary. Rejection is based instead on an appreciation that inaccessibility has done nothing but fuel interminable disputes.

Evolution: Genetic and Cultural

All research in the life sciences assumes Darwin's theory of evolution by natural selection. Natural selection can be stated simply. Given (i) variation in a population of (ii) hi-fidelity replicators, it follows that (iii) complete, functional designs will accumulate. This simple idea explains nature's manifold and exquisite designs. Darwin aptly referred to such designs as "endless forms most beautiful and most wonderful" (Darwin 1989 [1859]). Nature is beautiful and wonderful, and its complexity is, importantly, endless.

Natural selection is the starting point, not the terminus, for biological inquiry. Biologists ask: why this diversity rather than another? How do specific systems within this diversity operate? How are they related to others? By which steps did each evolve? Endless forms, endless

questions! The principle of integration suggests that researchers consider how evolution matters to the investigation of religions, as among Nature's endless forms most beautiful and wonderful.

Religious traits belong to humans. There are many ways to describe humans, none even remotely comprehensive. Setting the chimera of explanatory completeness to the side, there can be no principled reason to avoid approaching humans as creatures of nature. We are organisms; what else could we be? Organisms are collections of *phenotypic traits*. A phenotypic trait is a manifest characteristic or property of an organism. Phenotypic traits result from an interaction of genetic factors called *genotypes* with environmental factors, which vary. Biologists use the concept of a *norm of reaction* to describe possible ways in which variation in genotypes and variation in environments cause variation in phenotypic traits (Sterelny and Griffiths 1999). Phenotypic traits can be classified according to four basic norms of reaction.

1) Genetically-determined traits. Some genotypes lead to identical phenotypic traits across a broad spectrum of environments. For all intents and purposes, it is appropriate to say that genes determine such traits. The genes that code for eye pigmentation are insensitive to normal environmental influences; therefore, it is reasonable to say that iris pigmentation is a genetically-determined trait.

2) Environmentally-determined traits. Some phenotypic traits are substantially explained by environmental variance. Bob's Australian accent, for instance, is clearly not the result of specific Australian accent genes. If Bob were born to an exclusive Swahili-speaking community, he would have no Australian accent because he would not speak English. For all intents and purposes, Bob's specific accent is environmentally determined.

Notice however that the level at which a researcher specifies an interest in a trait allows different norms of reaction within a general category of interest. Bob's dog Cannibal does not acquire any accent whatsoever because Cannibal acquires no grammatical human language. The more general trait of having a human language shows a deeper reliance on the human genome. With respect to having some language, Bob's capacities in this domain are genetically determined. Key social inputs are required for language to develop; however, these inputs trigger growth

of a genetically-designed faculty, which linguists call the language faculty (Chomsky 2000). In turn, as Bob's language develops, his pronunciations, his lexicon, and a few grammatical rules will reflect environmental determinants. Each such trait may have a different norm of reaction.

3) Additive traits. Some phenotypic traits result from an interaction between genotypes and environments so that traits vary as environments vary, and the variance is in the same direction. Consider the following: Debbie and Ed's mathematical abilities differ. Such differences depend both on their genotypes and on their environments. In the same environment, Debbie is better than Ed at math. However, if Ed were to receive extra training, that is, if he were to inhabit an environment different from Debbie's, Ed's abilities would match and exceed those of Debbie.

4) Non-additive traits. Some phenotypic traits result from an interaction between genotypes and environments so that traits vary as environments vary, but the variance is in different directions. Consider: Fred and Gale are equally pale in environments that lack sunlight, yet when exposed to sunlight, Fred turns red and Gale turns brown. Each changes color, but in divergent ways.

Our discussion about norms of reaction, though brief, is sufficient to warn against any simplistic explanation of "religion" as determined by one or several factors, genetic or cultural. Core properties of religion appear to be genetically determined, though we shall see the jury remains out. Other specific religious traits vary with environments. For any trait of interest, general or variable, each of the four norms of reaction might, in principle, apply. We cannot say which applies, or how, before investigating. Researchers are currently undertaking such investigations. They are formulating testable hypotheses about how specific religious traits arise, what they do, and how they are transmitted. Such hypotheses are being put to the test. It is early days, however, and much remains unknown.

To a crude approximation, cultural evolution literatures focus on the dynamics that cause culturally-specific religious traits, for example, whether one worships Zeus or worships Odin. Genetic evolution literatures, on

the other hand, focus on the dynamics that cause pan-human psychological traits, such as whether one believes in some kind of super-nature (Bulbulia 2008b; Geertz 2010; Gervais et al. 2011). New research is beginning to integrate cultural and genetic models (see Rowthorn 2011, discussed below). For now, readers should bear in mind that cultural and genetic approaches each seek explanations at different levels of biological organization. If readers take nothing else from this discussion, we hope they will understand that in the biology of religion, nature and nurture are nowhere opposed.

To organize our survey, we use the biologist's distinction between proximate and ultimate explanations. Proximate explanations investigate the developmental, neural, and ecological causes of religious traits. Evolutionary explanations investigate the historical dynamics that elaborate and conserve such proximate designs.

Proximate Explanations

Hypotheses for the genetic determination of core properties of religious traits would be convincing if young children were to exhibit an easy, untutored mastery of religion. On the other side, hypotheses for social constructivism would be made stronger from evidence that children's religiosity required significant education. When evaluating research about childhood religiosity, we must be cautious about inferring too much from individual studies. To repeat, norms of reaction might operate differently for different components of religiosity, which are many and various (see Bulbulia 2005). For example, having a supernormal belief of some kind might be genetically determined, yet the desire for sacrifice might be socially determined and socially/environmentally expressed. Because we have to start somewhere, we begin our review with the trait of believing in supernormal agents or powers of some type. Does it take a religious education for children to believe in God/s of one kind or another?

Teleo-functional Bias

Deborah Kelemen hypothesizes that children are “intuitive theists.” By this term she means that children naturally attribute teleological

functions to objects in their world, including uncreated objects such as animals, landscapes, and weather patterns (Kelemen 2004; Kelemen et al. 2005). For example, when asked “what is this for?” American 4- to 5-year-olds ascribe functions to both living kinds (“lions go in the zoo”) and to inert kinds (“clouds are for raining”) (Kelemen 1999). Only among 9- to 10-year-olds do preferences for teleological explanations subside. (For similar effects among British children, see the study by Gelman and Kremer [1991].) Kelemen argues that such “promiscuous teleology” among young children is not likely to have been learned from their parents, who explicitly prefer non-teleological explanations. The preference for teleology appears to be genetically determined.

Importantly, children do not merely attribute functions indiscriminately to the world. They also prefer to attribute functional designs to the intentions, purposes, and actions of supernatural agents. When the developmental psychologist Margret Evans asked children: “How do you think the very first [item here] got here on earth?” Evans discovered that 8- to 10-year-olds from both fundamentalist and non-fundamentalist American homes favored supernatural explanations (“God made it”) over natural explanations (“a person made it”) and over impersonal explanations (“it just happened”) (Evans 2000).⁸ According to Evans’s analysis, only among 11- to 13-year-old non-fundamentalists are non-teleological preferences popular (Evans 2001).

What about adults? Kelemen’s results show that adults, too, are prone to teleological preferences, at least when they are not permitted full reflection. For example, when adults are required to respond quickly to questions about the purpose of inanimate objects, adults ascribe purposes and intentions to such objects (Kelemen and Rosset 2009). These effects under “cognitive loading” are common even among trained scientists. Kelemen suggests that teleological ascriptions under cognitive loading offer preliminary evidence for a general psychological bias for teleology. Adults overcome teleology only with effort. Why might such a result be interesting to classically-trained scholars of religion? Some scientists have hypothesized that teleological attributions, when

⁸) For similar results among British children, see Petrovich 1997. Similarly, Jesse Berling (2002) found that adults and children attribute supernatural agency to explain otherwise mysterious events.

combined with agency attributions, lie at the heart of genetically-structured designs that universally favor religiosity. We next consider a few such positions.

Anthropomorphism, Attachment, and Folk Dualism

Stewart Guthrie hypothesizes that anthropomorphism, which he defines as the attribution of human-like agency to inanimate factors, plays a fundamental, culture-independent role in organizing and maintaining religious cognition (Guthrie 1980; 1993). Guthrie conjectures that the cognitive mechanisms underlying our tendency to posit God/s are identical to those involved in ordinary agent perception. We perceive God/s for the same reason that we perceive faces in clouds. Guthrie speculates that we have evolved to be overly sensitive to perceiving persons in distal environments, and hence, to projecting agents everywhere (Guthrie 2008).⁹

There are, as every scholar of religion knows, many facets of religious cognition besides anthropomorphism. For example, humans do not merely perceive gods as distal persons but also form intense emotional bonds to such perceived persons. Lee Kirkpatrick argues that emotion-laden religious cognition arises from the extension of human attachment psychology (Kirkpatrick 1999; Weingarten and Chisholm 2009). Our commitments to God/s are the effects of a tendency to over-generalize from our attachments to others, according to Kirkpatrick. The attachment hypothesis would appear to account for facts that are left unexplained in Guthrie's model, facts about religious emotions. Notably, Kirkpatrick finds no evidence of dedicated functional designs for supernatural attachments. On Kirkpatrick's model, the benefits of the attachment complex are such that it is able to bear the costs of supernatural over-generalization. Both Kirkpatrick and Guthrie's models illustrate how Darwinian hypotheses for religious cognitive traits need not be functional hypotheses.

A question for both Guthrie and Kirkpatrick's models, however, is why religious persons do not revise or abandon their beliefs and attachments regarding God/s? Why is it so easy to over-generalize to supernatural

⁹ For a mathematical model, see Foster and Kokko 2009.

agents and to bond with them, but so hard to abandon such commitments? Most empirical beliefs are revisable (“I thought it would rain, brought my umbrella, but the sun appeared . . . so I put it away.”)

Some researchers hypothesize that our tendency to form strong beliefs in God/s are the by-product of how social intelligence is configured at its most basic levels. A central and unique feature of human cognition is our capacity to richly represent the beliefs, goals, and emotions of others. We imagine other minds effortlessly, rapidly, and from impoverished information — a remark, a glance, a gesture. Cognitive scientists refer to this inferential capacity as “theory of mind” (ToM). They use the term “theory” because such representations possess a richness that is not found in perceptual evidence: intentional representations require attributing to others internal and abstract mental properties — beliefs, desires, goals. Notably, the capacity for ToM emerges early in childhood without clearly structured learning environments (Bloom 2004; Spelke, Phillips, and Woodward 1995). While ToM operates largely automatically — for example, ToM is triggered from animal-like movements (Scholl and Tremoulet 2000) — the faculty’s later developmental properties permit rich meta-reflective representations. Such meta-representations are of the kind that enables Alice to infer that Bob wants Carol to persuade Donald to imagine how Esther would feel in Frank’s shoes. No other lineage remotely approaches humans in this capacity to represent other minds. Similar to language, theory of mind presents cross-culturally, with systematic regularities (Barrett, Todd, Miller, and Blythe 2005; Cohen 2007). The majority of every human population manifests theory of mind abilities. In their core properties, such capacities remain invariant.

ToM capacities are also vulnerable to selective impairment (Baron-Cohen 1995; Tager-Flusberg 2005). Such impairments, too, appear to be distributed in all human populations along a spectrum ranging from autism (deficient ToM) to schizophrenia (excessive ToM) (Crespi and Badcock 2008; Crespi, Stead, and Elliot 2009). Collectively, these data suggest strong genetic scaffolding for the capacities to assume what Daniel Dennett calls the “intentional stance” (Dennett 1991).

Important for our purposes is the finding that humans tend to view intentional representations as qualitatively distinct from material properties (Bloom 2004). Evolutionary psychologists of religion hypothesize

that the same capacities that enable the intentional stance also *suppress* judgments of others as governed by mechanistic causality (Bering and Parker 2006; Bloom 2004; Slingerland 2008). The folk dualism hypothesis for religiosity holds that it is in virtue of ToM that humans automatically project a dualistic picture of mind and matter: perceiving supernatural realms arises from a cognitive default to represent minds as ghosts. Our tendency to divide the world into minds and matter presents much like color vision, vertigo, and the taste of salt: folk dualism can only be suppressed, if at all, with cognitive effort (Bering and Parker 2006; Bloom 2004).¹⁰ On this model, dualism is not indebted to the philosophical legacy of Descartes or Plato but rather arrives from panhuman genetic endowment: we are born to believe in ghosts.

Supporting the folk dualism model of religiosity is evidence that those who score high on the autism spectrum also reliably score low for belief in God/s (Gervais et al. 2011). That degrees of theory of mind impairment should be associated with reduced levels of belief in God/s suggests that ToM may play a fundamental role in the enabling supernatural commitments which cultural environments specify.

Despite the interest of the folk dualism model, we caution against overinterpreting the existing evidence. Regarding the genetic component of ToM, psychologists disagree about the extent to which genetically-structured properties of theory of mind are subsequently modified, enhanced, and suppressed by social and cultural influences. Moreover, the suggested link between autism spectrum disorders and supernatural agent belief is only correlational, not causal. Even if ToM were heavily implicated in religious cognition, the degree to which religious cultures affect a person's intentional stance to God/s remains poorly understood.

Regarding Kelemen and Evan's intuitive theism model, while certain aspects of religious belief may be easy for children to acquire, the developmental data have only shown that children *prefer* teleological explanations. Indeed, enthusiasm for the idea that children are "intuitive theists" has recently been moderated by evidence that parental religious biases strongly affect children's attitudes to religion. (For evidence of parental dependencies, and for a re-interpretation of Evans's analysis of

¹⁰ For evidence that a robust mind-body dualism characterizes even supposedly "holistic" cultures such as early China, see Slingerland and Chudek 2011.

default creator beliefs, see Harris and Koenig [2006] and Henrich [2009].) The extent to which generic biases for supernatural beliefs are structured by genetic endowment remains, at present, unclear. (For discussion see Geertz and Markusson [2010].)

Finally, even if all adults were to divide the world into material and mental aspects, there are many dimensions of religiosity that would be poorly described as dualistic beliefs. Religious persons sing, pray, bow, march in time, dance, and do much else besides view the world as partly immaterial. Which factors affect the shape of these learned dimensions of religiosity? Such traits cannot be explained by any version of the born-to-believe model because such traits are not expressed as beliefs (see Bulbulia and Reddish forthcoming).

Memory

The previous discussion focused on the relationship between religiosity and generic features of supernatural agency. The cognitive anthropologist Pascal Boyer hypothesizes that religious concepts endure from their effects on memory. Boyer hypothesizes that we do not learn religion as we learn the periodic table, by rote. Rather the hypothesis is that religious concepts are largely given from highly-structured, innate mental faculties. Boyer holds the view that conceptual knowledge, generally speaking, develops much like organs of our bodies, relatively invariantly, barring serious impairments, as a species property. It may seem incredible that interpretations and perspectives that we never learn structure the concepts we use to think. Yet this view is widely accepted among most linguists, cognitive anthropologists, developmental psychologists, and others in the cognitive sciences. Debates center only on the extent of the environmental contribution. The most impressive evidence for genetic structuring comes from the observation that learning is computationally constrained. Children cannot examine all interpretations of the world before forming ideas about it and acting on such ideas. From computational considerations alone, it is clear that much of what children know must already arrive from genetic resources.¹¹

¹¹) The problem of computing solutions to problems is variously referred to as the “frame problem” or “combinatorial explosion.” For a clear and still relevant discussion of the issues see Cosmides and Tooby 1992.

Adding to these *a priori* mathematical considerations are data about the rate and manner of childhood language acquisition. Such data are inconsistent with the predictions of social constructivism. Children express language too quickly to learn it (Chomsky 2000).

Boyer's model holds that religious concepts are minimally modified natural concepts. His idea is that religious concepts violate a few, but not many, of the default assumptions that govern conceptual interpretations. Satan is understood to be not merely a serpent, but one who talks; Ganesh's proboscis is an elephant's trunk — not merely a large nose. The dissonance between intuitive expectations and their minimal violation renders religious concepts memorable, and facilitates their transmission (Boyer 1994; 2001). Religious concepts are easily learned because they are maximally uncanny. Several studies have supported Boyer's model. (For a recent example, see that of Fondevila et al. 2011.)

Scott Atran and Ilkka Pyysiainen find a "Mickey Mouse Problem" for Boyer's theory. Consider: although Mickey Mouse is minimally counterintuitive, Mickey Mouse is not easily believed, at least not among adults (Atran 2002; Pyysiainen 2001). Why do some believe in minimally modified agents, such as Thor, while others find Thor as incredible as Mickey Mouse? Boyer's model does not say.

Gaps in Boyer's model have focused attention on childhood development. According to certain learning models, children acquire convictions about supernatural agents from genetically-organized tendencies to trust adult testimonies, the contents of which vary depending on place and history. The evolutionary logic of testimony-based learning models is plausible. If children were adapted to acquire locally-relevant beliefs from trusted adults — as part of the flexible learning complex that characterizes the nearly two-decade-long period of childhood and adolescent development (and dependence) — then we would, knowing nothing else, expect children to acquire substantial properties of their religious beliefs from trusted adults (Harris and Koenig 2006; Henrich 2009). Testimony-based hypotheses do not reject Boyer's model so much as extend it. For such models are based on the idea that we acquire culturally-salient information. They presume that basic inclinations to trust are genetically structured. The outcomes of these basic inclinations however, vary depending on local environments, unique experiences, and cultural histories. It is therefore predictable that children will form

supernatural beliefs from a combination of their genetic endowment and historical surroundings.

Notice that the Mickey Mouse Problem did not offer a knock-down “critique” of Boyer’s model. On the contrary, gaps in Boyer’s model are exactly what researchers would expect in any young science. As Boyer himself has emphasized, there are no magic-bullet explanations for religion (Boyer 1994). The Mickey Mouse Problem proved to be an engine of subsequent research. Among the most distinguished revisions of Boyer’s early work is the later Boyer (Boyer and Wertsch 2009: preface), a clear sign of a healthy community of inquiry.¹²

Where is natural selection in Boyer’s model? As with most beta-generation cognitive models, Boyer suggests that religiosity is a by-product of ordinary cognition. To become a biologist of religion, notice, one need not become a card-carrying functionalist (or as biologists say, “adaptationist,” discussed in section 3). We close this section with the observation that no less than Charles Darwin held a by-product model of religious cognition. In the *Descent of Man*, Darwin wrote:

[t]he feeling of religious devotion is a highly complex one, consisting of love, complete submission to an exalted and mysterious superior, a strong sense of dependence, fear, reverence, gratitude, hope for the future, and perhaps other elements. No being could experience so complex an emotion until advanced in his intellectual and moral faculties to at least a moderately high level. (Darwin 1981 [1871]:68)¹³

Many cognitive scientists are Darwinians after Darwin’s fashion. They hypothesize that diverse cognitive systems are responsible for religious traits, none of which is specifically selected for religion. (We examine alternatives to by-product models below under “Ultimate Explanations.”)

Cognitive Neuroscience

To better understand the computational processes that support thinking and behavior quite generally, cognitive neurosciences study brain

¹²) For Boyer’s recent views, see Boyer & Bergstrom 2008. See Boyer and Lienard 2006 for Boyer’s explanation of ritualized behaviours.

¹³) For discussion, see Bulbulia 2004a; Sosis 2009.

activations. In an important paper, Anders Lisdorf points out that cognitive hypotheses for religiosity may be tested against predictions about activations in brains, so to speak, on religion. Lisdorf uses Guthrie's anthropomorphic model to illustrate this possibility. If anthropomorphic perception were central to religious experience, as Guthrie hypothesizes, then we would expect to find activity in perceptual regions of the brain associated with person perception (such as facial recognition systems). That neuroscientists do not find such evidence for brains on religion suggests to Lisdorf that Guthrie's anthropomorphism model needs to be modified or restricted.¹⁴ We next consider several results from experiments relevant to evaluating cognitive hypotheses for religious cognition.

Elite Prayer and Meditation

In a series of experiments (PET), Andrew Newberg and colleagues found that both Christian prayer (rosary repetition) and Tibetan meditation are associated with coordinated activity in brain regions related to attention, parasympathetic arousal, and spatial orientation (Newberg 2009). Such effects are coordinated in stages, beginning with attention activation in the dorsal-lateral prefrontal cortex, an area associated with planning. This frontal pattern is next associated with mesolimbic arousal. The sequence reveals an inhibition of processing in the posterior superior parietal cortex (pSPL), with different effects observed among those who practice prayer (Catholic nuns) and those who meditate (Tibetan monks) (Newberg and Newberg 2008). Whereas prayer was found to enhance activity consistent with object focus, meditation was found to suppress such activity. In both cases, however, spatial processing for the self appeared to be diminished, suggesting an experience that the researchers call "absolute unitary being" (Newberg, Raue, and D'Aquili 2002).

Newberg and colleagues also found considerable differences within the category of Christian prayer, noticing that glossolalia, or speaking in tongues, exhibited a pattern roughly opposite to the one observed in the rosary study, namely, suppressed frontal activations and enhanced

¹⁴ For a similar argument see Schjoedt 2007, 2008.

motor activations (Newberg, Wintering, and Morgan 2006). Such findings imply that prayers within roughly the same religious tradition are computed by distinct neural substrates. The category of “Christian prayer” masks significant neurological variability. (See also Schjoedt’s experiments described below.)

The results of Newberg et al. help to evaluate cognitive theories of religion by showing complexities in religious cognition that were unnoticed in beta-generation cognitive models. Beta-generation models do not discuss religious consciousness as a dynamic, practice-dependent affair. Newberg and colleagues’ results also challenge classical scholars of religion. The folk categories of religious similarity and difference serve to obscure within and between traditions variability in brain processing (see Paden forthcoming). Variability in religious brain activity suggests that religious experiences do not respect theological boundaries, at least not straightforwardly.

A separate challenge to folk wisdom about religious variation arises from the work of neuroscientist Nina Azari and colleagues (Azari and Slors 2007). In one study, they measured the brain activity of six Christian fundamentalists and of six non-religious participants. Participants were scanned (fMRI) as they read Psalm 23, a biblical passage for which Christians report strong emotions. Relative to control conditions, Azari et al. found evidence in the Christian group of increased activity in the dorsomedial frontal cortex, cerebellum, and precuneus. These regions form a distributed neural network related to personal reflection and action planning (Azari, Nickel, Wunderlich, and Niedeggen 2001). Such activations suggest higher-order reflection may be important to the reading of emotional religious passages. The experiment also revealed something quite novel. Contrary to expectations, the team found no evidence of recruitment in those areas of the brain associated with feelings (the mesolimbic system and the insula) (Azari and Birnbacher 2004; Azari, Missimer, and Seitz 2005). The authors suggest that, during biblical reading, anyway, religious emotion may depend more on interpretations than on feeling states, for such experiences do not appear to recruit trembling, fear, awe, or affection. The experiment also brings some preliminary support to the ideas of those classical scholars of religion who emphasize the culturally-mediated nature of religious experience (for example, Katz [1992] and Proudfoot [1985]) against

those phenomenologists who claim that religion is expressed mainly in feeling (for example, Schleiermacher [1996 (1799)]). Of course, the absence of evidence for feeling states should not be taken as evidence for their absence. Azari's methods, or her instruments, might not have been sufficiently sensitive. Were Christians in her experiments expressing higher order cognition because they were attempting to work out Azari's intentions?

The Social Cognitive Neuroscience of Ritual

The studies of Newberg et al. exemplify how proximate systems researchers are integrating the study of religious consciousness with the study of religious practice. A nascent movement combining social neuroscience, anthropology, and social psychology is experimentally investigating religious cognition among ordinary believers in natural religious ecologies (Atkinson and Whitehouse 2011; Konvalinka et al. 2011; McNamara 2009; Nielbo and Sorensen 2011; Sorensen 2007; Schjoedt 2008; Xygalatas 2008; Xygalatas et al. 2011). These experimental cognitive scientists are especially interested in the social interactive and ritual dimensions of religious cognition. We believe this interest forms an important, distinctive new direction for the cognitive science of religion, what we call the "next generation" in cognitive science of religion. Importantly, next-generation research is seeing classically-trained scholars of religion playing leading roles in collaboration with classically trained life-scientists, with impressive early results.

An example of such collaborative scholarship comes from a series of functional magnetic resonance experiments conducted by Uffe Schjoedt at the Religion, Cognition, and Culture Group at Aarhus University. The first experiment by Schjoedt et al. investigated the neural correlates of the Lord's Prayer, a common, non-elite Christian ritual in which a standardized locution is repeated, either in speech or by mental rehearsal. The authors discovered enhanced activity in the dorsal striatal system, a region that contributes to the representation of anticipated rewards (Schjoedt, Stødkilde-Jørgensen, Geertz, and Roepstorff 2009). The strength of activation in the dorsal striatum, moreover, was found to correlate positively with the frequency with which this ritual was practiced, suggesting modulation of religious cognition from training.

The second study by Schjoedt et al. investigated the neural correlates of intercessory prayer, an unscripted and informal non-elite Christian ritual (Schjoedt et al. 2011). In this second experiment, Schjoedt and researchers found different brain activations. While participants practiced intercessory prayer, social-cognitive regions were recruited, again with stronger effects observed among those who practiced more frequently. This result is important. Several prominent philosophers have denied that the religiously devout really believe in God/s. Such philosophers claim instead that the devout only “believe in belief” and that piety is a sham (Dennett 2006; Palmer and Steadman 2004). The second experiment weakens the “believe in belief” hypothesis. Evidence of brain activations during intercessory prayer is consistent with some type of personal religious experience. The second study also bears on the folk dualism model for religious beliefs, considered above (section 2). Theorizing about God’s mind *in vivo* appears to be something more than triggering an automatic theory of mind capacity. In one developed form, anyway, personal prayer requires effort.¹⁵

Notice the interest of these results. Mention “neuroscience of religion” and many scholars of religion will wince and pull out their “reductionist” barb. Yet in contrast to reductionist objections, the emerging picture from the social cognitive neurosciences reveals rich subtleties in the relationship of religious practices to circuit activations in the brain. The picture substantially supports phenomenological descriptions,¹⁶ but it carries researchers beyond phenomenological descriptions by quantifying precise levels of dependency for religious experiences from religious practices (see also Kapogiannis et al. 2009; Konvalinka et al. 2011; Xygalatas et al. 2011).

Importantly, Schjoedt and colleagues are careful not to generalize beyond their sample, explicitly cautioning that their studies shed light only a particular prayer form as it is practiced in a specific Danish community. The authors recommend patience in the pursuit of larger

¹⁵) Similar contextual dependencies are suggested by recent ethnographic data; see Luhrmann 2005, 2011.

¹⁶) Also see Luhrmann 2011. For analysis of the effects of gene/culture interactions, see Kim et al. 2010.

questions about variation among the many and diverse religious practices and populations (see Schjoedt 2008).

Finally, notice that Uffe Schjoedt, arguably the world's leading neuroscientist of religion, earned his Ph.D. in a religious studies program at Aarhus University. The work that he and his colleagues are pursuing at Aarhus University is intensely interdisciplinary and collaborative. Aarhus University researchers are not alone. Similar research is being conducted at Masaryk University in Brno, Czech Republic, which recently opened a laboratory for the experimental study of religions in its religious studies department, headed by Aleš Chalupa, Lee McCorkle, and Dimitris Xygalatas. Such research has been occurring at the Institute for Cognition and Culture at Belfast University for over a decade and at Oxford University's Centre for Anthropology and Mind since Harvey Whitehouse assumed the Oxford chair in social anthropology in 2006. Such research is also taking place at the University of British Columbia in Canada and at Victoria University in New Zealand, our home universities. Next-generation biologists of religion include those scholars of religion who have, in these and other institutions, assumed lead investigator roles. We see the beginnings of what we believe will become an institutional shift in the conduct of religious studies scholarship. The research flowing from the new, intensely collaborative projects that scholars of religion such as Schjoedt are initiating augurs the more precise, integrated, and subtle life science that will broadly characterize the discipline of the study of religion as a whole. When compared to the results of next-generation researchers in the biology of religion, the results of many classical studies appear reductive for all the subtleties they have missed.

Ultimate Explanations

We have been discussing proximate explanations for religion. Proximate investigations attempt to explain the developmental, neural/embodied, and ecological designs that cause and transmit religious traits. Ultimate explanations, on the other hand, attempt to elucidate the evolutionary dynamics that conserve such proximate designs. Proximate and ultimate explanations are, quite generally, mutually illuminating. Knowing

a design's function offers proximate researchers functional targets by which to investigate the specific complexity of a given system. Consider a simple example. To a novice field biologist, the sounds that a bat makes might be woefully mistaken as bird songs. (Indeed, bats have been mistaken for birds.) The assumption that bats sing as birds, if retained, would inevitably produce a superficial and inaccurate model of the proximate systems that underlie these sounds. Bat calls might be interpreted as mating calls or territorial defense signals. On such a model, nothing about a bat's impressive abilities to navigate by echolocation would be noticed. On the other hand, understanding that bat calls enable a blind creature to fly at speed through a three-dimensional environment offers a functional target. Proximate researchers may use this target to fix an interest in the call systems as navigation systems. With the right target at hand, totally new questions arise. How are bat trajectories computed from sound echoes? How does a bat's body absorb these sounds? Do sound and response patterns vary for different tasks, for example, between those of commuting and those of hunting? To notice a functional target, however, is only a preliminary step in the project of reverse-engineering a proximate system's design features. Explaining these design features, moreover, requires orchestrated collaborations among local field experts, acoustical experts, cave geologists, geneticists, and others. Such investigations cannot be conducted without taking to the field and learning facts about bats.

Proximate research may also inform ultimate research. In the first instance, evidence for a proximate design raises evolutionary questions about the design's step-wise historical emergence. What benefits flowed from intermediary designs? Which factors have been conserved over long periods of evolutionary history; which have evolved more recently? How does variation in the designs of species within a clade shed light on past selective environments? Might the proximate navigational systems of bats, say, help to clarify the evolution of proximate navigational systems among other echolocation lineages, such as sperm whales and Amazonian dolphins? Endless forms, endless questions. Evolutionary biology provides a framework for integrating such questions (Wilson 2008): a sturdy intellectual scaffolding within which the facts that scholars of religion have been gathering for dozens of decades can make sense, and contribute to progressive intellectual growth.

Evolutionary considerations apply to humans — we are, after all, organisms — and to those regions of human life that our religions occupy. The principle of intellectual consistency, then, implies that classical scholars of religion should consider the implications of evolutionary dynamics. The same principle, moreover, entails that scientists who study religion should acquire facts about religion from the field. Generally, scientists do not tolerate armchair investigations of nature, and the case of religion offers no exception. Scientists require scholars of religion.

Adaptive or an Adaptation?

Confusion in the evolutionary study of religion arises from failures to distinguish between the homologues “adaptation” and “adaptive.” “Adaptations” are designs whose functional properties evolve to promote survival and reproduction. “Adaptive,” on the other hand, denotes the quality promoting survival and reproduction. Though organic designs evolve because they are adaptive, not every adaptive trait is an adaptation. (For a lucid discussion, see Sosis 2009.) For example, avoiding fast food may be adaptive. Yet humans did not specifically evolve to avoid fast food. Similarly, not all adaptations are currently adaptive. Keeping with this example, our desire for foods loaded with sugar, saturated fats, and salt evolved for its survival value in worlds where nutrition of any kind was variable and scarce. Evolutionary scholars of religion debate whether religious traits are adaptations. That such debates have yet to be resolved suggests that more evidence is needed. Even if religious traits were currently maladaptive, they nevertheless might have evolved, like our love for unhealthy foods, to support life in a pre-modern world. On the other hand, evidence of religion’s current adaptativeness might be a red herring. We might be disposed to religion for reasons unrelated to any immediate benefits. Only careful investigations will decide. The biology of religion has no place for *a priori* doctrines. How can researchers of any kind formulate sensible hypotheses without an expert acquaintance with religious facts? Who will conduct factual investigations if not scholars of religion?

Evolutionary Models

Evolutionary models of religion can be roughly classified into one of three types: (1) by-product models, which suggest that religion is an evolutionary accident; (2) individual selection models, which suggest that religion evolves to enhance individual fitness; and (3) cultural group selection models, which suggest that religion evolved to promote the success of cultural groups. Such types need not be opposed to one another. Selection simultaneously operates at different levels. What is good for the individual might coincide with the good of a group. Several of the models we consider below, however, make distinct and incompatible predictions and thus are genuine rivals.

1) Cultural by-products. Most proximate systems research, as we emphasized above (in the section on “Proximate Explanations”), assumes that religious traits are by-products of functional designs. By-product models are also popular in the ultimate explanations literatures. Here we will consider evolutionary explanations for religion as a cultural by-product.

Kim Sterelny argues that religious beliefs propagate from human epistemic limitations on the one hand, as these interact with cultural learning strategies on the other. Religious explanations offer answers to questions about health, the afterlife, the origins of the world, and the meaning and purpose of life. Such questions arise in areas for which scientific explanations are difficult, inappropriate, or incoherent. Sterelny points out that religious explanations are not similarly invoked to improve military weaponry, an area where success is easy to spot from death counts (2007). Where questions are not easily settled, superstitions rush in, according to Sterelny (2003).

Robert Boyd, Lesely Newson, and Peter Richerson have made the cultural by-product model precise. Using mathematical models to explore specific historical case studies, the authors explain how the benefits of cultural learning compensate for the costs of occasionally harmful cultural transmission (Richerson and Boyd 2005; Richerson and Newson 2008). Is religion, in general, a cultural maladaptation? Richerson and Newson suggest that this question is under-determined by the evidence. Culturally transmitted religious information might be beneficial, neutral, or harmful. More data and analysis are needed to say which (Richerson and Newson 2008). Who will acquire and characterize

such data if not historians of religion? Inventing models is relatively easy; formulating models in terms of hypotheses that make testable predictions is the hard labor of scholarship.

A model superficially similar to the cultural by-product model is the memetic theory of religion. Richard Dawkins and Daniel Dennett argue that bits of religious information are adapted to propagate for their own success in the minds of host believers (Dawkins 1989 [1976]; Dennett 2006). For Dawkins, religion presents a spectacular example of how genetic and epigenetic interests come apart: religion is an adaptation, sure enough, but unfortunately not ours. Dawkins introduced his pathogen version of the memetic model in the 1970s. Since then, the public has come to virtually equate the biology of religion with Dawkin's pathogen theory (For analysis and criticism, see Richerson and Boyd 2005; Sterelny 2006.). Dennett's version argues that symbiosis between religious ideas and their hosts is possible. Certain religious ideas harm, others assist.

We suggest that Dawkins's pathogen model is improbable. While religious traits may sometimes damage religious individuals and religious groups, religion's strong conservation over human history makes it unlikely that it is *generally* harmful. There is a crucial dis-analogy between viruses and ideas. Ideas are, all other things being equal, easier to shed (Lanman 2009). Exhibit A: Richard Dawkins. Exhibit B: those millions who find Dawkins persuasive. On the other side, Dennett's symbiotic model does not indicate the specific learning mechanisms by which symbiosis is maintained. It is a model in need of facts. Who is competent to obtain such facts and to improve these conjectures, if not scholars of religion?

2) Individual adaptations for cooperation. Some evolutionary scholars of religion approach religious traits as adaptations for individual survival and reproduction. Within the individualist selection camp, some conjecture that religiosity evolved for the purposes of anxiety reduction (Boyer and Lienard 2006; Inzlicht, McGregor, Hirsh, and Nash 2009; Kay, Gaucher, McGregor, and Nash 2010). However, we set such explanations to the side. Evolutionary dynamics are unlikely to favor falsely optimistic outlooks for the same reason that evolutionary dynamics are unlikely to tolerate pathogenic ideas: tolerance of unnecessary

and easily avoided costs is bad for the business of survival. Regarding anxiety, we would expect adaptations for fear production to find appropriate levels without the inefficiencies and distortions of supernaturalisms. Indeed, knowing nothing else, we would expect indiscriminate fear reduction of the kind religion is alleged to generate maladaptive responses, and so to be weeded out by selection's grain. Fear, after all, is functional (Bulbulia 2006).

For similar reasons, we will not consider hypotheses that religion evolved to answer existential questions (Atran and Norenzayan 2004; Heine, Proulx, and Vohs 2006; Proulx and Heine 2009). It is remarkable to think that selection would have afforded humans either the time or the patience for such meaning quests. Indeed, some scholars of religion suggest that by adding supernatural threats, many religions substantially increase anxiety (Berger 1990). Comforting religions may be a rare, and recent, historical development (Gervais et al. 2011; Wright 2009).¹⁷

If religious traits are not viruses of the mind, anxiety soaks, or meaning pumps, why might religious traits be selectively favored? A functionalist tradition in anthropology conjectures that religions enhance social solidarity. Émile Durkheim, for example, describes religion as “a unified system of beliefs and practices relative to sacred things... that unite into one single moral community called a Church, all those who adhere to them” (Durkheim, 1995 [1912]:44). The connection between religion and cooperation is so intuitive that some worry there can be no ethical authority without religion. (This objection, incidentally, was long ago refuted in Plato's *Euthyphro*.) If the ultimate explanation for religion lies in the support religion brings to cooperative pursuits, then we would predict that religion would inspire social attachments among the faithful, not merely for deities (as Kirkpatrick conjectures, see above under “Proximate Explanations”).

Beta-generation cognitive accounts of religion did not investigate social-interactive designs because such accounts, by and large, did not consider the relevance of ultimate explanations of religion (Barrett 2000; Boyer 2001; McCauley and Lawson 2002; Whitehouse 2004).

¹⁷ A proviso: Though we will not review viral, anxiety, or existential models, we think that such models should be formulated in terms of testable hypotheses, and tested.

Without the right functional targets, cooperative design features are easily missed. Indeed, evolution might design us to specifically obscure religion's functionality, for such knowledge may impair functionality (see Bulbulia 2011).

In the early 1970s, the evolutionary anthropologist Roy Rappaport argued that religious beliefs have evolved to reduce cheating and free-riding (Rappaport 1971). Rappaport's hypothesis is not original. By the fifth century B.C.E., for instance, the Chinese thinker Mozi had already argued that morally concerned supernatural agents are believed because of the advantages such beliefs bring to the enforcement of social norms. (See Chapter 31, "Explaining Ghosts" in Johnston 2010.) Yet how might supernatural observers evolve to enhance cooperation?

Consider the case of natural observers. Experimental psychologists have long known that individuals who perceive themselves to be observed will behave more cooperatively (Bateson, Nettle, and Roberts 2006; Forsythe, Horowitz, Savin, and Sefton 1994; Gächter and Falk 2002). Still stronger cooperative inducements follow when observers are thought to be capable of harming those who cheat (Johnson and Bering 2009). God/s offer the perfect combination: they may see all, and they may punish all.

Among the most remarkable results in the biology of religion in recent years is the finding that subtle reminders of moralizing God/s increase cooperation even among those who profess no religion (Bering 2005; Mazar, Amir, and Ariely 2008; McKay and Anderson 2007; Saragin et al. 2010; Shariff and Norenzayan 2007). It appears that one need not believe in God/s for religious cues to affect cooperation.

Additional evidence for the supernatural policing model comes from correlational data associating moralizing gods with group size. In a survey of the Standard Cross-Cultural Sample (SCCS), Frans Roes and Michel Raymond (2003) found that warfare tends to favor religions with moralizing "high gods," and relatedly, that religions with moralizing high gods tend to be associated with larger social groups. In a similar study of the same database, Dominic Johnson found a significant correlation between the cultural prominence of "high gods" and a variety of proxy measures of cooperation (2005). In a recent study using a global database for eighty-seven countries, Atkinson and Bourrat found that beliefs in gods and beliefs in afterlives independently

predicted responses to questions about the permissibility of social transgressions (2011). Intriguingly, cooperative affects remained even after the authors controlled for religious attendance, denomination, education, and country of origin. Such correlations are well explained from the benefits to groups who place credence in policing gods. The authors notice, however, that causation cannot be determined from their correlational designs. Who will study the evolutionary dynamics of god concepts if not historians of religion? (For recent examples of such interdisciplinary studies see Slingerland and Chudek 2011.)

3) Cultural group adaptations. Beta-generation cognitive scholars of religion, we have noticed above, took little interest in culture. On the other hand, next-generation cognitive scientists argue for strong dependencies of religious cognition on religious cultures (Day 2004; Geertz 2010; Jensen 2003; Atran and Henrich 2010). What is the evolutionary importance of religious cultures?

Some argue that religious cultures evolve to benefit religious groups. Since the late 1960s, mainstream evolutionary biologists have viewed theories of group selection with suspicion, antipathy, or worse. Their reaction was a justifiable response to naïve ideas about cultural groups as genetically-constructed mega-organisms. (For examples of the mega-organism model, see Allee, Emerson, Park, and Schmidt 1949; Wynne-Edwards 1962.) Since the 1970s, David Sloan Wilson has led a movement to reformulate a concept of cultural group selection in a manner that is both biologically correct and theoretically illuminating (2006; Wilson and Wilson 2007). According to Wilson's reformulation, the unit of selection must be conceived as any trait that may be transmitted with high fidelity, that affects behavior, and that affects outcomes for the factors that produce such traits. Phenotypic traits may be expressed from genetic factors, but they may also be stably expressed from cultural factors (see Sober and Wilson 1998). Wilson argues, plausibly we think, that many human phenotypic traits are best explained as culturally-selected traits. This idea opens the prospect for religious cultural trait groups and lineages.

Not only has Wilson reinvented group selection, he has applied the model to the evolutionary study of religious cultural groups (2002; 2005). Wilson claims that while religions lack "factual realism," their

“practical realism” facilitates efficient social coordination (2002). How do religious cultural group traits affect social behaviors, and how do such groups evolve? Wilson hopes to answer such questions by combining the reverse-engineering techniques employed in human behavioral ecology (see Bulbulia and Sosis 2011) with cultural evolutionary analysis (see Boyd and Richerson 2005; Atran and Henrich 2010). Behavioral ecologists model the evolution of behaviors in terms of costs and benefits. Wilson urges classically-trained scholars of religion to investigate the cost-to-benefit ratios of religious cultural group traits. For over a decade, Wilson, a theoretical biologist, has aggressively pursued such collaborations.¹⁸

Are there any features common to successful religious cultures? Some argue that the differential success of high god doctrines, reported above, explains the historical diffusion of high god religions (Norenzayan and Shariff 2008). Gervais et al. (2011) develop an informal model for evaluating this co-evolutionary model. The authors contrast the religions of small-scale societies with those of the major world religions, such as Christianity, Islam and Buddhism, noting that popular religions more explicitly link supernatural beliefs with pro-social norms (see Swanson 1960; Wright 2009). The model proposed by Gervais et al. is interesting because it incorporates the genetic and cultural evolution of religion within a general evolutionary framework. Their model allows basic, panhuman dispositions for religion. Yet it also explains the specific quality of variance in the distribution of religious cultures from variations in culturally-mediated traits — beliefs in “high gods.” While the authors’ explanation for the diffusion of moralizing deities is plausible, it is built on interpretations of the Swanson database. Can this database be trusted? Only historians of religion acquainted with the relevant facts can evaluate this database. If researchers plant conceptual potatoes, they will harvest conceptual potatoes, no matter how precise their instruments.

¹⁸) See: <http://evolution.binghamton.edu/religion/>.

New Horizons for Integration

Norms

As scholars of religion understand, the link between religion and cooperation is more extensive than is captured by the policing God/s hypothesis. Religious convictions seem to undergird a certain class of social norms in a manner that imbues religious norms with a special psychological force (see Durkheim 1995 [1912]; Radcliffe-Brown 1922). Certain norms are regarded as sacred. An intriguing hypothesis connecting supernatural beliefs to the evolution of sacred norms comes from Roy Rappaport, who conjectured that deities boost norms by “sanctifying” them. Sanctification, in turn, affords the intrinsic motivations that enable large-scale cooperative networks to evolve: “Human organisation could not have come into existence, or persisted, in the absence of ultimate sacred propositions and [the] sanctification of discourse” (1971:29). Rappaport’s model coheres with anthropological observations that religions recruit intrinsic values for cooperative ends. His model is interesting, moreover, because as every scholar of religion is aware, intrinsic motivations drive religious cognition and its behavioral effects. Religious morality is not merely a case of fearing God’s wrath.

Experimental philosophers and social psychologists have accumulated considerable evidence for a distinction between (1) intrinsic moral absolutes and (2) conventional norms (Harman 1998; Joyce 2006; Pyysiäinen and Hauser 2010). Conventional norms occupy the thoughts of Miss Manners: they regulate modes of greeting and farewell, of forms of address, of road rules, and of appropriate dress at the beach and office. Such norms are recognized as culturally specific, as authority-dependent, and for the most part, as arbitrary. Their violation generally inspires only weak emotional responses. Moral absolutes, by contrast, are judged as universally binding, as authority-independent, and as certain as anything we may know. Murdering an innocent or torturing a child is felt to be categorically different from talking too much, or passing gas in an elevator; killing or torturing innocents is wicked. Moral absolutes are furthermore linked to spontaneous, self-motivated punitive sentiments. We wish to harm moral transgressors (Turiel 2010). Yet we do not (seriously) seek mortal vengeance for rude dinner guests.

Notably, moral judgments appear early in childhood (Nichols and Folds-Bennett 2003), are universally observed, and appear to have originated early in human history, perhaps before hominids were human (Sterelny 2003). Although debates linger about where to draw the line between moral and conventional norms, categorical differences between such types are widely observed (Huebner, Lee, and Hauser 2010; Nucci, Turiel, and Encarnacion-Gawrych 1983; Wellman, Fang, Liu, Zhu, and Liu 2006). The functional benefits of moralizing norms become apparent when we connect the motivating power of such norms to the problems of cooperation. Intrinsically motivating norms require no calculation of costs and benefits. To motivate cooperation, sacred norms require no hellish punishments or heavenly rewards, which may be discounted against time (Bulbulia 2004b). Sacred norms are self-motivating, and so may rapidly and automatically inspire punitive attitudes (Atran and Axelrod 2008; Fessler 2006; Sripada and Stich 2006:281; Taves 2010). Sacred norms manufacture their own motivational fuels.

Given that sacred norms appear sufficient to express cooperative behaviors among those bound by a common faith, an important question for the biological study of religions is whether beliefs in God/s are necessary for moral norms to retain their distinctive psychological force. The philosopher Charles Taylor has long argued for a distinction between what he calls “strong evaluations” (moral absolutes) and “weak evaluations” (conventions). For Taylor, moral evaluations are associated with powerful social emotions and are linked to perceived metaphysical realities, even when they occur in secular contexts (Taylor 1989; see also Anscombe 1958). Taylor documents the manner in which earlier societies viewed this link to supernatural authority in explicit mythological terms: moral commitments were uniquely important because they possessed supernatural warrants (sanctification). Taylor argues, however, that even the abstract ideals associated with morality in more recent, secular cultures offer what amount to functional equivalents to the sanctifying God/s of former societies. For many people, it is taken for granted that the demands of secular morality — for example those of justice, of equality, and of constitutional rights — are indubitable truths whose violation must be punished (1989; 2007). Taylor’s account of secular morality suggests the hypothesis that implicit supernatural beliefs of some type — perhaps de-anthropomorphised and

diffuse — underlie secular moral judgments (Bering 2006; Slingerland 2008). Taylor's account also raises the alternative hypothesis that both religious and secular absolutes are the effects of more basic social sensibilities, which humans interpret through cultural scripts, related to God/s or related to secular justice, depending on local histories (Boyer 2001; Boyer and Lienard 2006; Haidt and Kesebir 2010; Pyysiäinen and Hauser 2010). Taylor's work illustrates how discerning philosophers, armed with historical facts, may help evolutionary researchers to better appreciate the relationship between genetic and cultural evolution.

Cooperative Niche Construction

While cultural evolutionary models of religion focus on the dynamics of religious change, “niche-construction” models focus on the mechanisms that enable conservation. Questions that occupy niche-construction models include, “How are moral norms retained over time?” and “How are moral norms maintained across large populations and across large geographical territories?” The conservation of cooperative norms over time and their management across large territories becomes especially difficult to explain after norms have failed locally. As we have noticed above, humans are flexible learners. All norms will occasionally fail. Knowing nothing else then, we might have expected that unsuccessful norms would have been quickly unlearned. Why, then, have ancient religious norms been retained so relatively faithfully (Bulbulia 2012)?¹⁹ Niche construction considers the benefits both of religious change and of its conservation (see Bulbulia 2008b; Bulbulia and Schjoedt 2010; Bulbulia and Sosis 2011; Ostrom 2005; Turchin 2006). Such models notice that religious rites will coordinate the expression of pro-social motivations only among those who share a common faith. Sharing a faith in common demands that faiths remain interpretable, and so relatively constant, across those territories in which the faithful transact. In this respect religion is like a currency: to affect behavior of unknown

¹⁹ While many moral absolutes do change (most now regard chattel slavery, torture, the subjugation of women, vivisection, and other human calamities as wicked — thankfully) core religious norms have remained relatively stable for twenty centuries, and more. Some norms change, but core features are also retained.

partners the manifest properties of a currency must be recognized and affect social behaviors in similar ways. Stability facilitates this recognition. As religious cultures grow and spread, the recognition problem is made easier from conservation. Niche construction predicts that solutions to the recognition problem will manifest in historical effects, as the conservation of core properties. It also predicts that conservation itself will be among a religion's most cherished values. While niche contraction makes sense of the fidelity of religious transmission, its predictions remain largely untested. Do common faiths arise before, or after, the rise of cooperative civilizations? Moreover, basic measurements for rates of change within religious traditions are lacking. Progress in the evolutionary study of symbolic ecologies and of the institutions that manage them requires the collaborative efforts of historians of religion and biologists of religion, our recurring mantra.

Signaling Models

If we suppose that religious commitments motivate cooperative commitments, why do cheaters not evolve to exploit religiously-motivated cooperation? Signaling models find a recognition problem of another kind. If religious co-operators are to avoid cheaters, religious co-operators must reliably recognize and communicate their authentic religiosity. Faked religion must be easily detected as such.

Signaling models notice that wherever (1) religious commitment is intrinsically linked to cooperative commitment from fear of God's wrath, from sacred values, or from some other motivating resources, (2) and undertaking religious costs is difficult, awkward or impossible for those who lack the religious commitments, then (3) acts of undertaking religious costs will enable audiences to separate the cooperative wheat from the defecting chaff and so will enable the faithful to assort. In a slogan, religious costs function as cooperative signals (Bulbulia 2004b; Irons 1996, 2001, 2008; Schloss 2008; Sosis 2003). (For a recent review of the issues, see Schloss and Murray 2011.)

What prevents cheaters from easily faking religion, paying religious costs only to defect for a greater gain? Signaling models notice that cooperative signals are intrinsically linked to the motivations they name. Consider religious emotions. As the economist Robert Frank points out (1988), emotions quite generally are public, difficult to fake,

and intrinsically linked to specific motivational states. It is difficult to fake a rage, harm an innocent, or apologize without meaning it. What is more, emotions have public manifestations. They are easily detected and difficult to silence. Difficult does not mean impossible. To evolve as signals, emotions need not communicate motivations infallibly.²⁰ A functional explanation for the conservation of emotional religious rituals comes from the relative difficulty involved in effectively faking religious emotions, together with their capacity to communicate motivations (Alcorta and Sosis 2005; Bulbulia 2004b, 2008a; Schloss 2008). Religious costs appear functionally ordained to solve the cheater-detection problem.

What is the evidence for religious signaling? In a historical study of nineteenth-century communes, Richard Sosis found that religious communes were four times as likely in any given year to outlast secular communes (2000). He also found that the most costly of the religious communes in his sample were also the most successful (Sosis and Bressler 2003). Were the costly communes better able to differentiate cheaters? In a subsequent study conducted in Israel, Sosis and Ruffle found that participation in religious rituals strongly predicted cooperation in a public goods game that mimics real-world cooperation dilemmas (2004). Similar effects have been confirmed in cultural settings outside of Israel (Bulbulia and Mahoney 2008; Soler 2008).

Religious signaling models shed new light on permanent ritual markings. Notably, such markings do not change with the vagaries of emotion. It has long been known that many religious rituals score participants with indelible, easily detected, marks. Such marks come in the form of tattoos, scars, circumcisions, missing teeth, mutilated feet, and others. Such marks become associated with specific groups because they are symbolic markers, so that permanent marking offers an especially effective commitment device. Those symbolically marked cannot not live easily, if at all, after a symbolic opposition has assumed control. Once symbolically marked, one is forever branded, and so forever committed.

In an important study, Sosis and colleagues found a positive linear relationship between practices of permanent markings and extrinsic

²⁰) Emotions may lie, yet may nevertheless evolve as signals wherever signalling benefits exceed the costs of signalling failures.

threats of war (Sosis, Kress, and Boster 2007). Without the signaling model at hand, however, the idea of linking permanent marking to warfare might not have occurred to Sosis or anyone else. Were it to occur, the idea might fail to convince. To evaluate the claim that symbolic markings function as cooperative signals, statistical methods and large data sets are needed. Sosis and colleagues provided both. Their results form a platform for further research, because little is known about how religious systems foster cooperative communication.

Finally, if honest signaling were a mechanism for assuring cooperative commitments, it would be reasonable to predict that within-group prestige acquired through signaling practices would facilitate the cultural transmission of religious information. Joseph Henrich offers a model according to which costly signaling practices combine with cultural learning to foster the spread of cooperative religions. According to Henrich's integrated model, religious moralities evolve from a combination of signaling sensitivity and learning biases to trust only those who prove their credibility. This combination favors the cultural learning of religious moralities from elites who reliably signal authentic cooperative commitments. Henrich calls such cooperative signals "credibility enhancing displays" or "CREDS" (2009).

While Henrich's model is plausible, do the faithful trust religious authority from credibility signals? How do institutional roles affect interpretations and responses? (See Schjoedt et al. 2011.) While preliminary evidence supports signaling approaches to religion, many questions remain for scholars of religion whose training uniquely places them to put signaling hypotheses to the test.

Fertility

Robert Rowthorn has recently explored the co-evolutionary dynamics of genetic and cultural evolution (2011). Rowthorn offers a "how-possible" model for the persistence of religious genes, even in secular worlds that are increasingly hostile to religion. His model notices that where religion causes high fertility, the factors that lead us to be religious will be retained even as members of religious groups convert to secular lifeways. If there were no de-conversion, highly fertile religious groups such as the Amish and Hutterites would swamp non-religious and low-fertility religious groups in a matter of centuries (Kaufmann

2010; Rowthorn 2011).²¹ Rowthorn expects that the growth rate of pro-natal religious groups will slow down because he expects the rate of defection to increase. According to his crystal ball, secularity's blandishments will prove irresistible. Rowthorn's model is important because it demonstrates how a core group of fertile religionists is capable of spreading any genes associated with religion to the rest of society. The endurance of religious traits is possible even when adults in religious communities defect at a high rate. Rowthorn's surprising result offers an example of how small differences in fertility tend to snowball into large differences at the level of population structures. The demographic transition to the low birth rates, which characterizes secular industrial societies (Newson 2009), may not prevent religion's long-term success. If secularity is resisted, it may be that the devout will some day build temples on the graves of secularists. We might better predict the future of religion and of secularity were we to understand their past. How have religions affected fertility and conversion in recent history? What other factors have intervened? Such questions have yet to be raised, let alone answered, within an evolutionary framework. Historians and philosophers of religion will eventually rise to their challenge (see Turchin 2006).

Conclusion

The past several decades have seen growing interest in the study of religions as biological phenomena. For the most part, this research has been conducted outside of mainstream scholarship in religious studies. Scholars of religion, and the wider public, have instead come to know the biology of religion primarily through a handful of popular books (Dawkins 2006; Dennett 2006). However it is the less-publicized works, only a handful of which we have discussed here, that have produced the field's most impressive results.

²¹) Between 1991 and 2010 the Amish grew in the United States from a population of 123,000 to a population of 250,000. This is still a small fraction of the total American population, hardly noticeable to anyone outside their isolated communities. But at this rate of expansion the Amish would boast 44,000,000 members by the year 2150, a substantial fraction of the American population. Similar rates of growth apply for the Hutterites and Orthodox Jews, and lower but significant explosions may be predicted for conservative Christians and Muslim communities.

Consider several key findings. Despite strikingly apparent variation among religious traditions, basic dispositions for religion are explicable in terms of universal human cognitive capacities. Stable features of religious cognition appear to be anchored in genetically-structured designs. Learning nevertheless matters. Genetic designs, which prompt children and adolescents to acquire information from trusted authorities, lead to variation in beliefs, attitudes, and values. This variation affects behaviors, altering the structure and distribution of religious cultures. Initial cultural variability, in turn, affects the subsequent development of religious institutions, doctrines, rites, and material ecologies. Such developments, in turn, affect downstream cognitive and behavioral religious traits. There is much complexity in the genetic and the epigenetic systems that express, regulate, and conserve religious traits, making for complicated explanations. Complicated explanations are not well-suited to those who prefer their ideas in nutshells. Then again, ideas that can fit into nutshells deserve to remain there.

We hope that our readers retain a sense of the complexity that has been discovered for the causes of religion. We also hope that readers retain a sense of optimism for intellectual progress in the decades ahead, as the barriers between disciplines begin to become more permeable.

While biologists of religion agree that religious systems are the products of evolutionary dynamics, we have described several areas of fruitful disagreement about the scope and adequacy of specific proximate and ultimate explanations. A key difference between the disagreements of those life scientists who study religions and the disagreements familiar to classical religious studies scholars is that scientific debates almost never result in deadlocks. Data can, and do, resolve scientific disputes. Indeed, disagreements fuel progress. Hypotheses are formulated, their predictions are tested, and understanding grows. Scholars of religion, in our view, deserve an intellectual community that supports such intellectual growth. They deserve to re-conceive the study of religion as a life science.

When framed as a dimension of human biology it becomes apparent that much, in fact nearly everything, about religion remains to be discovered. Progress in the biology of religion, we have urged, will only arrive from a more thoroughgoing collaboration of religious studies experts and life scientists. Our argument for collaboration has not been pitched exclusively to scholars of religion. A science without facts is not

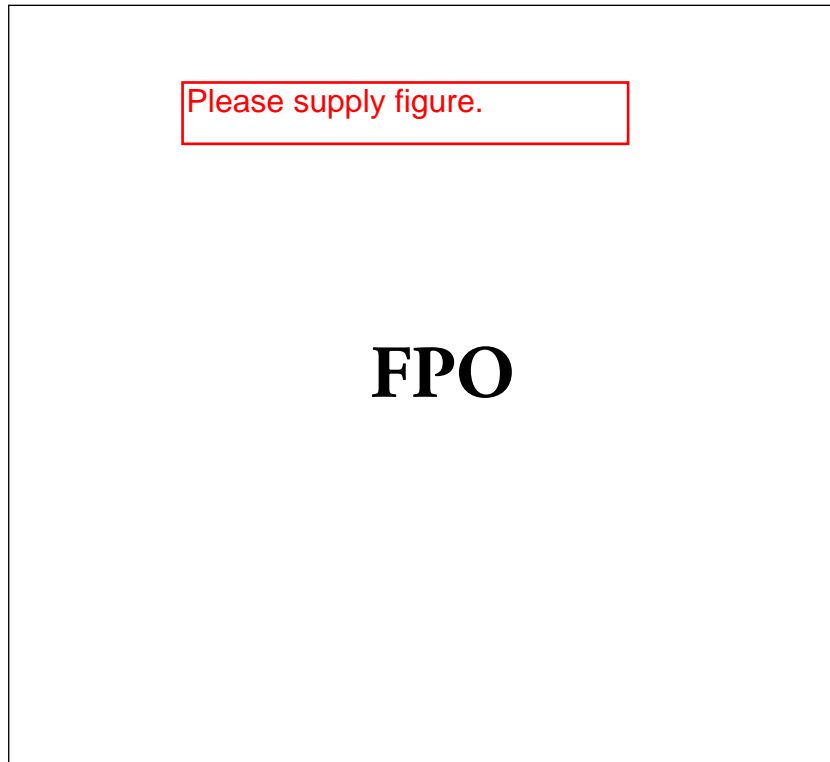


Figure 1. Evolutionary religious scholars approach religious systems as the effects of complex co-evolutionary dynamics.

a science. We hope that our review helps biologists of religion better to appreciate the need for religious studies experts.

We have noticed that some collaboration is already occurring, and that classically-trained scholars of religion have launched, and have assumed leading roles, in ambitious collaborative projects.²² While some theoretical quarters of religious studies harbor eddies of suspicion

²²) For examples, see:

<http://teo.au.dk/en/research/current/cognition>
<http://evolution.binghamton.edu/evos/>
<http://www.cam.ox.ac.uk/research/explaining-religion/exrel-events/>
<http://www.ibcsr.org/>

(e.g., Day 2010), a larger tide is turning in favor of more vigorous integration (e.g., Paden forthcoming; Taves 2009; Wilson and Green 2011). In 2005, the International Association for the Cognitive Study of Religion was established.²³ Its members come from a variety of disciplines in the humanities, the social sciences, and the natural sciences. In 2008, Patrick McNamara, Richard Sosis, and Wesley Wildman founded an Institute for the Biocultural Study of Religion, with the ambitious project of creating a database cataloguing all research on science, health, and religion.²⁴ New journals and book series have been launched.²⁵ Venues for the communication of ideas among scholars of religion and life scientists have been created within the frameworks of older scholarly organizations, including the American Academy of Religion, which recently sponsored a unit in the Cognitive Science of Religion. In 2010, the International Association for the History of Religion boasted over forty papers and several keynote addresses in the cognitive and evolutionary study of religions. Such events were attended by life scientists and by classical scholars of religion alike, with no intellectual holds barred. Sparks were flying.

We hope that scholars of religion will be persuaded to accept the challenges ahead. Biological approaches to religion are not merely optional, one among the many “theories” or “methods” on offer at the marketplace of ideas. Recent biological studies of religion afford a glimpse of how most scholarship in religious studies will be conducted in the future. The principles of hypothesis testing, of intellectual consistency, and of methodological naturalism will eventually bring a unification of religious studies with the rest of the biological sciences.

We hope, finally, that our review has helped to communicate some of the ways in which this unification is already occurring, and of how

²³) <http://www.iacsr.com/iacsr/Home.html>.

²⁴) <http://www.ibcsr.org/>.

²⁵) *Religion, Brain and Behaviour*: <http://www.tandf.co.uk/journals/RRBB>
Journal for the Cognitive Science of Religion: <http://www.equinoxjournals.com/index.php/JCSR/index>
Journal for Cognition and Culture: www.brill.nl/journal-cognition-and-culture
 Religion Cognition and Culture series, *Equinox*:

<http://www.equinoxpub.com/equinox/books/browse.asp?serid=31>

Cognitive Science of Religion Series, Berlin Academic: <http://www.berlinacademic.com/>.

the biological study of religions is contributing fundamental insights to the larger intellectual projects of understanding life's endless forms, most beautiful and most wonderful.

Acknowledgments

We are grateful to Olav Hammer for his help, and to an anonymous referee for insightful comments. Thanks to Aidan MacCleod for help with the manuscript. Victoria URF Grant Award 8-3046-108855 supported part of this research.

References

- Alcorta, C., and R. Sosis. 2005. "Ritual, Emotion, and Sacred Symbols: The Evolution of Religion as an Adaptive Complex." *Human Nature* 16(4):323–359.
- Allee, W. C., A. E. Emerson, O. T. Park, and K. T. Schmidt. 1949. *Principles of Animal Ecology*. Philadelphia: Saunders.
- Anscombe, G. E. M. 1958. *Modern Moral Philosophy: The Collected Philosophical Papers of G. E. M. Anscombe*, Vol. 3, *Ethics, Religion and Politics*. Oxford: Basil Blackwell.
- Atkinson, Q., and P. Bourrat. 2011. "Beliefs about God, the Afterlife and Morality Support the Role of Supernormal Policing in Human Cooperation." *Evolution and Human Behavior* 32(1):41–49.
- Atkinson, Q., and H. Whitehouse. 2011. "The Cultural Morphospace of Ritual Form: Examining Modes of Religiosity Cross-culturally." *Evolution and Human Behavior* 32(1):50–62.
- Atran, S. 2002. *In Gods We Trust: The Evolutionary Landscape of Religion*. New York: Oxford University Press.
- Atran, S., and A. Norenzayan. 2004. "Religion's Evolutionary Landscape: Counterintuition, Commitment, Compassion, Communion." *Behavioral and Brain Sciences* 27:713–770.
- Atran, S., and J. Henrich. 2010. "The Evolution of Religion: How Cognitive By-products, Adaptive Learning Heuristics, Ritual Displays, and Group Competition Generate Deep Commitments to Prosocial Religions." *Biological Theory* 5(1):18–30.
- Atran, S., and R. Axelrod. 2008. "Reframing Sacred Values." *Negotiation Journal* 24(3):221–246.
- Azari, N., and M. Slors. 2007. "From Brain Imaging Religious Experience to Explaining Religion: A Critique." *Archive for the Psychology of Religion* 29:67–85.
- Azari, N. P., and D. Birnbacher. 2004. "The Role of Cognition and Feeling in Religious Experience." *Zygon* 39(4):901–917.

- Azari, N. P., J. Missimer, and R. J. Seitz. 2005. "Religious Experience and Emotion: Evidence for Distinctive Cognitive Neural Patterns." *International Journal for the Psychology of Religion* 15(4):263–281.
- Azari, N. P., J. Nickel, G. Wunderlich, and M. Niedeggen. 2001. "Neural Correlates of Religious Experience." *European Journal of Neuroscience* 13:1649–1652.
- Baron-Cohen, S. 1995. *Mindblindness: An Essay on Autism and Theory of Mind*. Cambridge, Mass.: MIT Press.
- Barrett, H., P. Todd, G. Miller, and P. Blythe. 2005. "Accurate Judgments of Intention from Motion Cues Alone: A Cross-cultural Study." *Evolution and Human Behavior* 26(4):313–331.
- Barrett, J. L. 2000. "Exploring the Natural Foundations of Religion." *Trends in Cognitive Sciences* 4(1):29–34.
- Bateson, M., D. Nettle, and G. Roberts. 2006. "Cues of Being Watched Enhance Cooperation in a Real-world Setting." *Biology Letters* 2:412–414.
- Berger, P. 1990. *The Sacred Canopy: Elements of a Sociological Theory of Religion*. New York: Doubleday.
- Bering, Jesse. 2002. "Intuitive Conceptions of Dead Agents' Minds: The Natural Foundations of Afterlife Beliefs as Phenomenological Boundary." *Journal of Cognition and Culture* 2(4):263–308.
- Bering, J., and B. Parker. 2006. "Children's Attributions of Intentions to an Invisible Agent." *Developmental Psychology* 42(2):253–262.
- Bering, J. M. 2005. "The Evolutionary History of an Illusion: Religious Causal Beliefs in Children and Adults." In B. Ellis and D. F. Bjorklund (eds.), *Origins of the Social Mind: Evolutionary Psychology and Child Development*, New York: Guilford Press, 411–437.
- . 2006. "The Folk Psychology of Souls." *Behavioral and Brain Sciences* 29: 453–498.
- Bloom, P. 2004. *Descartes' Baby: How the Science of Child Development Explains What Makes Us Human*. New York: Basic Books.
- Boyd, R., and P. Richerson. 2005. *The Origin and Evolution of Cultures*. New York: Oxford University Press.
- Boyer, P. 1994. *The Naturalness of Religious Ideas: A Cognitive Theory of Religion*. Berkeley: University of California Press.
- . 2001. *Religion Explained: The Evolutionary Origins of Religious Thought*. New York: Basic Books.
- . 2008. "Religion: Bound to Believe?" *Nature* 455(7216):1038–1039.
- Boyer, P., and B. Bergstrom. 2008. "Evolutionary Perspectives on Religion." *Annual Review of Anthropology* 37:111–130.
- Boyer, P., and C. Ramble. 2001. "Cognitive Templates for Religious Concepts: Cross-cultural Evidence for Recall of Counter-intuitive Representations." *Cognitive Science* 25:535–564.
- Boyer, P., and J. V. Wertsch (eds.). 2009. *Memory in Mind and Culture*. Cambridge, U.K.: Cambridge University Press.

- Boyer, P., and P. Lienard. 2006. "Why Ritualized Behavior? Precaution Systems and Action Parsing in Developmental, Pathological and Cultural Rituals." *Behavioral and Brain Sciences* 29(6):595–613.
- Bulbulia, Joseph. 2004a. "The Cognitive and Evolutionary Psychology of Religion." *Biology and Philosophy* 18(5):655–686.
- . 2004b. "Religious Costs as Adaptations that Signal Altruistic Intention." *Evolution and Cognition* 10(1):19–38.
- . 2005. "Are There Any Religions?" *Method and Theory in the Study of Religion* 17(2):71–100.
- . 2006. "Nature's Medicine: Religiosity as an Adaptation for Health and Cooperation." In P. MacNamara (ed.), *Where Man and God Meet: The New Sciences of Religion and Brain*, Westwood: Greenwood Publishers, 87–121.
- . 2008a. "Free Love: Religious Solidarity on the Cheap." In J. Bulbulia, R. Sosis, R. Genet, E. Harris, K. Wyman, and C. Genet (eds.), *The Evolution of Religion: Studies, Theories, and Critiques*, Santa Margarita, Calif.: Collins Foundation Press, 153–160.
- . 2008b. "Meme Infection or Religious Niche Construction? An Adaptationist Alternative to the Cultural Maladaptationist Hypothesis." *Method and Theory in the Study of Religion* 20(1):67–107.
- . 2011. "The Hypnotic Stag Hunt." *Journal of Cognition and Culture* 11:353–365.
- . 2012. "Spreading Order: Religion, Cooperative Niche Construction, and Risky Coordination Problems." *Biology and Philosophy* 27(1):1–27.
- Bulbulia, J., and A. Mahoney. 2008. "Religious Solidarity: The Hand Grenade Experiment." *Journal of Cognition and Culture* 8:295–320.
- Bulbulia, J., and P. Reddish. Forthcoming. "Explaining Effervescence." In G. Dawes and I. Maclaurin (eds.), *A New Science of Religions*, New York: Routledge.
- Bulbulia, J., and R. Sosis. 2011. "Signalling Theory and the Evolution of Religious Cooperation." *Religion* 41(3):363–388.
- Bulbulia, J., and U. Schjoedt. 2010. "Charismatic Culture and Prediction under Risk: Perspectives from Social Neuroscience." In I. Pyysiainen (ed.), *Religion, Economics, and Evolution*. New York: de Gruyter, 35–59.
- . Forthcoming. "The Neural Basis of Religious Belief." In F. Krueger and J. Grafman (eds.), *The Neural Basis of Human Belief Systems*, Psychology Press.
- Cho, F., and R. Squier. 2008. "'He Blinded Me with Science': Science Chauvinism in the Study of Religion." *Journal of the American Academy of Religion* 76(2):420–448.
- Chomsky, Noam. 2000. *New Horizons in the Study of Language and Mind*. Cambridge, U.K.: Cambridge University Press.
- Cohen, E. 2007. *The Mind Possessed: The Cognition of Spirit Possession in an Afro-Brazilian Religious Tradition*. New York: Oxford University Press.
- Cosmides, L., and J. Tooby. 1992. "The Psychological Foundations of Culture." In J. H. Barkow, L. Cosmides, and J. Tooby (eds.), *The Adapted Mind: Evolutionary Psychology and the Generation of Culture*, New York: Oxford University Press, 19–136.

- Crespi, B., and C. Badcock. 2008. "Psychosis and Autism as Diametrical Disorders of the Social Brain." *Behavioral and Brain Sciences* 31(3):241–261.
- Crespi, B., P. Stead, and M. Elliot. 2009. "Comparative Genomics of Autism and Schizophrenia." *Proceedings of the National Academy of Science* 107:1736–1741.
- Darwin, Charles. 1981 [1871]. *The Descent of Man and Selection in Relation to Sex*. Princeton: Princeton University Press.
- . 1989 [1859]. *The Origin of Species*. London: William Pickering.
- Dawkins, Richard. 1989 [1976]. *The Selfish Gene*. New York: Oxford University Press.
- . 2006. *The God Delusion*. Boston: Houghton Mifflin.
- Day, M. 2004. "Religion, Off-Line Cognition and the Extended Mind." *Journal of Cognition and Culture* 4(1):101–121.
- . 2010. "How to Keep It Real." *Method and Theory in the Study of Religion* 22(4):272–282.
- Dennett, Daniel. C. 1991. *Consciousness Explained*. Boston: Little, Brown and Co.
- . 2006. *Breaking the Spell: Religion as a Natural Phenomenon*. New York: Viking.
- Durkheim, Émile. 1995 [1912]. *The Elementary Forms of Religious Life*. Trans. K. Fields. New York: Free Press.
- Evans, E. M. 2000. "The Emergence of Beliefs about the Origin of Species in School-age Children." *Merrill Palmer Quarterly* 46:221–254.
- . 2001. "Cognitive and Contextual Factors in the Emergence of Diverse Belief Systems: Creation versus Evolution." *Cognitive Psychology* 42:217–266.
- Fessler, D. M. T. 2006. "Steps toward an Evolutionary Psychology of a Cultural-dependent Species." In P. Carruthers, S. Laurence, and S. Stich (eds.), *The Innate Mind*, Vol. 2, *Culture and Cognition*, Oxford: Oxford University Press, 61–77.
- Fondevila, S., M. Martín-Loeches, L. Jiménez-Ortega, P. Casado, A. Sel, A. Fernández-Hernández, and W. Sommer. 2011. "The Sacred and the Absurd — An Electrophysiological Study of Counterintuitive Ideas." <http://www.tandfonline.com/doi/abs/10.1080/17470919.2011.641228> (also forthcoming in *Social Neuroscience*).
- Forsythe, R., J. L. Horowitz, N. E. Savin, and M. Sefton. 1994. "Fairness in Simple Bargaining Experiments." *Games and Economic Behavior* 6:347–369.
- Foster, K. R., and H. Kokko. 2009. "The Evolution of Superstitious and Superstition-like Behaviour." *Proceedings of the Royal Society of London Biological Sciences* 276:31–37.
- Frank, R. 1988. *Passions within Reason: The Strategic Role of the Emotions*. New York: Norton and Company.
- Gachter, S., and A. Falk. 2002. "Reputation and Reciprocity: Consequences for the Labour Relation." *Scandinavian Journal of Economics* 104:1–26.
- Geertz, A. 2010. "Brain, Body and Culture: A Biocultural Theory of Religion." *Method and Theory in the Study of Religion* 22:304–321.
- Geertz, A. W., and G. I. Markusson. 2010. "Religion Is Natural, Atheism Is Not: On Why Everybody Is Both Right and Wrong." *Religion* 40(3):152–165.

- Gelman, S., and K. Kremer. 1991. "Understanding Natural Cause: Children's Explanations of How Objects and Their Properties Originate." *Child Development* 62:396–414.
- Gervais, W., A. Willard, A. Norenzayan, and J. Henrich. 2011. "The Cultural Transmission of Faith: Why Natural Intuitions and Memory Biases Are Necessary, but Insufficient, to Explain Religious Belief." *Religion* 3:389–410.
- Guthrie, S. 1980. "A Cognitive Theory of Religion." *Current Anthropology* 21(2):181.
- . 1993. *Faces in the Clouds: A New Theory of Religion*. New York: Oxford University Press.
- . 2008. "Spiritual Beings: A Darwinian, Cognitive Account." In J. Bulbulia, R. Sosis, R. Genet, E. Harris, K. Wyman, and C. Genet (eds.), *The Evolution of Religion: Studies, Theories, and Critiques*, Santa Margarita: Collins Foundation Press, 239–248.
- Haidt, J., and S. Kesebir. 2010. "Morality." In S. Fiske and D. Gilbert (eds.), *Handbook of Social Psychology*, Vol. 2 (5th edition), New York: Oxford University Press, 797–832.
- Haack, Susan. 2003. *Defending Science Within Reason: Between Scientism and Cynicism*. Amherst: Prometheus Books.
- Harman, G. 1998. "Moral Philosophy and Linguistics." In K. Brinkmann (ed.), *Proceedings of the Twentieth World Congress*, Vol. 1, *Ethics*, Bowling Green: Philosophical Documentation Center, 107–115.
- . 2000. *Reasoning, Meaning, and Mind*. Oxford: Clarendon Press.
- Harris, P., and M. Koenig. 2006. "Trust in Testimony: How Children Learn about Science and Religion." *Child Development* 77(3):505–524.
- Heine, S., T. Proulx, and K. Vohs. 2006. "The Meaning Maintenance Model: On the Coherence of Social Motivation." *Personality and Social Psychology Review* 10(2):88–110.
- Henrich, J. 2009. "The Evolution of Costly Displays, Cooperation, and Religion: Credibility Enhancing Displays and Their Implications for Cultural Evolution." *Evolution and Human Behaviour* 30:244–260.
- Huebner, B., J. Lee, and M. Hauser. 2010. "The Moral-Conventional Distinction in Mature Moral Competence." *Journal of Cognition and Culture* 10(1–2):1–26.
- Inzlicht, M., I. McGregor, J. B. Hirsh, and K. Nash. 2009. "Neural Markers of Religious Conviction." *Psychological Science* 20(3):385–392.
- Irons, W. 1996. "Morality as an Evolved Adaptation." In J. P. Hurd (ed.), *Investigating the Biological Foundations of Morality*, Lewiston: Edwin Mellon Press, 1–34.
- . 2001. "Religion as Hard-to-Fake Sign of Commitment." In R. Nesse (ed.), *Evolution and the Capacity for Commitment*, New York: Russell Sage Foundation, 292–309.
- . 2008. "Why People Believe (What Other People See As) Crazy Ideas." In J. Bulbulia, R. Sosis, R. Genet, E. Harris, K. Wyman, and C. Genet (eds.), *The Evolution of Religion: Studies, Theories, and Critiques*, Santa Margarita: Collins Foundation Press, 51–60.

- Jensen, J. S. 2003. *The Study of Religion in a New Key: Theoretical and Philosophical Soundings in the Comparative and General Study of Religion*. Aarhus, Denmark: Aarhus University Press.
- Johnson, D. 2005. "God's Punishment and Public Goods: A Test of the Supernormal Punishment Hypothesis in 186 World Cultures." *Human Nature* 16(4): 410–446.
- Johnson, D., and Bering, J. 2009. "Hand of God, Mind of Man: Punishment and Cognition in the Evolution of Cooperation." In J. Schloss and A. Plantinga (eds.), *The "Nature" of Belief: Scientific and Philosophical Perspectives on the Evolution of Religion*, Oxford: Oxford University Press, 26–43.
- Johnston, I. 2010. *The Mozi: A Complete Translation*. New York: Columbia University Press.
- Joyce, R. 2006. *The Evolution of Morality*. Cambridge, MA: MIT Press.
- Kapogiannis, D., A. K. Barbey, M. Su, G. Zamboni, F. Krueger, and J. Grafman. 2009. "Cognitive and Neural Foundations of Religious Belief." *Proceedings of the National Academy of Science USA* 106(12):4876–4881.
- Katz, S. 1992. *Mysticism and Language*. New York: Oxford University Press.
- Kaufmann, E. 2010. *Shall the Religious Inherit the Earth?* London: Profile Books.
- Kay, A., D. Gaucher, I. McGregor, and K. Nash. 2010. "Religious Conviction as Compensatory Control." *Personality and Social Psychology Review* 14:37–48.
- Kelemen, D. 1999. "Why Are Rocks Pointy? Children's Preference for Teleological Explanations of the Natural World." *Developmental Psychology* 35:1440–1453.
- . 2004. "Are Children 'Intuitive Theists?': Reasoning about Purpose and Design in Nature." *Psychological Science* 15:295–230.
- Kelemen, D. and C. DiYanni. 2005. "Intuitions about Origins: Purpose and Intelligent Design in Children's Reason about Nature." *Journal of Cognition and Development* 6(1):3–31.
- Kelemen, D., and E. Rosset. 2009. "The Human Function Compunction: Teleological Explanation in Adults." *Cognition* 111:138–143.
- Kim, H. S., D. Sherman, J. Sasaki, J. Xu, T. Chu, C. Ryu, E. Suh, K. Graham, and S. Taylor. 2010. "Culture, Distress, and Oxytocin Receptor Polymorphism (OXTR) Interact to Influence Emotional Support Seeking." *Proceedings of the National Academy of Sciences* 107(36):15717–15721.
- Kirkpatrick, L. 1999. "Toward an Evolutionary Psychology of Religion and Personality." *Journal of Personality* 67:921–951.
- Konvalinka, I., D. Xygalatas, U. Schjoedt, J. Bulbulia, E. Jegindoe, A. Geertz, and A. Roepstorff. 2011. "Synchronized Arousal Between Performers and Related Spectators in a Fire-walking Ritual." *Proceedings of the National Academy of Sciences* 108(18). doi: doi:10.1073/pnas.1016955108.
- Landman, J. 2009. *A Secular Mind: Towards a Cognitive Anthropology of Atheism*. Oxford: Oxford University Press.
- Laudan, Larry. 1996. *Beyond Positivism and Relativism: Theory, Method, and Evidence*. Boulder: Westview Press.

- Luhrmann, T. M. 2005. "The Art of Hearing God: Absorption, Dissociation, and Contemporary American Spirituality." *Spiritus* 5(2):133–157.
- . 2011. *When God Talks Back*. New York: Oxford University Press.
- Mazar, N., O. Amir, and D. Ariely. 2008. "The Dishonesty of Honest People: A Theory of Self-concept Maintenance." *Journal of Marketing Research* 45(6):633–644.
- McCauley, R. N. 2007. "Reduction: Models of Cross-Scientific Relations and Their Implications for the Psychology-Neuroscience Interface." In P. Thagard (ed.), *Handbook of the Philosophy of Science: Philosophy of Psychology and Cognitive Science*, Amsterdam: Elsevier, 105–158.
- . 2011. *Why Religion Is Natural and Science Is Not*. Oxford University Press: New York.
- McCauley, R. N., and E. T. Lawson. 2002. *Bringing Ritual to Mind*. New York: Cambridge University Press.
- . 2007. "Cognition, Religious Ritual, and Archaeology." In E. Kyriakidis (ed.), *The Archaeology of Ritual*, Los Angeles: Cotsen Institute of Archaeology Publications, 209–254.
- McKay, R., and D. Dennett. 2010. "The Evolution of Misbelief." *Behavioral and Brain Sciences* 32(6):493–510.
- McKay, R., and M. Anderson. 2007. "Reconciling Psychodynamic and Neurological Perspectives on Denial." *Cortex* 43(8):1102–1103.
- McNamara, P. 2009. *The Neuroscience of Religious Experience*. Cambridge: Cambridge University Press.
- Newberg, A. B. 2009. *How God Changes Your Brain: Breakthrough Findings From a Leading Neuroscientist*. New York: Ballantine Books.
- Newberg, A. B., and S. K. Newberg. 2008. "Hardwired for God: A Neuropsychological Model for Developmental Spirituality." In K. Kovner Kline (ed.), *Authoritative Communities: The Scientific Case for Nurturing the Whole Child*, Vol. 5, New York: Springer, 162–186.
- Newberg, A. B., N. A. Wintering, and D. Morgan. 2006. "The Measurement of Regional Cerebral Blood Flow during Glossolalia." *Psychiatry Research: Neuroimaging* 148:67–71.
- Newberg, A. B., V. Rause, and E. D'Aquili. 2002. *Why God Won't Go Away: Brain Science and the Biology of Belief*. New York: Ballantine Publishing Group.
- Newson, L. 2009. "Cultural versus Reproductive Success: Why Does Economic Development Bring New Tradeoffs?" *American Journal of Human Biology* 21(4):464–471.
- Nielbo, K. and J. Sorensen. 2011. "Spontaneous Processing of Functional and Non-Functional Action Sequences." *Religion, Brain, and Behavior* 1(1):18–30.
- Nichols, S., and T. Folds-Bennett. 2003. "Are Children Moral Objectivists? Children's Judgments about Moral and Response-dependent Properties." *Cognition* 90(2):B23–B32.
- Norenzayan, A., and A. Shariff. 2008. "The Origin and Evolution of Religious Prosociality." *Science* 322(58):58–62.

- Nucci, L., E. Turiel, and G. Encarnacion-Gawrych. 1983. "Children's Social Interactions and Social Concepts: Analyses of Morality and Convention in the Virgin Islands." *Journal of Cross-Cultural Psychology* 14(4):469–487.
- Ostrom, E. 2005. *Understanding Institutional Diversity*. Princeton: Princeton University Press.
- Paden, W. E. Forthcoming. "The Prestige of the Gods: Evolutionary Continuities in the Formation of Sacred Objects." In *Origins of Religion, Cognition and Culture*, London: Equinox.
- Palmer, C. T., and L. B. Steadman. 2004. "With or Without Belief: A New Approach to the Definition and Explanation of Religion." *Evolution and Cognition* 10(1):138–147.
- Petrovich, O. 1997. "Understanding of Non-natural Causality in Children and Adults: A Case against Artificialism." *Psyche en Geloof* 8:151–165.
- Proudfoot, W. 1985. *Religious Experience*. Berkeley: University of California Press.
- Proulx, T., and S. Heine. 2009. "Connections from Kafka: Exposure to Meaning Threats Improves Implicit Learning of an Artificial Grammar." *Psychological Science* 20(9):1125–1131.
- Pyysiäinen, I. 2001. *How Religion Works: Towards a New Cognitive Science of Religion*. Leiden: Brill.
- Pyysiäinen, I., and M. Hauser. 2010. "The Origins of Religion: Evolved Adaptation or By-product?" *Trends in Cognitive Sciences* 14(3):104–109.
- Radcliffe-Brown, A. R. 1922. *The Andaman Islanders*. New York: The Free Press.
- Rappaport, R. 1971. "Ritual, Sanctity, and Cybernetics." *American Anthropologist* 73(1):59–76.
- Richerson, P. J., and L. Newson. 2008. *Is Religion Adaptive? Yes, No, Neutral, but Mostly, We Don't Know*. Santa Margarita: Collins Foundation Press.
- Richerson, P. J., and R. Boyd. 2005. *Not By Genes Alone: How Culture Transformed Human Evolution*. Chicago: The University of Chicago Press.
- Roes, F. L., and M. Raymond. 2003. "Belief in Moralizing Gods." *Evolution and Human Behavior* 24(2):126–135.
- Rowthorn, R. 2011. "Religion, Fertility and Genes: A Dual Inheritance Model." *Proceedings of the Royal Society B: Biological Sciences* 278(1717):2519–2527.
- Sagarin, R., C. Alcorta, S. Atran, D. Blumstein, G. Deitl, M. Hochberg, D. Jonson, S. Levin, E. Madin, J. Madin, E. Prescott, R. Sosis, T. Taylore, J. Tooby, and G. Vermeij. 2010. "Decentralize, Adapt and Cooperate." *Nature* 465:292–293.
- Saler, B. 2009. "Reduction, Integrated Theory, and the Study of Religion." *Religion* 39(4):348–351.
- Schjoedt, U. 2007. "Homeostasis and Religious Behaviour." *Journal of Cognition and Culture* 7(3–4):313–340.
- . 2008. "Evolutionary Psychology, Neuroscience and the Study of Religion." In J. Bulbulia, R. Sosis, R. Genet, E. Harris, K. Wyman, and C. Genet (eds.), *The Evolution of Religion: Studies, Theories, and Critiques*, Santa Margarita: Collins Foundation Press, 303–310.

- . 2009. “The Religious Brain: A General Introduction to the Experimental Neuroscience of Religion.” *Method and Theory in the Study of Religion* 21(3): 310–339.
- Schjoedt, U., A. Geertz, H. Stødkild-Jørgensen, and A. Roepstorff. 2009. “Highly Religious Participants Recruit Areas of Social Cognition in Personal Prayer.” *Social Cognitive and Affective Neuroscience* 4(2):199–207.
- Schjoedt, U., H. Stødkild-Jørgensen, A. Geertz, and A. Roepstorff. 2011. “The Power of Charisma: Perceived Charisma Inhibits the Attentional and Executive Systems of Believers in Intercessory Prayer.” *Social Cognitive and Affective Neuroscience* 6(1):119–127.
- Schleiermacher, F. (1996 [1799]). *On Religion: Speeches to Its Cultured Despisers*. Cambridge, U.K.: Cambridge University Press.
- Schloss, J. 2008. “He Who Laughs Best: Involuntary Religious Affect as a Solution to Recursive Cooperative Defection.” In J. Bulbulia, R. Sosis, E. Harris, R. Genet, C. Genet, and K. Wyman (eds.), *The Evolution of Religion: Studies, Theories, and Critiques*, Santa Margarita: Collins Foundation Press, 197–207.
- Schloss, J., and M. Murray. 2011. “Evolutionary Accounts of Belief in Supernormal Punishment: A Critical Review.” *Religion, Brain, Behaviour* 1(1):44–96.
- Scholl, B., and P. Tremoulet. 2000. “Perceptual Causality and Animacy.” *Trends in Cognitive Sciences* 4(8):299–308.
- Shariff, A. F., and A. Norenzayan. 2007. “God Is Watching You: Priming God Concepts Increases Prosocial Behavior in an Anonymous Economic Game.” *Psychological Science* 18(9):803–809.
- Slingerland, Edward. 2008. *What Science Offers the Humanities: Integrating Body and Culture*. Cambridge, U.K.: Cambridge University Press.
- Slingerland, E., and J. Bulbulia. 2011. “Introductory Essay: Evolutionary Science and the Study of Religion.” *Religion* 41(3):307–328.
- Slingerland, E., and M. Chudek. 2011. “The Prevalence of Mind-Body Dualism in Early China.” *Cognitive Science* 35(5):997–1007.
- Smith, J. Z. 1998. “Religion, Religions, Religious.” In Mark Taylor (ed.), *Critical Terms for Religious Studies*, Chicago: University of Illinois Press, 269–284.
- Sober, E., and D. S. Wilson. 1998. “Unto Others: The Evolution and Psychology of Unselfish Behavior.” Cambridge, Mass.: Harvard University Press.
- Soler, M. 2008. “Commitment Costs and Cooperation: Evidence from Candomble, an Afro-Brazilian Religion.” In J. Bulbulia, R. Sosis, E. Harris, R. Genet, C. Genet, and K. Wyman (eds.), *The Evolution of Religion: Studies, Theories, and Critiques*, Santa Margarita: Collins Foundation Press, 167–174.
- Sosis, R. 2000. “Religion and Intragroup Cooperation: Preliminary Results of a Comparative Analysis of Utopian Communities.” *Cross-Cultural Research* 34(1):77–88.
- . 2003. “Why Aren’t We All Hutterites?” *Human Nature* 14(2):91–127.
- . 2009. “The Adaptationist-Byproduct Debate on the Evolution of Religion: Five Misunderstandings of the Adaptationist Program.” *Journal of Cognition and Culture* 9(3):315–332.

- Sosis, R., and B. Ruffle. 2003. "Religious Ritual and Cooperation: Testing for a Relationship on Israeli Religious and Secular Kibbutzim." *Current Anthropology* 44(5):713–722.
- Sosis, R., and E. Bressler. 2003. "Co-operation and Commune Longevity: A Test of the Costly Signaling Theory of Religion." *Cross-Cultural Research* 37(2):11–39.
- Sosis, R., H. Kress, and J. Boster. 2007. "Scars for War." *Evolution and Human Behavior* 28(4):234–247.
- Spelke, E., A. Phillips, and A. Woodward. 1995. "Infants' Knowledge of Object Motion and Human Action." In D. Sperber, D. Premack, and A. Premack (eds.), *Causal Cognition*, Oxford: Clarendon Press.
- Sripada, C., and S. Stich. 2006. "A Framework for the Psychology of Norms." In P. Carruthers, S. Laurence, and S. Stich (eds.), *The Innate Mind: Culture and Cognition*, New York: Oxford University Press, Vol. 2, 280–301.
- Stausberg, M. 2010. "Prospects in Theories of Religion." *Method and Theory in the Study of Religion* 22(4):223–238.
- Sterelny, K. 2003. *Thought in a Hostile World: The Evolution of Human Cognition*. Oxford: Blackwell.
- . 2006. "Memos Revisited." *The British Journal for the Philosophy of Science* 57(1):145–165.
- . 2007. "SNAFUs: An Evolutionary Perspective." *Biological Theory* 2(3):317–328.
- Sterelny, K., and P. Griffiths. 1999. *Sex and Death: An Introduction to the Philosophy of Biology*. Chicago: The University of Chicago Press.
- Swanson, G. 1960. *The Birth of the Gods: The Origin of Primitive Beliefs*. Ann Arbor: University of Michigan Press.
- Tager-Flusberg, H. 2005. "What Neurodevelopmental Disorders Can Reveal about Cognitive Architecture." In P. Carruthers, S. Laurence, and S. Stich (eds.), *The Innate Mind: Structure and Content*, New York: Oxford University Press.
- Taves, A. 2009. *Religious Experience Reconsidered: A Building Block Approach to the Study of Religion and Other Special Things*. Princeton, New Jersey: Princeton University Press.
- . 2010. "No Field Is an Island: Fostering Collaboration between the Academic Study of Religion and the Sciences." *Method and Theory in the Study of Religion* 22(2):170–188.
- Taylor, C. 1989. *Sources of the Self: The Makings of Modern Identity*. Cambridge, Mass.: Harvard University Press.
- . 2007. *A Secular Age*. Cambridge, Mass.: Harvard University Press.
- Turchin, P. 2006. *War and Peace and War: The Rise and Fall of Empires*. New York: Penguin Group.
- Turiel, E. 2010. "Domain Specificity in Social Interactions, Social Thought, and Social Development." *Child Development* 81(3):720–726.
- Weingarten, C. P., and J. S. Chisholm. 2009. "Attachment and Cooperation in Religious Groups." *Current Anthropology* 50(6):759–785.

- Wellman, H., F. Fang, D. Liu, L. Zhu, and G. Liu. 2006. Scaling of Theory-of-Mind Understandings in Chinese Children." *Psychological Science* 17(12):1075.
- Whitehouse, H. 2004. *Modes of Religiosity: A Cognitive Theory of Religious Transmission*. Lanham: AltaMira Press.
- . 2008. "Cognitive Evolution and Religion: Cognition and Religious Evolution." In J. Bulbulia, R. Sosis, R. Genet, E. Harris, C. Genet, and K. Wyman (eds.), *The Evolution of Religion: Studies, Theories and Critiques*, Santa Margarita: Collins Foundation Press, 31–42.
- Wiebe, D. 2008. "Does Talk about the Evolution of Religion Make Sense?" In J. Bulbulia, R. Sosis, R. Genet, E. Harris, K. Wyman and C. Genet (eds.), *The Evolution of Religion: Studies, Theories, and Critiques*, Santa Margarita: Collins Foundation Press.
- Wilson, D. S. 2002. *Darwin's Cathedral: Evolution, Religion, and the Nature of Society*. Chicago: University of Chicago Press.
- . 2005. "Testing Major Evolutionary Hypotheses about Religion with a Random Sample." *Human Nature* 16(4):419–446.
- . 2006. "Human Groups as Adaptive Units: Toward a Permanent Consensus." In P. Carruthers, S. Laurence, and S. Stich (eds.), *The Innate Mind: Culture and Cognition*, New York: Oxford University Press, 78–90.
- . 2008. "Evolution and Religion: The Transformation of the Obvious." In J. Bulbulia, R. Sosis, E. Harris, R. Genet, C. Genet, and K. Wyman (eds.), *The Evolution of Religion: Studies, Theories and Critiques*, Santa Margarita: Collins Foundation Press, 23–29.
- Wilson, D. S., and W. S. Green. 2011. "Evolutionary Religious Studies: A Beginner's Guide." In E. Slingerland and M. Collard (eds.), *Creating Consilience: Integrating the Sciences and Humanities*, New York: Oxford University Press, 225–242.
- Wilson, E. O., and D. S. Wilson. 2007. "Rethinking the Theoretical Foundation of Sociobiology." *The Quarterly Review of Biology* 82(4):327–348.
- Wright, R. 2009. *The Evolution of God*. New York: Little, Brown and Co.
- Wynne-Edwards, V. C. 1962. *Animal Dispersion in Relation to Social Behaviour*. New York: Hafner Publishing Company.
- Xygalatas, D. 2008. "Firewalking and the Brain: The Physiology of High-arousal Rituals." In J. Bulbulia, R. Sosis, R. Genet, E. Harris, K. Wyman, and C. Genet (eds.), *The Evolution of Religion: Studies, Theories, and Critiques*, Santa Margarita: Collins Foundation Press, 189–196.
- Xygalatas, D., I. Konvalinka, A. Roepstoff, and J. Bulbulia. 2011. "Quantifying Collective Effervescence Heart-rate Dynamics at a Fire-walking Ritual." *Communicative and Integrative Biology* 4(6):735–738.