Ritual, Emotion, and Sacred Symbols

The Evolution of Religion as an Adaptive Complex

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This paper considers religion in relation to four recurrent traits: belief systems incorporating supernatural agents and counterintuitive concepts, communal ritual, separation of the sacred and the profane, and adolescence as a preferred developmental period for religious transmission. These co-occurring traits are viewed as an adaptive complex that offers clues to the evolution of religion from its nonhuman ritual roots. We consider the critical element differentiating religious from nonhuman ritual to be the conditioned association of emotion and abstract symbols. We propose neurophysiological mechanisms underlying such associations and argue that the brain plasticity of human adolescence constitutes an "experience expectant" developmental period for ritual conditioning of sacred symbols. We suggest that such symbols evolved to solve an ecological problem by extending communication and coordination of social relations across time and space.

KEY WORDS Adolescence; Costly signals; Emotion; Neuropsychology; Religion; Ritual; Symbolic thought

The evolution of religion and its possible adaptive function have been the subject of considerable recent investigation by a wide array of researchers with diverse theoretical and methodological approaches. Cognitive scientists and evolutionary psychologists have been prominent among these researchers (Atran 2002; Barrett 2000; Bering 2005; Boyer 2001; Bulbulia 2004a, 2004b; Guthrie 1993; Kirkpatrick 1999; Mithen 1996, 1999). They have primarily studied religion in terms of beliefs, uncovering the psychological mechanisms that produce supernatural agents in all cultures. With the notable exceptions of Bering (2005) and Bulbulia

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(2004a), these researchers have concluded that religion constitutes a by-product of cognitive adaptations selected for "more mundane" survival functions. Evolutionary anthropologists have also revitalized studies of religion over the past two decades (see Sosis and Alcorta 2003). In contrast to the cognitive scientists, however, these researchers have tended to focus on religious behaviors rather than beliefs. The primary debate among these investigators has centered on the relative importance of group selection and individual selection in the evolution of religious systems (Cronk 1994a, 1994b; Rappaport 1994; Sosis 2003a; Sosis and Alcorta 2003; Wilson 2002). Drawing on both ethological studies and a rich theoretical legacy beginning with Durkheim (1969), evolutionary anthropologists have proposed that religious behaviors constitute costly signals that contribute to social cohesion (Cronk 1994a; Irons 1996a, 1996b, 2001; Sosis 2003b). These theorists situate religious ritual within a broader, nonhuman evolutionary continuum related to socially adaptive behaviors. Costly signaling theory has received empirical support from the research of Sosis and colleagues (Sosis 2000; Sosis and Bressler 2003; Sosis and Ruffle 2003, 2004), whose work has demonstrated a significant and positive association between participation in religious ritual and enhanced cooperation. However, these researchers have yet to examine how the high levels of cooperation observed within religious communities (e.g., Sosis and Bressler 2003; Sosis and Ruffle 2003) translate into individual fitness gains.

Although not guided by evolutionary analyses, the cumulative findings of a third body of research that has emerged over the past two decades does provide evidence of individual benefits for religious practitioners. This work has been conducted by sociologists, epidemiologists, psychologists, and physicians, and has explored the health impacts of religion on adherents (Hummer et al. 1999; Levin 1994, 1996; Matthews et al. 1998; Murphy et al. 2000). Accumulating findings from this body of research show significant positive associations between religious participation and individual health. These studies demonstrate decreased mental and physical health risks, faster recovery times for a wide variety of disorders, and greater longevity for those who regularly attend weekly Western religious services, even when social and lifestyle confounds are controlled (Hummer et al. 1999; Matthews et al. 1998; Murphy et al. 2000). In association with ongoing neurophysiological research (Austin 1998; McNamara 2001, 2002; Newberg et al. 2001; Saver and Rabin 1997; Winkelman 1986, 1992, 2000), these findings suggest proximate mechanisms by which religious participation may impact psychoneuroimmunological systems and, thus, individual fitness.

FOUR FEATURES OF RELIGION

These various approaches to religion have provided significant insights, but individually each is insufficient for an evolutionary understanding of religion. A synthesis that encompasses religion's cross-culturally recurrent features and captures that which differentiates the religious from the secular is required. We propose that

religion may best be understood as an evolved complex of traits incorporating cognitive, affective, behavioral, and developmental elements selected to solve an adaptive problem. Here we focus on four cross-culturally recurrent features of all religions that we consider to be integral components of this complex. These are:

- Belief in supernatural agents and counterintuitive concepts;
- Communal participation in costly ritual;
- Separation of the sacred and the profane; and
- Importance of adolescence as the life history phase most appropriate for the transmission of religious beliefs and values.

These four elements emerge and reemerge throughout the anthropological and sociological literature and encompass cognitive, behavioral, affective, and developmental aspects of religious systems across a wide variety of cultures (Douglas 1966; Durkheim 1969; Eliade 1958, 1959; Malinowski 1948; Rappaport 1999; Turner 1967, 1969; Tylor 1871). Although each trait may be variably expressed across different socioecological systems, their recurrence in societies as diverse as totemic Arunta hunter-gatherers and Protestant American industrialists suggests that they constitute basic elements of religion.

In this paper we examine each of these traits in relation to an evolutionary theory of religion as an evolved mechanism for social cooperation. We posit that the critical element in the differentiation of religious from nonhuman ritual was the emergence of emotionally charged symbols. Drawing on the seminal insights of Durkheim (1969), Turner (1967, 1969), and Rappaport (1999), we propose proximate mechanisms by which religious ritual serves to invest stimuli with motivational meaning. The brain plasticity of extended human adolescence is examined as an "experience expectant" developmental period for the emotional valencing of emergent symbolic systems. Following Richerson and Boyd (1998) we conclude that the symbolic systems of religious ritual in early human populations solved an ecological problem by fostering cooperation and extending the communication and coordination of social relations across time and space.

Supernatural Agents and Counterintuitive Concepts

Belief in supernatural agents may be the most commonly offered definition of religion (see Sosis and Alcorta 2003). Durkheim (1969) was the first to propose that supernatural agents represent the reification of society itself and function to maintain social order. Although Durkheim's reification of society as a causal explanation for religion has largely fallen into disfavor, his observation that the type of agent represented in a society's religion reflects the social organization of that society has been subsequently supported by the work of Wallace (1966) and the cross-cultural analyses of Swanson (1960).

More recently, Guthrie (1993), and other cognitive scientists (Atran 2002; Barrett 2000; Boyer 2001; Kirkpatrick 1999; Pinker 1997) have reexamined the supernatu-

ral beliefs of religious systems and have concluded that such beliefs are merely a "byproduct of numerous, domain-specific psychological mechanisms that evolved to solve other (mundane) adaptive problems" (Kirkpatrick 1999:6). Rejecting any adaptive function of religious beliefs per se, these researchers view the conceptual foundations of religion as deriving from categories related to "folkmechanics, folkbiology, (and) folkpsychology" (Atran and Norenzayan 2004). Supernatural agents, similar to moving dots on computer screens or faces in the clouds, are simply the result of innate releasing mechanisms of agency detection modules evolved to respond to animate, and therefore potentially dangerous, entities (Atran and Norenzayan 2004). Likewise, the attribution of intentionality to supernatural agents is viewed as the application of folkpsychology mental modules evolved in response to complex human social interactions. For many cognitive scientists, supernatural agents, as well as religious beliefs in general, constitute little more than "mental module misapplications."

Anthropological and psychological evidence, however, suggests that supernatural agents of religious belief systems not only engage, but also modify, evolved mental modules. Moreover, they do so in socioecologically specific and developmentally patterned ways. Although agency detection modules probably do give rise to the human ability to imagine a broad array of supernatural agents, those that populate individual religions are neither random nor interchangeable. Whether supernatural agents are envisioned as totemic spirits, ancestral ghosts, or hierarchical gods is very much dependent upon the socioecological context in which they occur (Durkheim 1969; Swanson 1960; Wallace 1966). The types of religious practitioners present, as well as the nature of religious practices performed in a society, have been shown to be significantly correlated with measures of social complexity and integration (Bourguignon 1976; Winkelman 1986, 1992). The shamanic use of trance to communicate with totemic ancestors found among the Athapaskan hunter-gatherers of the Arctic would be very familiar to the desert-dwelling Arunta hunter-gatherers of Australia. Likewise, the presence of priests and hierarchical gods typifies religions of state-level agricultural societies from the Maya of Mexico to the Ashanti of Africa. Cross-cultural statistical research by Swanson (1960) and subsequent analyses by Roes and Raymond (2003) have shown that the presence of moralizing gods "who tell people what they should and should not do" is significantly and positively related to group size, social stratification, environmental resource levels, and extent of external conflict.

The supernatural beings of all these religious belief systems engage evolved mental modules of agency and intentionality, as noted by cognitive scientists. This, however, does not preclude the possibility that religion is an evolved adaptation. As we have argued elsewhere (Sosis and Alcorta 2004), evolution is opportunistic and necessarily co-opts existing traits to solve novel ecological problems. It is the modification of these traits through natural selection that constitutes evolution. The question to be posed, therefore, is not "Does religion incorporate preexistent mental modules?" Instead, the relevant question is whether there exists evidence of adapta-

tion of those modules to solve ecological challenges. Recent experimental work by developmental psychologists suggests that the answer to this question is "yes." The supernatural agents of religious belief systems incorporate attributes of agency and intentionality, but they also possess an additional attribute not shared with natural category agents. In contrast to natural category agents, the supernatural agents of religious belief systems are "full access strategic agents" (Boyer 2001). They are "envisioned as possessing knowledge of socially strategic information, having unlimited perceptual access to socially maligned behaviors that occur in private and therefore outside the perceptual boundaries of everyday human agents" (Bering 2005:419). Moreover, accumulating research indicates that humans exhibit a developmental predisposition to believe in such socially omniscient supernatural agents, appearing in early childhood and diminishing in adulthood (Bering 2005; Bering and Bjorklund 2004). Cross-cultural studies conducted with children between the ages of 3 and 12 indicate that young children possess an "intuitive theism" (Kelemen 2004) that differentiates this social omniscience of supernatural agents from the fallible knowledge of natural social agents (Bering 2005). As the child's theory of mind develops, parents and other natural agents are increasingly viewed as limited in their perceptual knowledge. Supernatural agents, however, not only remain socially omniscient, but are viewed by children in late childhood as agents capable of acting on such knowledge. This developmental predisposition to believe in socially omniscient and declarative supernatural agents contrasts with evolved mental modules of folkpsychology for natural categories. It also goes far beyond natural agency-detection modules to encompass socially strategic agents with behaviorally motivating characteristics.

Supernatural agents of religious belief systems also diverge from evolved mental modules for natural ontological categories (e.g., animate/inanimate; people/animals) in another significant way. Such agents do not uphold natural categories; they violate them. Totemic animals that can talk, dead ancestors who demand sacrificial offerings and visit the living, and incorporeal gods capable of being in all places at all times violate basic premises of natural ontological categories. Yet, these exceedingly unnatural constructs comprise powerful religious schema that elicit deep devotion and belief across traditional and contemporary cultures alike. If religious beliefs are merely by-products of mental modules evolved to deal with the "natural world," why do such beliefs consistently violate the basic cognitive schema from which they are presumed to derive?

In addressing this question, a number of cognitive scientists have noted that the counterintuitive concepts that characterize religious beliefs are both attention-arresting and memorable (Atran 2002; Boyer 2001; Kirkpatrick 1999). Experimental tests validate these observations (Atran and Norenzyan 2004; Boyer and Ramble 2001). Counterintuitive concepts, such as bleeding statues and virgin births, do grab attention. Atran and Norenzayan (2004) note, however, that the efficacy of counterintuitive concepts in engaging attention, improving recall, and promoting transmission is highly dependent upon the broader context within which these con-

cepts are framed. Comparing belief sets with intuitive and counterintuitive concepts, they found that the specific profile of the counterintuitive/intuitive concepts most frequently encountered in religious belief systems achieved the "highest rate of delayed recall and lowest rate of memory degradation over time" (Atran and Norenzyan 2004:723). Thus, the counterintuitive beliefs of religious systems not only violate natural ontological categories, they do so in a specifically patterned way that renders them maximally memorable and maximally transmissible. This suggests selection for such concepts.

Counterintuitive concepts have yet another important feature of significance for social groups. In addition to their mnemonic efficacy, they comprise almost unbreakable "codes" for the uninitiated. Most language distortions occur within ontological categories (Bartlett [1932] as reported in Atran and Norenzayan 2004). When distortions do cross ontological boundaries, they are most common from counterintuitive to intuitive concepts; distortions occurring from intuitive to counterintuitive concepts are extremely rare. For example, it would be much more likely for a listener to modify "talking horse" to "walking horse" than the converse. These findings indicate that counterintuitive concepts are not readily generated on the basis of intuitive concepts, and they suggest that the chances of spontaneously re-creating a preexistent counterintuitive concept are exceedingly low. This probability is lowered even further by embedding multiple counterintuitive concepts within religious belief sets. By incorporating counterintuitive concepts within belief systems, religion creates reliable costly signals that are difficult to "fake." They must be learned, and since such learning has been orally transmitted throughout the vast majority of human evolution, this also implies participation in religious ritual. As a result, religious belief systems serve as both costly and reliable signals of group membership.

Finally, the irrationality of counterintuitive concepts contributes to their efficacy as honest signals of commitment to a group who share that belief (Lee Cronk, personal communication 2002). Within a pluralistic context, adherents who propound counterintuitive beliefs risk censure. Early Christian belief in the resurrection of Christ constituted a potent signal to Romans, Jews, and other Christians. Only individuals knowledgeable about the religious tenets of Roman Catholicism would conceive of the transmutation of wine to blood, and only those initiated into the faith through the emotional conditioning of those tenets would truly believe that such a transmutation occurs during the sacrament of Communion. Through the eyes of nonadherents, such beliefs may be viewed as extraordinary and irrational. Such perceptions contribute to both the costliness and the effectiveness of religious signals.

In summary, neither the content nor the structure of religious belief systems supports the assertion that such beliefs constitute epiphenomenal "by-products." Although supernatural agents engage mental modules of agency and intentionality that evolved in response to "mundane" selection pressures, they modify these modules in specific and developmentally patterned ways. Cross-culturally, supernatural agents are integral elements of religious beliefs and they consistently reflect sig-

nificant socioecological relations within their respective cultures. The agents of religious belief are not natural category agents, as would be predicted if they were simply by-products of mental modules evolved to deal with such agents. They are instead counterintuitive agents that not only modify natural agency module parameters, but do so in consistently patterned and behaviorally significant ways. A developmental propensity to believe that such agents are not only intentional, but also socially omniscient, is indicated by accumulating experimental evidence (Bering and Bjorklund 2004). Although the predisposition to believe in such supernatural agents appears to be innate, the development of such beliefs is dependent upon cultural transmission. Religious cognitive schema exhibit structural elements that maximize transmission through the incorporation of minimally counterintuitive concepts that engage attention, promote recall, and insure exclusivity.

These features of religious belief systems provide ontogenetic lability for the construction of socially relevant moral systems across diverse ecologies, and they do so within a structure that is maximally transmissible and minimally invasive. Bering (2005:430) notes that "children are simultaneously immersed in unique cultural environments where morality is chiefly determined by socioecological conditions. Although there is likely a common 'moral grammar' underlying all children's development in this domain, the moral particulates of any given society are given shape by the demands of local environments." Bulbulia, too, argues that religion, like language, exhibits an innate grammar in which "development consists of fixing labels to preexisting cognitive structures" (J. Bulbulia, personal communication 2004). For both Bulbulia (2004a, 2004b) and Bering (2005), the idea of socially omniscient supernatural agency is a central component of this system. These researchers view the adaptive value of such agents to be the maintenance of group cooperation and cohesion across a broad spectrum of socioecologies. Atran, likewise, acknowledges religion's use of supernatural agents in "maintaining the cooperative trust of actors and the trustworthiness of communication by sanctifying the actual order of mutual understandings and social relations" but asserts that "religion has no evolutionary function per se"(2002:278–279). In contrast, we argue that religion's ability to promote cooperation is its evolutionary function, and that the costliness of religious ritual bears a direct relationship to the nature of the collective action problems faced. When individual costs are high, but the potential benefits of cooperation are great, costly religious ritual provides a reliable mechanism for minimizing free-riding and maximizing cooperation. We consider the cognitive schema of religious systems to be a fundamental evolved element in ensuring such cooperation. Both the ontogenetic and structural features of religious belief systems suggest evolved features. Yet, we also maintain that religious belief systems in isolation are incapable of "sanctifying the actual order of mutual understandings and social relations" (Atran 2002:278). It is certainly possible to be cognizant of religious beliefs without subscribing to them, as any schoolchild who has ever studied Greek mythology can attest. In order for religious beliefs to sanctify social relations, they must first themselves be sanctified. This is achieved through ritual.

Communal Participation in Costly Ritual

The pivotal role of communal ritual in religion has been noted by numerous researchers (Bloch 1989; Bourguignon 1973, 1976; Durkheim 1969; Eliade 1958, 1959; McCauley 2001; Rappaport 1999; Turner 1967, 1969). The formality, patterning, repetition, and rhythm of religious ritual have direct parallels in nonhuman ritualized display (Laughlin and McManus 1979; Lorenz 1965; Rappaport 1999; Rogers and Kaplan 2000; Smith 1979). In animal species such displays have evolved to serve intra- and inter-specific communication functions (Dugatkin 1997; Lorenz 1965; Rogers and Kaplan 2000; Rowe 1999). On its most basic level, nonhuman ritual constitutes "a process by which behavior specialized to be informative becomes differentiated from behavior that is informative only incidentally to its other functions" (Smith 1979:54). Ritualized displays represent but one end of a continuum in animal signaling systems that also includes simple indexical signals. Signal costs appear to be driven by both competition and receiver selection. Under conditions of ambiguity, or when signals can readily be faked, costlier signals may evolve to improve signal reliability. Ritualized displays are among the costliest of animal signals in terms of time, energy, and somatic resources required of the signaler. Zahavi (1975, 1981) has argued that such costly signals provide honest information for receiver assessment since only those who are sufficiently fit can bear the costs of such displays (Johnstone 2000; Zahavi and Zahavi 1997). Empirical research supports this hypothesis (Johnstone 2000; Zahavai and Zahavi 1997). Laboratory experiments indicate that the costliness of ritualized display is driven by receiver selection for reliable signals (Rowe 1999). The formality, sequence, repetition, and patterning that increase both time and energy costs of ritual also improve the ability of the receiver to assess the reliability of the message transmitted. These elements alert and focus attention, enhance memory, and promote associational learning (Rowe 1999). They neurophysiologically "prime" both the sender and receiver for action (Lewis and Gower 1980; Rogers and Kaplan 2000; Tinbergen 1965). The type of action that results is dependent both upon the receiver's assessment of the sender and upon the encoded "action releasers" embedded within the ritual display (Lewis and Gower 1980; Tinbergen 1965).

Animal signals and signal responses show considerable ontogenetic and socioecological malleability (Ball 1999; Lewis and Gower 1980; Marler 1999; Rogers and Kaplan 2000; Wingfield et al. 1999). Although some species-specific signals, such as the pecking response of herring-gull chicks to red dots, constitute relatively fixed, environmentally stable action-response sequences (Lewis and Gower 1980; Tinbergen 1965), others incorporate individually variant and ontogenetically learned patterns, as seen in the male courtship songs of various bird species (Ball 1999; Marler 1999). Signals of some species, including the esthetic nest constructions of male bowerbirds (Dissanayake 1995) and the friendship greeting rituals of baboons (Watanabe and Smuts 1999) show considerable malleability and high proportions

of environmentally variable behaviors. The continuum of simple to complex ritual signals clearly encompasses a broad range of "fixed" and "learned" elements.

Ritual signals communicate important information regarding the condition, status, and intent of the sender. The intensity of plumage coloration in birds, the pitch of croaking in frogs, and the stotting height of springboks constitute indexical signals that provide information regarding parasite load, size, and agility, respectively (Krebs and Davies 1984; Rogers and Kaplan 2000). Such signals may also convey information regarding intent. In many species, intent signals frequently involve the transference of behaviors from their original context to a ritual context. The incorporation of food begging displays in bird courtship rituals, and presentation of the ano-genital area by subordinate primates to dominants, both represent signals that have been emancipated from their original feeding and copulating behaviors and transferred to new contexts of courtship and social hierarchies. In both instances, affiliative responses eliciting approach behaviors are associated with the original function of the signal and the transferred signal intent (Lewis and Gower 1980). Transference of these signals from their original contexts to ritual communicates the intent of the sender by evoking the autonomic and neurophysiological state associated with the signal's origins. The incorporation of these intent signals in ritual derives from their preexisting motivational characteristics (Laughlin and McManus 1979).

Religious ritual, like nonhuman ritualized displays, is demarcated from ordinary behaviors and is composed of the same structural elements (Rappaport 1999). Formality, patterning, sequencing, and repetition are basic components of religious ritual, and signals of condition, status, and intent constitute "action releasers" embedded within that structure. Pan-human social signals of dominance and submission, such as bowing and prostration, are prominent components of religious ritual worldwide (Atran 2002; Bloch 1989; Boyer 2001; Leach 1966; Rappaport 1999). As in nonhuman ritual, these signals convey information regarding status and intent. Religious ritual also incorporates indexical and iconic signals. Masks, statues, and other "agent" representations are prominent elements in religious ritual across cultures. They engage innate mental modules evolved for mundane functions and potentiate human predispositions to autonomically respond to specific classes of stimuli, including animate agents and angry faces (LeDoux 2002). Incorporation of evocative, grotesque, and dissonant features further intensify such responses. Like the signals of nonhuman ritual, the signals of religious ritual clearly elicit neurophysiological responses in participants and influence the nature of social interaction (Lewis and Gower 1980; Reichert 2000; Rogers and Kaplan 2000; Sapolsky 1999). In contrast to nonhuman ritual, however, iconic, indexical, and ontogenetic signals are not the primary encoded elements of human religious ritual. The fundamental elements of human religious ritual are, instead, abstract symbols devoid of inherent emotional or cognitive meaning. Words such as "Allah," the geometric designs of Australian Dreamtime paintings, and religious beliefs do not, in and of

themselves, elicit any innate or ontogenetically derived neurophysiological response. Although, like language, religious systems across cultures appear to share a "deep structural grammar" that has an ontogenetic basis, the specific symbols embedded within that syntax are shaped by historical and socioecological parameters. In contrast to the signals of animal ritual, the meaning of abstract religious symbols must be created, both cognitively and emotionally. This important difference between nonhuman ritual and human religious systems not only requires that the abstract symbols of religious ritual be learned; it additionally requires that the emotional and behavioral significance of these symbols be learned as well. Whereas animal ritual elicits behavior through encoded signals, religious ritual elicits behavior to encode symbols. The creation of these symbols provides ritual tools for the shaping of social behaviors across space and time. Sosis (2003b) has argued that ritual participation generates belief among performers. He examined the psychological mechanisms underlying this process. Here we extend this argument to explain the interrelationship between emotions, symbols, and the sacred, and describe the neurological underpinnings of how ritual participation impacts belief.

Separation of the Sacred and the Profane

Religious ritual is universally used to define the sacred and to separate it from the profane (Douglas 1966; Durkheim 1969; Eliade 1959; Rappaport 1999). As noted by Rappaport (1999), ritual does not merely identify that which is sacred; it *creates* the sacred. Holy water is not simply water that has been discovered to be holy, or water that has been rationally demonstrated to have special qualities. It is, rather, water that has been *transformed* through ritual. For adherents who have participated in sanctifying rituals, the cognitive schema associated with that which has been sanctified differs from that of the profane. For Christians, profane water conjures associations of chemical structure and mundane uses; holy water, however, evokes associations of baptismal ritual and spiritual cleansing. Of greater importance from a behavioral perspective, the emotional significance of holy and profane water is quite distinct. Not only is it inappropriate to treat holy water as one treats profane water, it is emotionally repugnant. Although sacred and profane things are cognitively distinguished by adherents, the critical distinction between the sacred and the profane is the emotional charging associated with sacred things.

This distinction in emotional valence is created through participation in religious ritual. Sacred symbols have distinct cognitive schema, but their sanctity derives from their emotional meaning. It is the emotional significance of the sacred that underlies "faith," and it is ritual participation that invests the sacred with emotional meaning. The creation of religious symbols from abstract objects, and the imbuing of these symbols with attributions of "awe," "purity," and "danger" (Douglas 1966), are consistent and critical features of religious ritual everywhere (Douglas 1966; Durkheim 1969; Rappaport 1999; Turner 1969). Why is this so?

Emotions Motivate Behavior. Accumulating research indicates that emotions constitute evolved adaptations that weight decisions and influence actions. Emotions "rapidly organize the responses of different biological systems including facial expression, muscular tonus, voice, autonomic nervous system activity, and endocrine activity" (Levenson 1994:123) in order to prepare the organism for appropriate response to salient sensory stimuli. The ability of emotions to "alter attention, shift certain behaviors upward in response hierarchies, and activate relevant associative networks in memory" (Levenson 1994:123) directly impacts individual fitness. Since emotions are generated from limbic cortices that are outside conscious control, they are difficult to "fake" (Ekman et al. 1983). They, therefore, provide reliable communication signals among conspecifics. EEG patterns for simulated and real emotions are not the same, nor are the motor control areas for an emotion-related movement sequence and a voluntary act (Damasio 1994, 1998; Ekman and Davidson 1993). The somatic markers of emotion, including such things as pulse rate, skin conductance, pupil dilation, and facial expressions, differ from those under voluntary control. Emotionally motivated smiles engage different muscles from "Duchenne smiles," as do emotionally motivated frowns (Ekman 2003). As a result, emotions constitute powerful and honest cues of state and intent (Ekman 2003; Ekman et al. 1983).

Emotions may be elicited by sensory stimuli both internal and external to the organism. Predators, passing thoughts, and pulse rate are all capable of evoking emotional response. The emotional processing and appraisal of these stimuli engage widespread and complex cortical and subcortical systems within the brain. Initial unconscious processing of stimuli occurs in subcortical structures of the brain, including the basal ganglia, the amygdala, and the hypothalamus. This "first pass" level of processing appears to incorporate a superordinate division based on positive/approach and negative/withdrawal ratings of stimuli (Cacioppo et al. 2002).

Positive Stimuli Activate the Dopaminergic Reward System. The dopaminergic reward system constitutes "an emotional system that has evolved to motivate forward locomotion and search behavior as a means of approaching and acquiring rewarding goals" (Depue et al. 2002:1071). This system originates in the ventral tegmental area of the midbrain and projects to the nucleus accumbens of the ventral striatum. Its activation triggers the release of dopamine (DA), a neuromodulator which functions as a reward for the organism (Davidson and Irwin 2002). Stimuli intrinsic to somatic and reproductive success, such as food and sex, activate dopamine neurons within this system, and initiate goal-seeking behaviors. The potentiation of dopaminergic neurons induces a positive motivational state in the organism and simultaneously increases stimuli salience and locomotor activity (Pearson 1990). "Activation of this system has been shown to function as a reward, and animals will perform an arbitrary operant in order to self-administer stimulation of this pathway" (Pearson 1990:503). Drugs of addiction potentiate this system, as do subjec-

tively rated "pleasurable" activities (Cacioppo et al. 2002). Repeated potentiation of this system transfers "the ability to phasically activate DA transmission from incentive stimuli intrinsic to the goal to incentive stimuli extrinsic to it" (DiChiara 1995:95). This results in the assignment of a positive affective valence to stimuli perceived under that state (DiChiara 1995). Such "incentive learning" creates associational neural networks that link stimuli associated with rewarding experiences to behavioral motivators, thereby investing previously neutral stimuli with positive valence. For former drug addicts, the paraphernalia, settings, and even neighborhoods associated with drug use constitute such incentive stimuli capable of activating mesolimbic neural networks, as revealed through brain imaging studies (DiChiara 1995).

Negative Stimuli Activate the Amygdala. The amygdala is a subcortical collection of specialized nuclei located beneath the temporal cortex. A central function of the amygdala is the rapid appraisal of potentially dangerous and threatening stimuli. Activation of the amygdala initiates a cascade of specific neuroendocrine events that prepare the organism to respond quickly to threats and danger. These responses appear to be "hard wired" in the nervous system (LeDoux 2002). Animals with lesioned or removed amygdala lack a fear response, even when placed in highly dangerous situations (LeDoux 1996).

In humans, the amygdala is also pivotal in initiating fear responses. Humans exhibit an innate predisposition to negatively valence potentially harmful and threatening stimuli, including animate objects and angry or fearful faces. There is considerable evidence that such stimuli elicit a greater response than positive stimuli, particularly in relation to action tendencies (Ito et al. 2002). The amygdala also processes human facial cues in relation to social judgments of trust. This processing occurs both consciously and unconsciously by the left and right amygdala, respectively (Adolphs 1999, 2002a, 2002b; Adolphs et al. 1998; Dolan 2000; Morris et al. 1998; Oram and Richmond 1999).

While specific stimuli innately activate the amygdala, it is also possible for neutral stimuli to acquire negative valence through classical and contextual conditioning. Previously neutral stimuli that are present or otherwise associated with a negatively valenced stimulus that activates the amygdala may subsequently initiate such response themselves. Once such conditioning occurs, it is difficult to reverse. Extinction of such conditioning "is not a process of memory erasure, [but rather] involves cortical inhibition of indelible, amygdala-mediated memories" (LeDoux 2002:404). As a result of both the negativity bias in information processing and the indelible nature of emotional memory, amygdala-conditioned stimuli constitute powerful long-term elicitors of emotional response.

The amygdala is highly interconnected with sensory, motor, and autonomic output systems. These interconnections "provide an anatomical basis for adaptive responses to stimuli" (Dolan 2000:1117). Interconnections with the hypothalamus ensure rapid somatic responses to stimuli through a cascade of neuroendocrine events.

These events prepare the organism for behavioral response and provide feedback information regarding body state to the amygdala. Reciprocal interconnections with the nuclear basalis ensure amygdalar participation in cortical arousal and selective attention. Direct interconnections of the amygdala with the hippocampal formation allow affective modifications of spatial behavior (Cacioppo et al. 2002; Cardinal et al. 2002; Damasio 1994, 1998; LeDoux 2002). Specific reciprocal projections from the amygdala to other emotional processing regions, including the ventral striatum and brainstem nuclei, provide an important link between positive and negative affective systems (Dolan 2000; LeDoux 2002; Rolls 1998). It is, however, the direct interconnections between the amygdala and the prefrontal cortex that are of particular significance for human social and symbolic systems (Deacon 1997; Groenewegen and Uylings 2000; Rolls 1998).

The Prefrontal Cortex Plays a Critical Role in Decision Making. McNamara (2001, 2002) has convincingly argued that the self-responsibility, impulse control, and morality which religions seek to instill in adherents are frontal lobe functions. Ongoing research supports the pivotal role of the prefrontal cortex in social judgment and impulse control, as well as symbolic thought (Deacon 1997; Dehaene and Changuex 2000; McNamara 2001, 2002; Rolls 1998). The orbitofrontal (OFC) region of the prefrontal cortex is the area of the brain activated in anticipation of rewards and punishments. Injuries to this brain area affect the delicate calculus of personal interest, environmental contingencies, and social judgments that motivate and guide individual behaviors within a social group (Dehaene and Changeux 2000; Rolls 1998). The valuation of behavioral alternatives, particularly in relation to social behaviors, appears to be processed in the OFC. Impairments to this area correlate highly with socially inappropriate or disinhibited behavior (Anderson et al. 2002; Damasio 1994; Kolb et al. 2004).

The behavioral deficits of OFC impaired patients are also seen in individuals who have intact prefrontal cortices and intact amygdala but lack interconnections between the two (Damasio 1994; LeDoux 1996, 2002). These individuals perform well on abstract reasoning tasks but are unable to apply such reasoning to personal decision making (Damasio 1994; LeDoux 1996, 2002). The loss of emotion typical of OFC impaired patients is also a characteristic of these disconnect patients. For these individuals, the affective cues required for valuation of predicted outcomes are absent. In the absence of emotional input from the basolateral amygdala, the OFC lacks valuation information necessary for the prediction of reward/punishment outcomes. Recent laboratory experiments conducted by Schoenbaum and colleagues demonstrate that both the orbitofrontal cortex and the basolateral amygdala are "critical for integrating the incentive value of outcomes with predictive cues to guide behavior" (Schoenbaum et al. 2003:855). It is through the emotional inputs of the amgydala that "otherwise neutral cues acquire motivational significance or value through association with biologically significant events" (Schoenbaum et al. 2003:863).

Ritual, Emotion, and Sanctification. Religious rituals are biologically significant events. Ongoing research with ritual participants engaged in meditation and trance demonstrate changes in brain wave patterns, heart and pulse rate, skin conductance, and other autonomic functions (Austin 1998; Davidson 1976; Kasamatsu and Hirai 1966; MacLean et al. 1997; Mandel 1980; Newberg et al. 2001; Winkelman 2000). Meditation also alters neuroendocrine levels, including testosterone, growth hormone, and cortisol (MacLean et al. 1997). Although little research has been conducted on the neurophysiological effects of less intense religious participation, there is mounting evidence that participation in weekly Western religious services may impact blood pressure (Brown 2000; Dressler and Bindon 2000), adolescent testosterone levels (Halpern et al. 1994), and other neurophysiological systems (Levin 1994, 1996; Matthews et al. 1998; Murphy et al. 2000). Experiments suggest that some of these neurophysiological changes may be associated with the "rhythmic drivers" that characterize human religious ritual.

Music Is a Universal Feature of Religious Ritual. Human and nonhuman ritual share basic structural components of formality, pattern, sequence, and repetition. Human religious ritual further amplifies and intensifies these elements through the incorporation of "rhythmic drivers." Described by Bloch as "distinguishing marks of ritual" (1989:21), these elements, including music, chanting, and dance, constitute recurrent and important components of religious ritual across cultures. Although Bloch derived these features from ethnographies of traditional societies, the recent survey of U.S. congregations conducted by Chaves et al. (1999) found music to be a consistent feature of contemporary U.S. religious services, as well. Even in the most ritually constrained religions, music remains a key consistent feature (Atran 2002). Not only is music an important component of religious ritual, across traditional cultures it is inseparable from it (Becker 2001).

Music has important neurophysiological effects. As a "rhythmic driver," it impacts autonomic functions and synchronizes "internal biophysiological oscillators to external auditory rhythms" (Scherer and Zentner 2001:372). The coupling of respiration and other body rhythms to these drivers affects a wide array of physiological processes, including brain wave patterns, pulse rate, and diastolic blood pressure (Gellhorn and Kiely 1972; Lex 1979; Mandel 1980; Neher 1962; Walter and Walter 1949). This "coupling effect" has been shown to be present in humans at a very early age (Scherer and Zentner 2001). Music amplifies and intensifies this effect through the use of instruments, or "tools," thereby providing a means of synchronizing individual body rhythms within a group. Recent work by Levenson (2003) has shown that synchronized autonomic functions, including such things as pulse rate, heart contractility, and skin conductance, are positively and significantly associated with measures of empathy. The prominent role of music in religious ritual promotes such empathy.

Music also has demonstrated effects on measures of stress and immunocompetence. A significant negative correlation between exposure to "relaxing" music and

salivary cortisol levels was found in experiments conducted by Khalfa et al. (2003). Other research has demonstrated significant positive correlations between music and immunocompetence, as measured by salivary immunoglobin A (SIgA), with active participation correlating most highly with immunocompetence and no music exposure correlating the least (Hirokawa and Ohira 2003; Kuhn 2003). These associations between music and measures of stress and health may be mediated by music's ability to alter autonomic functions and evoke emotions. The capacity of music to alter skin temperature, muscle tension, cardiovascular function, respiration, norepinephrine, and brain wave patterns all have subjectively reported "emotion inducing effects" (Hirokawa and Ohira 2003; Scherer and Zentner 2001). The contour, rhythm, consonance/dissonance, and expectancy within a musical structure contribute to both the intensity and valence of the experienced emotion (Hirokawa and Ohira 2003; Scherer and Zentner 2001; Sloboda and Juslin 2001). Studies of subliminal facial expression demonstrate that musically induced physiological changes closely correspond with both involuntary facial expressions of emotion and subjectively described emotions evoked by particular types of music (Krumhansl 1997).

The capacity of music to entrain autonomic states and evoke congruent emotions in listeners provides the basis for creating and synchronizing motivational states in ritual participants. Although the communal songs and vocalizations of nonhuman species, including birds, whales, and wolves, may also function in social accommodation, only human music is capable of amplifying, intensifying, and modifying these effects through the use of "tools." The externalization of auditory signal production through the use of musical instruments fundamentally alters the signal/signaler relationship. The signal produced through the use of musical instruments is no longer indexical of either the signaler's state or condition. Two warriors can sound like twenty through the use of drums. Moreover, discrete sounds produced with musical instruments can be manipulated and juxtaposed to create emotionally evocative signals independent of the musician's state. Like the phonemes, words, and sentences of language, the use of musical instruments to produce sounds permits the combining of such sounds to create emotionally meaningful signals. These, in turn, can be arranged and rearranged within encompassing musical structures. The formality, sequence, pattern, and repetition of such musical structures themselves elicit emotional response through their instantiation of ritual. Music thereby creates an emotive "proto-symbolic" system capable of abstracting both the signals and structure of ritual. This abstraction and instantiation of ritual through music may well have established the foundation for symbolic thought in human evolution. It certainly provided a tool for the evocation of communal emotions across time and space.

Religious Ritual Evokes Both Positive and Negative Emotions. Cross-culturally, the emotion most frequently evoked by music in religious ritual is happiness (Becker 2001). In its most intense version, this may reach ecstasy. Such extreme joy "almost by definition involves a sense of the sacred" (Becker 2001:145) and is not unlike

that attained through use of various psychoactive drugs. Such drugs also constitute prominent elements in many religious systems. These components of religious ritual activate noradrenergic, serotonergic, and dopaminergic systems in the brain that heighten attention, enhance mood, and increase sociability (Regan 2001). These components of religious ritual elicit positive emotional responses in participants and engage the brain's dopaminergic reward system.

There are also numerous elements of religious ritual that evoke fear and pain rather than happiness and joy (Douglas 1966; Eliade 1959; Glucklich 2001; Turner 1967, 1969). Many ritual settings, including caves, caverns, and cathedrals, arouse vigilance by altering sensory perception through unpredictable illumination. Grotesque masks, bleeding statues, and fearsome icons engage innate "agency" modules that initiate emotional responses to danger and threat. Physical and mental ordeals inflict suffering and alter autonomic states. Vengeful gods and demons mete out punishment and demand painful sacrifices. Such negative stimuli comprise central elements of many religious systems and are particularly prevalent within the context of rites of passage (Eliade 1958, 1959; Glucklich 2001; Turner 1969). In contrast to the positive affect induced by ecstatic religious ritual, these components of ritual initiate responses related to fear and danger and evoke intense negative emotions in ritual participants.

The ability of religious ritual to elicit both positive and negative emotional responses in participants provides the substrate for the creation of motivational communal symbols. Through processes of incentive learning, as well as classical and contextual conditioning, the objects, places, and beliefs of religious ritual are invested with emotional significance. The rhythmic drivers of ritual contribute to such conditioning through their "kindling effects." Research on temporal lobe syndrome patients has shown that repeated neuronal firing of the amygdala can result in the conditioned association of arbitrary stimuli with heightened emotional significance (Bear 1979; Bear et al. 1981; Damasio 1994; Geschwind 1979). The increased religiosity characteristic of some temporal lobe epileptics has been attributed to this kindling effect (Bear 1979; Saver and Rabin 1997). Rhythmic environmental stimuli, including both music (Peretz 2001) and rapid, flashing lights, contribute to the rapid neuronal firing that results in such kindling (LeDoux 2002). Temporal lobe patients have a low threshold for such firing. EEG recordings have shown that the driving effects of ritual, such as music, drumming, and dancing, are capable of altering neuronal firing patterns in nonclinical populations, as well (Lex 1979; Neher 1962; Walter and Walter 1949). Elements of religious ritual that increase neuronal firing rates prime ritual participants for the conditioned association of symbols and emotions, both positive and negative, and create communal conditions for investing religious stimuli with these emotions (DiChiara 1995). The "ecstasy" achieved through the music and movement of Sufi dancing is transferred to the religious poetry with which it is associated. Likewise, ingestion of peyote by the Huichol Indians with its potentiation of the dopaminergic reward system provides a neurophysiological basis for investing the communal Peyote Hunt itself with sacred sig-

nificance (Myerhoff 1974). The negative emotional responses elicited by shadowed cathedrals, fearsome masks, and painful ordeals are heightened by drumming, music, and chants. The emotions thereby elicited and intensified become conditionally associated with the gods, ghosts, and demons that populate religious belief systems. Such symbols are not inherently pleasurable, but they are motivationally powerful and emotionally indelible. The use of communal ritual to invest previously neutral stimuli with deep emotional significance creates a shared symbolic system that subsequently valences individual choices and motivates behavior (Dehaene and Changeux 2000).

Most Religions Incorporate Both Positive and Negative Elements. The extent to which positive and negative elements are emphasized varies considerably both across the rituals within a given religion and among religions. Whether religious ritual predominantly incorporates positively or negatively valenced symbols appears to be correlated with both the political characteristics of the group and the risk-to-benefit ratio of their cooperative endeavors. We anticipate that when collective action issues are predominantly problems of coordination with few potential costs to individuals, positively valenced rituals will serve to promote affiliative cooperation. Such rituals engender empathy among participants and conditionally associate religious symbols with internal reward systems through incentive learning. When the predominant collective action issues faced by a group involve high individual costs but potentially great collective benefits, however, we expect increases in the costliness of religious ritual through the incorporation of negatively valenced stimuli to deter free riders. Since negatively valenced components of ritual are motivationally more powerful than positive stimuli, they provide a more reliable emotionally anchored mechanism for the subordination of immediate individual interests to cooperative group goals. In societies lacking a central political authority with police powers capable of subordinating individual interests to those of the group, intense and negatively valenced religious rituals address the inherent free-rider problems of collective action. The prominence of negatively valenced elements in religions associated with large, socially stratified, preindustrial societies (Roes and Raymond 2003) underscores this "policing" role of religion in motivating cooperation when a central secular authority is weak (Paige and Paige 1981). This is particularly pronounced in adolescent rites of passage in such societies (Eliade 1958; Glucklich 2001; Turner 1969). The incorporation of painful and dangerous elements in such rites is positively and significantly correlated with the incidence of warfare in preindustrial societies (Sosis et al., n.d.). These highly charged negative ritual experiences not only bond initiates, they also motivate intense cooperation and obedience under conditions of high individual risk and low central authority. The less powerful in such societies bear a larger share of the fitness costs of such subordination, but they may still gain greater benefits as members of a successful cooperative group than they would otherwise realize.

Yet, even when religious systems emphasize negatively valenced symbols, the

use of ritual to invest such symbols with emotional meaning necessarily incorporates positively valenced components that benefit ritual participants both psychologically and politically. Powerfully valenced symbols that motivate behavioral choices reduce cognitive dissonance, particularly under conditions of socioecological stress. Research by Bradshaw (2003) indicates that in contemporary Western societies, weekly worship attendance results in relatively greater decreases in psychological distress for the socioeconomically disadvantaged. The positive correlation of music and immunocompetence, and its inverse correlation with stress, suggests that ritual participation may differentially benefit group members facing the highest stress loads.

At the same time, joint participation in costly ritual creates empowering conditions. Ritual not only promotes more efficient and effective group functioning for politically and socially sanctioned endeavors, it simultaneously creates motivationally coordinated coalitions that can surmount existing in-group/out-group boundaries and provide a mechanism for social and political change (Bourguignon 1973). The Protestant Reformation of the sixteenth century, the role of African-American churches in the U.S. Civil Rights Movement, the contemporary importance of Pentecostalism in Latin America, and messianic movements in general, all illustrate the important role of religion in creating cooperative coalitions that have been instrumental in transforming existent social and political relationships.

Adolescence and Religion

Adolescent Rites of Passage. Adolescent rites of passage are one of the most consistent features of religions across cultures (Bettleheim 1962; Brown 1975; Lutkehaus and Roscoe 1995; Paige and Paige 1981; van Gennep 1960). In some societies, such as the Yamana and Halakwulup of Tierra del Fuego, such rites traditionally consisted of little more than oral transmission of sacred knowledge from elder to youth (Eliade 1958). In other cultures, such as the Ndembu and the Elema, pubertal initiation rites involved "kidnapping" of adolescents, months of sequestered seclusion, and ritual ordeals that included dietary restrictions, sleep deprivation, physical pain, and genital mutilation (Eliade 1958; Glucklich 2001; Paige and Paige 1981; Turner 1969; van Gennep 1960). In modern societies, adolescence also constitutes an important developmental period for religious training (Atran 2002; Elkin 1999; Regnerus et al. 2003). Although the intensity and duration of adolescent rites of passage vary from culture to culture, all share a common structure (Turner 1969; van Gennep 1960), as well as a common emphasis on the evocation of emotion and its association with symbols in the teaching of sacred things (Eliade 1958; Turner 1967, 1969).

The expressed purpose of rites of passage is to *initiate* particular categories of a society's adolescents into "the sacred." Initiates not only learn the sacred, they live it. The social and psychological death, transformation, and rebirth of the individual achieved through these rites not only train initiates, but transform them as well

(Turner 1967, 1969). Initiates enter as children but leave as adults invested with both social and reproductive rights, as well as the responsibilities entailed therein.

Through rites of passage initiates learn what things constitute the sacred. This requires the development of new cognitive schema for previously mundane things, whether words, images, or objects, involving the generation of new neural associative networks. More importantly, however, initiates directly experience the sacred. The separation; sleep and food deprivation; exposure to novel, dangerous, and terrifying stimuli; and subjection to physical and mental ordeals that are frequently an integral part of such rites evoke autonomic and emotional responses in initiates. Rites of passage purposefully engage unconscious emotional processes, as well as conscious cognitive mechanisms. The conditioned association of such emotions as fear and awe with symbolic cognitive schema achieved through these rites results in the sanctification of those symbols, whether places, artifacts, or beliefs. Because such symbols are deeply associated with emotions engendered through ritual, they take on motivational force. When such rites are simultaneously experienced by groups of individuals, the conditioned association of evoked emotions with specific cognitive schema creates a cultural community bound in motivation, as well as belief.

Adolescent Brain Development. Adolescence may constitute a neurophysiologically sensitive developmental period for the learning of abstract concepts and the conditioned association of such concepts with emotions (Kolb et al. 1998; Kwon and Lawson 2000; Plant 2002; Spear 2000). The human brain demonstrates great plasticity during development. Infancy, childhood, adolescence, and adulthood are marked by differentiated growth patterns in various brain cortices and nuclei (Casey et al. 2000; Giedd et al. 1999; Keshavan et al. 2002; Kolb and Whishaw 1998; Kolb et al. 1998; Kwon and Lawson 2000; LeDoux 2002; Plant 2002; Sowell et al. 1999; Spear 2000; Walker and Bollini 2002). The differential patterns of brain growth across the life course create sensitive periods for particular types of learning (Greenough 1986). Early childhood language acquisition is an example of such "experience expectant" learning (Pinker 1997). We propose that adolescence constitutes a second critical period of "experience expectancy" for the learning of emotionally valenced symbolic systems.

The Adolescent Brain Does Not Mature Uniformly. Whereas the preadolescent brain grows through an increase in cortical gray matter, during adolescence synaptic pruning eliminates as much as one-half of the number of cortical synapses per neuron (Spear 2000). Synapse elimination does not occur uniformly throughout the human cortex, however. Frontal and parietal lobes follow a similar developmental trajectory, with increases in gray matter up to a maximum occurring at 12.1 and 11.8 years, respectively, for males and 11.0 and 10.2 years, respectively, for females, followed by a decline, resulting in a net decrease in volume across adolescence. The growth of temporal lobe gray matter has also been found to be nonlinear, with maximum size reached at 16.5 years for males and 16.7 years for females, and

slight declines thereafter (Giedd et al. 1999; Sowell et al. 1999). Both frontal and temporal lobe maturation occurs late in development and is completed in early adulthood (Keshavan et al. 2002; Sowell et al. 1999). This heterochronous adolescent loss of cortical gray matter is accompanied by increased volume in amygdalar and hippocampal nuclei. Concurrent changes in white matter density facilitate the propagation of electrical signals and increase the speed of neural transmission (Keshavan et al. 2002; Walker and Bollini 2002).

These changes streamline brain function by eliminating irrelevant interconnections and enhancing those that remain. This ontogenetic sculpting of the brain results from differential activation of specific neurons on the basis of experience in the accommodation of environmental needs (Greenough and Black 1991; Kolb and Whishaw 1998; Kolb et al. 1998; LeDoux 2002). Kolb and colleagues note that "experience can alter different parts of neurons differently (and) . . . changes in synaptic organization are correlated with changes in behavior" (1998:156). As a result, "the environment or activities of the teenager may guide selective synapse elimination during adolescence" (Giedd et al. 1999:863). Emotionally evocative experiences that occur during adolescence may, therefore, actually shape neural networks in the maturing brain. This is particularly true for brain areas such as the temporal lobes and prefrontal cortices undergoing maturation.

The maturation of the prefrontal cortex that occurs during adolescence has important implications for abstract reasoning abilities and symbolic thought. The prefrontal cortex (PFC) is "essential for such functions as response inhibition, emotional regulation, planning and organization" (Sowell et al. 1999:860). The interconnectivity of the PFC with nearly all other brain regions uniquely situates this cortical structure in its ability to associate diverse stimuli (Groenewegen and Uylings 2000; Robbins 2000; Rolls 1998). Maturation of the prefrontal cortex during adolescence provides the neurophysiological substrate for social cognition, abstract reasoning, and symbolic thought (Adolphs 2002a; Deacon 1997; Robbins 2000).

There Is a Shift in the Dopaminergic Reward System during Adolescence. Significant changes in neurotransmitter systems occur during adolescence. Receptors for dopamine, serotonin, acetycholine and GABA (γ-aminobutyric acid) are pruned from their preadolescent over-production, and limbic areas, including the hippocampus, also undergo pruning of excitatory receptors. Hippocampal receptors for endogenous cannabinoids peak during adolescence at higher than adult levels (Spear 2000). Studies by Carlson et al. (2002) demonstrate increased long-term potentiation as a result of endocannabinoid production, suggesting enhanced memory functions during this period. Concurrent with the decline in excitatory neurotransmitter receptors during adolescence, a shift in dopamine balance from mesolimbic to mesocortical regions occurs. This shift impacts reward learning and has significant behavioral implications (Schultz et al. 2002). Dopamine inhibitory input to the prefrontal cortex is greatest during adolescence, whereas dopamine activity in the anterior cingulate cortex and other subcortical regions, including the amygdala, is

lowest. While dopamine activity in the anterior cingulate cortex is under inhibitory control of the amygdalar dopamine system, the amygdala is, in turn, tonically inhibited by prefrontal cortex activity. According to Walker and Bollini, "the enhancement of neuronal connection between the cortex and limbic regions may play a role in the integration of emotional behaviors with cognitive processes" (2002:18) during this time. The shifting dominance of amygdalar dopamine projections from anterior cingulate cortex to the prefrontal cortex during adolescence impacts both conditioned associations and the intrinsic reward system. In addition to cortical maturation during adolescence, MRI studies have shown differences in the activity of the amygdala in adolescents, as compared with adults. Human adolescents exhibited "greater brain activity in the amygdala than in the frontal lobe when engaged in a task requiring the subjects to identify emotional state from facial expressions, while adults conversely exhibited greater activation in frontal lobe than amygdala when engaged in the same task" (Spear 2000:440).

Adolescent Changes in Brain Function Have Important Implications for Learning and Behavior. The concurrent maturation of the temporal lobe and amygdala are relevant to facial recognition and social judgments (Adolphs et al. 1998). Studies indicate that the amygdala mediates judgment of other people's social behavior, particularly with regard to approachability and trustworthiness (Adolphs 2002a, 2002b; Cardinal et al. 2002). The shift in the dopaminergic reward system from mesolimbic to mesocortical dominance that occurs during adolescence provides a unique developmental window for the conditioned association of abstract symbols with intensely experienced emotions and for the integration of these associations with both social interactions and symbolic thought. Heightened adolescent sensitivity to stressors amplifies this process (Spear 2000). The synaptogenesis and neurotransmitter shifts occurring during adolescence intensify the impacts of environmental stimuli experienced during this developmental phase. This is particularly true for the late-maturing frontal and temporal cortices, and for such limbic nuclei as the amygdala and the hippocampus. The specific changes occurring in the adolescent brain render this a particularly sensitive developmental period in relation to social, emotional, and symbolic stimuli. These are precisely the type of stimuli of greatest importance in adolescent rites of passage.

Adolescent Rites of Passage Bombard Initiates with Environmental Stimuli that Engage Prefrontal, Temporal, and Limbic Functions. The ritual components of these rites optimize stimulus impacts while amplifying the kindling effects of the stimuli through rhythmic drivers, including music, chanting, and dance, all of which may be particularly salient for adolescents. Intensification of the stimuli through sleep and food deprivation, fear, physical ordeals, and drugs can be expected to increase the neurophysiological impacts in terms of memory, reward learning, and emotional charging of stimuli. The "breaking down" of initiates during the liminal phase of adolescent rites of passage engenders a common autonomic state among

initiates. The empathy and shared emotional charging experienced in rites of passage valence the cognitive schema associated with sacred things.

Not all schemata constitute equal candidates for sanctification. Accumulating evidence suggests a developmental propensity for schema incorporating socially omniscient and declarative supernatural agents (Bering 2005). Moreover, schema of religious belief systems exhibit consistent structural features. Dichotomies, inversions, and counterintuitive concepts are consistent elements of this structure (Atran 2002; Atran and Norenzayan 2004; Boyer 2001; Boyer and Ramble 2001; Levi-Strauss 1963). The cognitive schema of religious systems also consistently incorporate the salient socioecological features of the society in which they occur, yet they do so while transcending the momentary, individual, and specific attributes of those features. Both the abstraction of social relations and their transformation into eternal truths are the hallmarks of religious schema (Rappaport 1999). These schema leave no outwardly visible signs but instead carve their indelible mark on the very minds of initiates. Through adolescent rites of passage, "the abstract is made alive and concrete by the living substance of men and women" (Rappaport 1999:148).

THE EVOLUTION OF RELIGION

Many recent evolutionary studies define religion in terms of cognition, focusing on the beliefs rather than the behaviors of religious systems. From a cross-cultural perspective, however, it is ritual that lies at the heart of all religions (Durkheim 1969; Eliade 1958, 1959; Rappaport 1999; Turner 1967, 1969), and it is participation in ritual that creates believers (Sosis 2003b). In the absence of ritual indoctrination and practice, religious beliefs lack both emotional salience and motivational force.

Ritual in nonhuman species functions to communicate social information and to coordinate social behaviors through the use of species-specific signals evolved to elicit neurophysiological responses in participants (Dugatkin 1997; Rogers and Kaplan 2000; Rowe 1999; Wingfield et al. 1999). Although ritual displays may be costly in terms of time, energy, and somatic expenditures, they provide information to participants that can impact individual fitness. By providing reliable signals, ritual allows accurate assessment of conspecific condition and intent (Zahavi and Zahavi 1997). It also "primes" participants for social interaction. Ritual winners reap resource and mating advantages; losers, however, also benefit from reductions in conflict achieved through ritual. Within the context of social groups, ritual further functions to decrease individual stress through the stabilization of social organization (Sapolsky 1999) and provides a means of facilitating both group fission/fusion and the coordination of group activities (Dugatkin 1997; Goodall 1986; Laughlin and McManus 1979; Rogers and Kaplan 2000). The pre-hunt ritual of wolves represents such coordination, and the friendship rituals of chimps and baboons have been observed to facilitate cooperative alliances that force changes in

troop hierarchies (Goodall 1986; Watanabe and Smuts 1999). Among human groups, these same functions are apparent in the rituals of both sports and politics.

Religious ritual, too, functions to communicate and coordinate social behaviors and does so through the elicitation of neurophysiological responses. Participation in religious ritual results in empirically demonstrated effects on both cooperation (Sosis and Bressler 2003; Sosis and Ruffle 2003, 2004) and individual health and longevity (Hummer et al. 1999; Matthews et al. 1998; Murphy et al. 2000). Like the ritualized displays of nonhuman species, religious ritual is positively associated with decreased stress and improved immunological function (Murphy et al. 2000). Bradshaw (2003) has further found that decreases in psychological distress associated with participation in religious ritual may be particularly relevant for the relatively deprived. Under conditions of inequality, religious ritual may, thus, confer direct fitness benefits for participants while simultaneously providing a mechanism for cooperative action for political change. The parallels between nonhuman and religious ritual extend, as well, to the use of religious ritual in the reintegration of social groups across cultures, and the coordination of group endeavors. Nonhuman and religious ritual clearly share important structural and functional elements selected for their adaptive value in social communication (Rowe 1999). The two are, however, separated by a critical distinction. While nonhuman ritual encodes signals as neurophysiological primes for behavior, religious ritual encodes symbols created through the ritual process itself.

Although it is impossible to retrace ritual's evolution to a symbolic signaling system, the "distinguishing marks of ritual"—chanting, music, and dance—may provide important clues. As discussed above, all religions incorporate music in some form, and in most it is a dominant element. Music is uniquely adapted to instantiate the structure of ritual precisely because it incorporates the formality, sequencing, patterning, and repetition that define ritual. As a result, it is able to elicit the neurophysiological responses associated with such ritual in the absence of ritual behaviors. Music's direct impacts on autonomic function, its ability to enhance immunocompetence (Kuhn 2002), and its role in entraining ritual participants may all have led to its selection as a fundamental component of early hominid ritual. Ultimately, however, the most important evolutionary consequence of music may well have been its "proto-symbolic" attributes. The ability of music to abstract and codify ritual meaning over time and space may have been the critical first step toward symbolic thought. The introduction of such a symbolic ritual system introduced a new type of cognition in hominid evolution. The use of ritual to create associational neural networks linking symbolic, social, and affective systems provided social groups with a highly flexible tool for motivating individual behavior, forging inter-group alliances, and discriminating between friends and enemies. Individuals within such groups would have realized fitness benefits resulting from inter-alliance sharing of patchily distributed resources, as well as enhanced cooperation for in-group ventures, including hunting and warfare.

When symbolic behavior emerged in human evolution remains unknown. Some

researchers argue for the emergence of symbolic culture in early archaic populations (Bednarik 1995; Hayden 1993; Marshack 1990); others maintain that symbolic thought appeared in early *Homo sapiens sapiens* prior to migration out of Africa (Henshilwood et al. 2001; McBrearty and Brooks 2000; Watts 1999). Still others argue for a "big bang" theory of symbolic culture first appearing approximately 50,000 years ago in western European populations (Mithen 1996). All, however, associate the emergence of symbolic systems with ritual. Mithen notes that "the very first art we possess appears to be intimately associated with religious ideas by containing images of what are likely to be supernatural beings" (Mithen 1996:155). Watts (1999) also argues for a ritual origin of symbolic systems but maintains that such systems emerged some 100,000 years earlier than posited by Mithen. Watts (1999) argues that the ubiquitous presence of red ochre pigments at numerous African MSA (Middle Stone Age) sites indicates ritual activity. Noting a jump in ochre presence over time, he concludes that "the preoccupation with redness clearly indicates that ochre was primarily used for signalling" (1999:128) and argues that "the habitual nature of such behaviour from the MSA2b onwards strongly suggests that the signalling was symbolic rather than solely indexical or iconic" (1999:137). The MSA Blombos Cave excavations of Henshilwood and colleagues lend further support for symbolic behaviors in African MSA populations. These researchers recovered twenty-eight bone tools dated ca. 70,000 years ago exhibiting "formal" techniques of bone tool manufacture, as well as ochre pencils and objects bearing geometric designs. They note that "bone tools are . . . only one element of a range of techniques used at BBC during the MSA to produce practical and/or symbolic artefacts indicative of a complex technological society" (2001:668). The occurrence of pigment processing at numerous MSA sites, as well as the notching and incising of ochre, bone, and ostrich shell, are also interpreted by McBrearty and Brooks as evidence of symbolic behavior. These researchers note that "Despite the relatively small number of excavated MSA sites, the quantity and quality of evidence for symbolic behavior . . . far exceeds that known for the European Middle Paleolithic where the site sample is more than ten times greater" (2000:531).

The irregularly patterned and increasing use of red ochre pigment by African MSA/LSA populations suggests that ritual was of variant but increasing importance in human social groups throughout this period. The widespread occurrence of red ochre pigments has been interpreted by Dunbar (1999) as evidence of "badging." He argues that red ochre badging increased during the African MSA in order to mark and identify group members when both the size and the number of groups were increasing. Yet, Dunbar notes that "external badges encounter a common problem . . . they are easy to fake" (1999:202).

If, however, red ochre badging is viewed within a broader context of ritual, as Watts and others (Knight et al. 1995) have interpreted it to be, then both the costs and the reliability of these badges increase, as well. Participation in ritual entails time and energy costs which may deter free riders (Irons 2001; Sosis 2003b). More importantly, participation in communal ritual provides the context for the creation

and internalization of communally shared motivators. The use of ritual to emotionally charge badges and other selected artifacts would have added to the costs of such badges, but would have significantly increased their reliability as signals of motivational intent. This ritual transformation of signal badges to emotionally charged and positively valenced symbols of social relationships may have served to facilitate the creation of alliances under conditions of resource scarcity and conflict (Hayden 1987). The red ochre, beadwork, bone incising and regional stone- and bone-working styles evident in the archaeological record of the African MSA between 250,000 and 50,000 BP all indicate an increasing importance of ritual, an intensification of costly signals, and the emergence of symbolic systems specific to social groups. The emergence of dance, music, and even language may have their roots in this intensification process. Why did these changes occur during the MSA?

There is evidence of increasing population, increasing use of a fission/fusion social organization, and shared use of patchy resources within an environment of overlapping group ranges throughout the MSA. McBrearty and Brooks (2000) report that MSA sites in Africa are more numerous than those of the Acheulian and are found in previously uninhabited zones, suggesting both the need and the ability of MSA populations to exploit a wider range of habitats. Moreover, these sites provide evidence of deliberate foresight and planning in cooperative hunting strategies (Chase 1989), specialized tool use (McBrearty and Brooks 2000; Shea 1988), and in the transport of both water and materials across long distances (Deacon 1989). The development of technologies such as ostrich eggshell containers that permitted the transport of critical resources such as water opened up previously uninhabitable areas (Watts 1999). The appearance of blades, as well as retouched stone and bone points, indicates increasing technological sophistication, as well. McBrearty and Brooks (2000) have interpreted the diversification of MSA toolkits and the varying proportions of different artifact classes at different sites as evidence of regional tradition differences, as well as differences in extractive activities. These authors present compelling arguments for continuing intensification and scheduling of resource use throughout the African MSA into the LSA. Evidence of both selective, tactical hunting of large game and intensifying use of aquatic and small-scale resources is cited, as well as proliferation and geographic extension of trade networks. This intensification of extractive and hunting technologies, as well as expansion into previously unexploited habitats and increasing territorial sizes during the African MSA, have been viewed by McBrearty and Brooks (2000) as evidence of both population growth and environmental degradation.

The picture that emerges from the accumulating archaeological record for the African MSA is one of population growth, geographic dispersion, and technological intensification and specialization. Tactical hunting strategies for large game emerged. Simultaneously, the irregular distribution of critical items, such as water, and the regional distribution of other prized resources, such as obsidian, introduced increased inter-group interaction and competition for utilization of these patchy resources. The ecological context of human groups in the African MSA suggests

that the nature of hominid social groups underwent change during this period. Larger group sizes punctuated by seasonal fission/fusion, and the creation and maintenance of alliances in response to resource irregularity, are indicated. An increased reliance on cooperative subsistence strategies, including large game hunting and joint utilization of dispersed water sources, as well as increased competition between groups for patchy resources, can be surmised from the archaeological record. Red ochre pigments and decoratively incised stone and bonework suggest that these changes were accompanied by increases in ritual and the emergence of an abstract symbolic system.

It is likely that the incorporation of rhythmic drivers in human ritual preceded these developments. The drumming and "proto-dances" of chimpanzees suggest that precedents of music, chanting, and dance existed in common ancestral hominoids (Goodall 1986). Such behaviors may have originated as communication signals. The ability of these drivers to enhance positive affect would have rendered rhythmic ritual a useful tool in the reintegration of fissioned groups and in the creation of inter-group alliances. The use of rhythmic ritual to invest artifacts with symbolic, emotionally valenced meaning would have provided dispersed groups with a tangible and motivational symbol of the abstract social relationships codified through the ritual process. With increasing resource competition, however, there would also be increasing need to differentiate and cohesify groups in order to more efficiently and effectively extract and defend resources. These conditions would further promulgate in-group specialization and stratification. Under such conditions, negatively valenced religious symbols would assume increasing importance owing to both their greater motivational force and their signaling efficacy (Johnson and Kruger 2004).

In contrast to the indexical signals of animal ritual, which elicit congruent motivational states within an immediate time and space, the symbols of religious ritual afforded early humans a means of engendering congruent motivational states across space and time. And, although signals elicit neurophysiological responses that permit social interaction in the here and now, symbols extend the horizon of those responses to future activities, as well. Religious symbols, thus, provided tools for creating cooperative coalitions across time. In doing so, they introduced a new level of cognition and social organization in human evolution.

CONCLUSION

Religion is an important and unique human adaptation defined by four recurrent traits: belief systems incorporating supernatural agents and counterintuitive concepts, communal ritual, separation of the sacred and the profane, and adolescence as a preferred developmental period for religious transmission. Although the specific expression of each of these traits varies across cultures in socioecologically patterned ways, the belief systems and communal rituals of all religions share common structural elements that maximize retention, transmission, and affective en-

gagement. The roots of these structural elements can be found in nonhuman ritual where they serve to neurophysiologically prime participants and ensure reliable communication. Religion's incorporation of music, chanting, and dance intensifies such priming and extends the impacts of ritual beyond dyadic interactions. Music constitutes an abstract representation of ritual that can be recreated across time and space to evoke the emotions elicited by ritual. Human use of ritual to conditionally associate emotion and abstractions creates the sacred; it also lies at the heart of symbolic thought. The brain plasticity of human adolescence offers a unique developmental window for the creation of sacred symbols. Such symbols represent powerful tools for motivating behaviors and promoting in-group cooperation. Although religion evolved to solve an ecological problem by promoting group communication and cooperation across space and time, the symbols it created laid the foundation for a new adaptive niche in human evolution.

A number of empirically testable hypotheses emerge from this view of religion. We have posited that the adaptive function of religion is to ensure cooperation when individuals can achieve net benefits through collective action, and we have proposed that ritual serves to engender such cooperation through the motivational valencing of symbols. If so, religious ritual should be most pronounced within groups of individuals who are not genetically related and are pursuing high-cost cooperative endeavors, and least pronounced among kin groups pursuing individualistic subsistence strategies. Significant associations between ritual intensity, positive and negative symbolic valence, and age of initiation should also exist among these variables. We expect to find the highest intensity of ritual in groups encompassing unrelated individuals who must engage in intermittent, high-risk, cooperative endeavors, such as external warfare or long-term sharing of scarce and patchy resources. In contrast, the lowest levels of religious ritual should occur among non-cooperating groups of kin. We would further expect to find permanent, highly charged religious symbolic systems in non-kin groups engaged in high risk or widely dispersed cooperative endeavors. Based on emotion theory, we expect ritual systems to incorporate more negative affect in the emotional conditioning of symbols under conditions of large group size and political inequality. We have argued that adolescence constitutes an experience expectant period for the emotional valencing of symbols. We, therefore, anticipate adolescent rites of passage to be most intense and prolonged among unrelated adolescents in societies engaging in high-risk, cooperative activities. In addition, there should be a positive association between the duration/intensity of adolescent rites of passage and concomitant changes in both brain response patterns to religious symbols and individual cooperative behaviors. Music should be a particularly powerful elicitor of such responses.

Numerous research questions remain. If adolescence is an "experience expectant" period for the emotional valencing of symbolic systems, is adolescent development dependent on such valencing? In the absence of religious ritual, how is such valencing achieved? Does ritual participation impact adolescent health and behavior? Do adolescent rites of passage measurably alter neurotransmitter and

endocrine levels? Are there gender and/or status differences in the neurophysiological effects of ritual? Can we empirically demonstrate autonomic congruence in ritual participants? If so, is such congruence significantly associated with perceived empathy and increased cooperation? To what extent do the various components of ritual impact emotional charging of symbolic stimuli? Can we define socioecological parameters associated with the positive and negative emotional charging of religious symbols? Does the developmental propensity to believe in socially omniscient supernatural agents peak in adolescence? Are such agents a necessary component of symbolically charged belief systems, or can such systems instead achieve cooperation through the emotional charging of unfalsifiable non-agent schema, such as "liberty" and "freedom"? Finally, if religion is an evolved adaptation for cooperation, can humanity achieve such cooperation in its absence? This is among the most salient questions facing the world today. The answer must begin with a better understanding of religion as a specifically human adaptation.

Signals are necessarily bound to the moment; symbols, however, have existence and meaning that extend beyond the immediate to link the past, present, and future. They, thus, lay the foundation for creating and identifying groups, but also for motivating cooperation among the individuals within these groups across both space and time (Rappaport 1999). Far from being an evolutionary by-product, religion represents a critical adaptive complex evolved in response to ecological challenges faced by early human populations. Individual fitness benefits resulted both from participation in ritual itself, and from the cooperative activities it enabled. The use of music-based ritual to imbue group signals with emotional and motivational meaning gave impetus to a new system of social communication and a new level of human cognition.

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Reasoning about Dead Agents Reveals Possible Adaptive Trends

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We investigated whether (*a*) people positively reevaluate the characters of recently dead others and (*b*) supernatural primes concerning an ambient dead agent serve to curb selfish intentions. In Study 1, participants made trait attributions to three strangers depicted in photographs; one week later, they returned to do the same but were informed that one of the strangers had died over the weekend. Participants rated the decedent target more favorably after learning of his death whereas ratings for the control targets remained unchanged between sessions. This effect was especially pronounced for traits dealing with the decedent's prosocial tendencies (e.g., ethical, kind). In Study 2, a content analysis of obituaries revealed a similar emphasis on decedents' prosocial attributes over other personality dimensions (e.g., achievement-relatedness, social skills). Finally, in Study 3, participants who were told of an alleged ghost in the laboratory were less likely to cheat on a competitive task than those who did not receive this supernatural prime. The findings are interpreted as evidence suggestive of adaptive design.

KEY WORDS: Afterlife; Attribution; Cooperation; Death; Evolutionary theory; Religion; Theory of Mind

Let nothing be said of the dead but what is good.
—Solon

Over the past few years, the cognitive science of religion has become something of a hothouse for evolutionary critique (see Atran and Norenzayan 2004; Bering 2005; Boyer 2001; Pyysiäinen 2001; Sosis 2003; Wilson 2002). According to many

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scholars in the field, religion historically has been the subject of undue adaptationist speculation, all too susceptible to "just-so" stories. Although the debate over whether religion occurred by design or by chance has lately been stirred up by the publication of several new books on the topic, the question has been around for some time.

In their classic indictment of human sociobiology for its "Panglossian" theorizing, Gould and Lewontin (1979) tagged religion, along with music, law, and language, as a prime example of a spandrel—a *non-selected-for* and incidental by-product of *selected-for* large brain size in humans. In later writings, Gould even joins forces with Freud by contending that religion is likely owed to *Homo sapiens*' unique awareness of death, which itself is a side-effect of human consciousness.[1] In a heated tête-à-tête with Pinker over what he considered to be the promiscuous usage of adaptationist arguments in evolutionary psychology, Gould (1997:56) singled out religion once again:

> I don't see how a biologist could argue that the human brain evolved consciousness in order to teach us that we must die. Knowledge of death is therefore probably a spandrel—an ineluctable consequence of consciousness evolved for other reasons. But this spandrel may then have inspired one of our defining institutions.

We believe that Gould is mistaken in his claims that humans' unique struggle with death is the sole reason for religion. Nevertheless, it is undoubtedly an integral feature of religion. It has also been a focus of our own recent laboratory studies. Ironically, however, many evolution-minded cognitive scientists would tend to agree with Gould (and Pinker, for that matter) that the psychological foundations of religion are by-products of other design features of the mind (Barrett 2000; Boyer 2001; Pyysiäinen 2001; Sperber 1996). According to many researchers in this area, religious concepts are argued to exploit information-processing mechanisms into paying attention to them because they violate ontological regularities by hybridizing or violating natural categories (Atran and Norenzayan 2004; Barrett 2000; Boyer 2000, 2001). These writers argue that only the cognitive architecture itself can be the product of natural selection; religious ideas are seen as simply being parasitic on this evolved architecture—as nothing more than noise that shares a general frequency between cultures (e.g., Pyysiäinen 1999; Sperber 1996).

We too argue that religion is grounded in and enabled by engineering requirements of our species' naturally designed cognitive systems. But this is where our shared opinion with most other cognitive scientists begins to diverge (see also Bering 2002, in press). This is because stating that religious concepts work by "parasitizing" psychological architecture is different from stating that behaviors that are associated with religion, by virtue of their incidental phylogeny, did not confer fitness advantages in the ancestral past or were limited to cultural selection (Bulbulia 2004). The psychological foundations of some religious behaviors, including those related to death, may be *co-opted spandrel*s (Andrews, Gangestad, and Matthews 2002; Buss et al. 1998). They may be side effects of other design features that, quite by chance, had salutary effects of their own on the organism's ability to pass on its genes and, over time, were independently subjected to natural selection.

REPRESENTATION OF PSYCHOLOGICAL CONTINUITY AFTER DEATH

As a test case for these adaptationist speculations, we have begun a research program designed to investigate the possibility that ancestral humans' confrontation with death—an ontological regularity in the surest sense—led to species-specific psychological mechanisms that bear hallmarks of adaptive design (Bering 2002; Bering and Bjorklund 2004; Bering, Hernández-Blasi, and Bjorklund in press). Because evolved systems often demonstrate precursory components through developmental emergence, we began with what we knew about children's reasoning about death. Although Piaget never wrote about children's understanding of death from the perspective of his cognitive stage model, research on this topic was, until recently, dominated by Piagetian-style analyses (for a review, see Kenyon 2001). Thus, previous investigators argued that children's views of death must be constrained by their particular stage of cognitive development, with children in the preoperational stage (2–6 years), for example, seeing death as reversible, as personally avoidable, and as leaving dead agents with bodily functions still intact. According to Speece and Brent (1984), not until age 7 (marking the transition to concrete operations) do children develop a comprehensive death concept that mirrors adults' biological understanding (with the transition to formal operations, adolescents are said to think in abstract terms about what death *means* from social and religious perspectives).

As with many Piagetian frameworks, however, subsequent research served to roll back the developmental trajectory of these abilities. Slaughter and her colleagues found that preschoolers who understand the vitalistic purpose of various activities, such as eating and drinking, correctly identify these activities as ceasing at death (Slaughter and Lyons 2003; Slaughter, Jaakola, and Carey 1999; see also Inagaki and Hatano 2002). Because young children who are given explicit information about these vitalistic activities (e.g., that people eat food in order to stay alive) display a more sophisticated understanding of death than those who are not, these findings suggest that Piaget's cognitive stages do not impose impassable constraints on children's ability to reason about the biology of death.

In addition, findings reported by Barrett and Behne (2005) and by Bering and Bjorklund (2004) demonstrate that even 3- and 4-year-olds may possess implicit knowledge of the biological verities associated with death, particularly when death is made visually apparent. Bering and Bjorklund (2004) found that the majority (85%) of young children reasoned that the brain of a mouse killed and eaten by an alligator (both puppets) stopped working at its death. In the same study, however, preschoolers often reasoned that the psychological functions associated with these biological imperatives *continued* after death—for example, despite the dead mouse's brain not working anymore, it could still think and remember; or despite the fact that the dead mouse needn't drink water anymore, it still retained the capacity for thirst (see also Bering et al. in press).

With increasing age, and likely as the result of an accretion of scientific facts

concerning mind-body relations, children's belief in the continuity of psychological states after death declines. But it declines in a predictable fashion, such that certain categories of mental states (e.g., perceptual and psychobiological states) are more frequently reported as ceasing than other, ostensibly more ethereal categories (e.g., emotional, desire, and epistemic states). Whether they grow up in overtly or only peripherally religious surroundings, most young adolescents continue to strongly endorse psychological continuity after death for these latter types of states (e.g., Bering et al. in press).

In terms of capacity to harbor such beliefs, then, children's reasoning about life after death is not solely a function of acquiring these ideas through various cultural channels. Rather, reasoning that psychological states survive death appears to be the *default* stance and is fleshed out into more sophisticated, adult-like afterlife beliefs through cultural exposure (and sometimes, rarely, usurped altogether by science-mindedness). In an earlier study with adults, Bering (2002) found that even individuals who classified themselves as agnostic or as having "extinctivist" beliefs about life after death (that personal consciousness is entirely snuffed out at the moment of death) nevertheless often attributed emotions, desires, and beliefs to a character *after* this person's sudden death (e.g., by reasoning that the character "knows" that she has died). Furthermore, Bering reported that, in looking at latency of response, it took participants *longer* to report that emotions, desires, and beliefs had been permanently interrupted than it did to report that other functions had ended.

These findings converge to suggest that humans are intuitively biased toward holding mental representations of psychological continuity after death and that it may be cognitively effortful to adopt a true materialist stance in relation to this subject. (For related, more formal philosophical treatments of people's inability to conceptualize posthumous nonexistence, see Clark 1994; Luper 2002.)

MENTAL STATE REPRESENTATION AS UNDERLYING SYSTEM

The capacity to represent higher-order mental states is a defining feature of human social cognition (Povinelli and Bering 2002; Tomasello et al. in press). An absence or impoverishment of this "theory of mind" capacity would obviously disallow the entertainment of beliefs about psychological continuity at death. It is therefore a non sequitur to ask whether those species that are biologically unequipped to take the intentional stance (cf. Dennett 1987) can form such representations. We believe that this cognitive specialization in humans served as the starting point for more recent psychological adaptations related to afterlife beliefs (as well as potentially many other psychological adaptations; see Bering and Shackelford 2004).

Both children and adults can best be classified as "common-sense dualists" (Bloom 2004). Recent findings by Kuhlmeier, Bloom, and Wynn (2004) show that infants might start off with a better grasp of the immaterial properties of people (that they are intentional agents) than of material properties (that they are also physical objects). These investigators presented 5-month-old infants with an expectancy

violation test in which a solid object appears to violate the law of continuous motion by "skipping" through empty space in real time. Whereas infants dishabituate to (i.e., look longer at) inanimate objects that violate this law (their surprise reflecting an understanding of naïve physics), they appear nonplussed when observing a human similarly engaged in discontinuous motion.

Although Kuhlmeier and colleagues are cautious in their interpretation of these findings, they reason that 5-month-olds may have separate construals for processing the physical dynamics of agent-related behaviors and object-related events. They argue that these data show that "infants do not readily view humans as material objects" (2004:101) and that an "appreciation that . . . people *are* just objects may be a developmental accomplishment" (2004:102; italics in original).

The capacity to see others as intentional agents lays the cognitive groundwork for people's stubborn penchant for reasoning that other agents' minds survive their corporeal death. Operating in concert with this set of sophisticated social skills, however, are more ancient adaptations that solved basic and recurrent problems but that are not clearly grounded in representational competencies. Boyer (2001) has pointed out that because of the problems of contamination and predators, the reality of a rapidly decaying human body in one's immediate environment demanded effective behavioral recourse, including burial, incineration, and abandonment of corpses in remote areas (e.g., see Reynolds and Tanner 1995). People's strong emotional reactions of disgust to dead bodies appear to trigger such adaptive behavioral responses (Rozin, Haidt, and McCauley 1993).

But all this does not make the case for psychological adaptations that implicate the *minds* of dead agents. What would be required to make this case is to show that a representational bias leading to belief in the continued existence of mental states after death fructified into self-contained psychological mechanisms dedicated to processing information and generating adaptive responses relevant to this domain (Andrews et al. 2002; Buss et al. 1998). One must establish, first, how this representational bias came to impact the net genetic fitness of individual humans and, second, that natural selection likely operated on this representational bias in ancestral environments.

We do not pretend to accomplish this difficult task with the set of studies reported here. Nevertheless, we believe that the current studies, which explore people's trait attributions to recently dead agents and investigate whether a prospective ghost in the environment curbs selfish intentions, move us in the right direction. We view these studies as an initial step toward testing the adaptationist hypothesis that representational biases underlying afterlife beliefs led to genetic fitness advantages in the ancestral past.

PRESENT RESEARCH

In Study 1, on two separate occasions, we asked undergraduates to rate the same three strangers (depicted in black-and-white "head shots") on a large number of

both desirable (e.g., "intelligent," "trustworthy") and undesirable (e.g., "hypocritical," "conceited") traits. Upon arrival at the laboratory for the second session (one week after their first visit), participants were informed that one of the individuals shown in the photographs had died, but that they should nevertheless re-rate each of the targets on the same scale as before. This gave us the opportunity to see if participants' subjective liking of others is influenced by having knowledge of these others' recent death. Popular wisdom and everyday observation that people "don't speak ill of the dead" led us to predict that the participants would rate the dead agent more favorably than they would before learning of his death.

More importantly, this would also be consistent with the evolutionary hypothesis that belief in dead agents' minds served an adaptive moral regulatory function (e.g., Boyer 2001). It is not only true that a belief in the afterlife is culturally recurrent; in the majority of hunter-gatherer societies dead agents also are envisioned as wielding considerable punitive power over social transgressors (Bering and Johnson 2005; Boyer 2001; Reynolds and Tanner 1995). The cross-cultural literature suggests that dead agents are most frequently seen as causal agents who (1) are particularly concerned with and emotionally invested in behaviors from the moral domain; (2) have privileged epistemic access to the self's actions within this domain—knowing about the self's actions even when they occur in private; and (3) reciprocate through positive life events for the self's prosocial actions and retaliate through negative life events for the self's antisocial actions (Fiske 2002).

We reasoned that the *proximate* cause of positive changes in subjective liking of the recently dead is fear of being punished through negative life events. This fear can be either implicit or explicit; individuals who do experience increased positive feelings of the recently dead may not be consciously aware of the proximate cause of these emotional changes. Many individuals are fully cognizant of this fear of dead others, but as cognitive philosophers such as Stocker (1987) and Deigh (1994) point out, belief, and perhaps even thought, are not prerequisites for fear. (Even the most science-minded of us would likely cringe at the idea of spending a night alone in a cemetery, or sharing a room with an angry spirit in a presumably haunted house.) From an evolutionary perspective that emphasizes unconscious processes, people should act submissively toward dead agents since the latter's "behaviors" cannot be subjected to normative punitive sanctions. Similar obsequious attribution processes involving genuine threats of social punishment by other (living) dominant group members have been hypothesized in the cooperation literature (see Fessler and Haley 2003; Fiske 2002; Gilbert 2000). These mechanisms should be particularly pronounced when it comes to making submissive appeals to the *morality* of the dominant other, especially when this other wields so-called absolute power. This is because reminding dominant others that they are, for example, good and kind should have the overall effect of rebinding them to social contracts whenever they are tempted to engage in arbitrary punishment without penalty (think of the hapless plebe who throws himself at the mercy of the king).

To test this secondary (morality-specific trait attribution) hypothesis further,

and to secure a measure of validity outside the laboratory, Study 2 involved a content analysis of the attributions of trait variables found in obituaries authored by family members and close friends of recently deceased individuals. In line with our evolutionary model, we hypothesized that descriptions of the recently dead should emphasize prosocial and morality-relevant traits (e.g., "generous," "loving") over other traits (e.g., "hardworking," "outgoing").

We also hypothesized that the *ultimate* cause in positive attributions to recently dead agents—the long-term genetic gain—is a consequence of the adaptive behaviors that these attributions would have been associated with in the ancestral past. Increasingly positive attributions should be linked to cooperative behaviors to the extent that prosocial actions can be motivated by fear of supernatural punishment (Fiske 2002; Johnson and Krüger 2004).

In general, selfish strategies are detrimental to one's genetic fitness in the long run because of the importance of reputation-related reproductive strategies in human sociality (Bering and Shackelford 2004; Frank 1988; Sober and Wilson 1998). Therefore, whether it works through veridical or illusionary means, any psychological trait that facilitates inhibition of selfish actions in group settings is a candidate for adaptive design (Bjorklund and Kipp 2002). If the fear of watchful dead agents facilitates the inhibition of selfish behaviors, which would yield the real-world benefits of preserving reputation in situations where individuals underestimated the risk of detection by living group members, then a person who is primed with a "ghost story" should be less likely to cheat on a difficult task than participants who are not exposed to this dead agent prime. Study 3 aimed to test this hypothesis.

STUDY 1

Participants

Fifty-two (20 men, 32 women) undergraduates participated in and completed the study (mean age = 21.40 ± 4.86). Data from five participants who did not return for the second half of the study were excluded from the analyses.[2] All students were enrolled in an introductory psychology class at the University of Arkansas and participated in exchange for course credit.

Stimulus Photographs

Three black-and-white photographs were selected from a pool of 50, obtained from the Psychological Image Collection at Stirling University (PICS). The photographs depicted forward-facing head-and-neck images of college-age men displaying a neutral facial expression.

The initial pool of images was collated into a serial presentation of such photographs (5 × 10 cm each) which were then rated for attractiveness by students in an

undergraduate psychology class ($N = 29$) at the University of Arkansas. Attractiveness ratings were based on a scale of 1 ("very unattractive") to 4 ("very attractive"). The three images most closely matched on attractiveness (mean = $3.32 \pm .05$) were selected as the stimuli. These images were then enlarged to 10×15 cm displays and laminated for use in the study.

Evaluation of Others Questionnaire (EOOQ)

The Evaluation of Others Questionnaire (EOOQ) is a 38-item checklist assessing attributions of traits from four psychosocial categories: achievement-relatedness (AR: 9 items), social skills (SS: 9 items), subjective well-being (SWB: 8 items), and kindness/morality (KM: 12 items). Because the items comprising the SWB subscale were pragmatically odd (e.g., "happy with their lives") in their application to a newly dead agent, they served as filler items only and were not included in the analyses.

The scale was developed by Shapiro (1988) as a measure of one's evaluation of other people in general. The EOOQ is based on social comparison theory and has received concurrent validity with a depressed sample by showing that evaluation of others is related to one's own evaluation and self-concept. Because in the current study the scale was adopted for rating specific individuals, the reliability and validity of the scale for this purpose is unknown. Each trait was rated on a Likert-type scale from 1 ("has none of the characteristic") to 10 ("has a very great deal of the characteristic"). Thirteen of the items in the EOOQ were negative. After reverse-scoring these items, dividing each of the subscale scores by the number of items in that subscale produces a score ranging from 1 to 10, with higher scores reflecting more positive attributions to the specific individual.

Procedure

The experiment consisted of two 20-minute sessions, separated by exactly one week. During the first session, participants were informed that the purpose of the study was to determine how people judge strangers on the basis of physical appearance alone. Furthermore, the researcher told participants that the study was being conducted in collaboration with a researcher in the U.K. and that the photographs they would be asked to judge were of students from this foreign university.

Participants were then separately presented with the three photographs, in counterbalanced order, and asked to complete the EOOQ for each of the individuals shown. The researcher provided verbal instructions for completing the questionnaire; in addition, explicit directions were given on each EOOQ answer sheet. Participants were assured that their ratings would remain anonymous and confidential. The researcher remained nearby during the session and intervened only for procedural purposes.

Upon their second visit one week later, the same researcher instructed the par-

ticipants that they would now be given the opportunity to re-rate the people shown in the photographs. ("Now that you have had a week to think about your ratings, we want to give you a chance to re-rate the photos in case you have changed your mind.") The second session was therefore identical to the first, with one exception. Just prior to being shown one of the photographs, the researcher informed the participant that the individual had died over the weekend but that he should still be rated.

Control factors associated with the "decedent" variable were completely counterbalanced (1–3 of image presentation *as well as* 1–3 of specifically photographed person). If probed by the participant about the death, the researcher reported that he/she had not received any additional details.

To address possible diffusion of treatment effects (i.e., subjects communicating with each other about their experiences in the study), participants received an e-mail debriefing following completion of the data collection. The debriefing statement also included a query that asked participants if they believed, at the time of the study, that the individual had died or if they were aware that this was an experimental manipulation. Although the probability of a retrospective knowledge and/or self-presentation bias precluded using this belief measure as a meaningful covariate, the majority (60%) of those who responded to this query ($N = 20$) claimed to have believed that the person had in fact died.

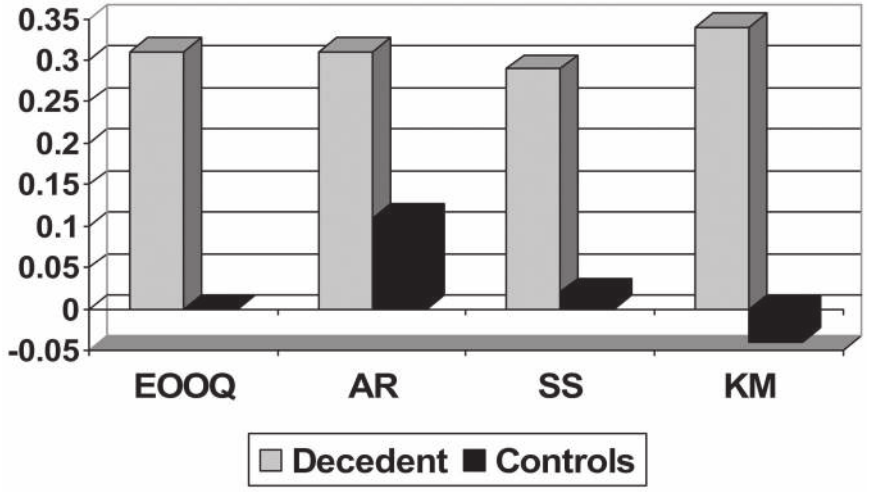
Results and Discussion

Overall Change (Time 2 – Time 1) on EOOQ. Figure 1 presents the mean change (Time 2 – Time 1) in participants' ratings of the targets on both the overall EOOQ and the individual subscales (AR, SS, KM). Preliminary analyses showed no significant main effect or interaction of participant gender or the position of the Decedent Target (presented first, middle, or last at Time 2) ($p > .05$), and subsequent analyses were collapsed across these variables.

A *t*-test revealed no significant difference between Target 1 and Target 2 on mean overall change between sessions, $t_{102} = -1.09$, $p > .05$. These data were therefore combined and compared to the data for the Decedent Target, revealing a significant effect of target, $t_{102} = 2.27$, $p < .05$. Participants were significantly more likely to adjust their attributions for the Decedent Target (mean = .31) than they were for the Control Targets (i.e., "still-living" individuals) (mean = .00) between the sessions. As hypothesized, participants rated the Decedent Target more favorably after learning of his death than they did the previous week, before having knowledge that he had died.

Change (Time 2 – Time 1) on Independent Subscales of EOOQ. To test the secondary hypothesis that morality-relevant traits should be especially susceptible to a posthumous attribution shift, we conducted *t*-tests for the independent subscales (AR, SS, KM) of the EOOQ. As in the foregoing analysis, scores for Target 1 and

Figure 1. Average Intersession Change—Study 1. Mean change on attribution ratings for the overall EOOQ scale and on each of the three subscales (SS, AR, KM) between Time 1 and Time 2. Scores for control targets ("still-living") have been averaged in the figure. Higher values reflect more favorable attributions to the targets.



Target 2 were combined for each of the following subscale analyses after *t*-tests showed no significant difference ($p > .05$) between these two targets on any of the subscales between sessions.

For the Achievement-Relatedness (AR) subscale, a *t*-test comparing the average change (Time 2 – Time 1) between the Decedent Target and the Control Targets showed no significant effect of target, $t_{102} = 1.11$, $p > .05$, although a general trend of positive attribution change was more apparent for the Decedent Target (mean = .31) than for the other targets (mean = .11). Similarly, there was no significant effect of target on average change between sessions for the Social Skills (SS) subscale, $t_{102} = 1.63$, $p > .05$, although again the trend was in the predicted direction (Decedent Target mean = .29; Control Targets mean = .02). For the Kindness and Morality subscale (KM), as hypothesized, there was a significant effect of target on degree of change between sessions, $t_{102} = 2.15$, $p < .05$ (Decedent Target mean = .34; Control Targets mean = –.04), with participants rating the Decedent Target more favorably on this trait dimension after his death than before.

The findings from Study 1 show that individuals do change their views of others to reflect more positive trait attributions after learning that these others have died. Although there are numerous explanations for these overall findings, we believe that the data from the individual subscales present problems for more parsimonious interpretations (e.g., social desirability, stimulus enhancement, sympathetic concern) and support the theory that these attribution changes are evidence of implicit social submission to the recently dead. This is because the only subscale in which participants showed a degree of change between the sessions greater than chance

was the kindness/morality subscale, where participants' ratings of the decedent significantly spiked between sessions relative to the two controls.

Nevertheless, the demand characteristics of the study may have led participants to become "good subjects" by rating the decedent more favorably than the other targets because they knew what was expected of them. However, since, again, the data show that people's ratings of the recently dead significantly increases in the content-specific area of prosocial and morality-relevant traits (i.e., the KM subscale), but not significantly for other types of personality traits (i.e., the AR and SS subscales), this interpretation seems problematic. It seems unlikely that participants would have shared knowledge of this secondary hypothesis with the experimenters.

Furthermore, this interpretation is left wanting by the nature of the dependent measure. The study measured change in the evaluation of the targets over a week-long interval. Although it is possible that participants recalled their general rating patterns from the previous week, and simply shifted their ratings in a positive direction for the Decedent Target, but not for the Control Targets, this would require participants to have retained relatively accurate knowledge of their prior ratings for 114 items (38 items of the EOOQ × 3 targets) over an extended period of time. Even a gist recollection of the previous week's ratings would probably strain the participants' memory.

Although we cannot rule out competing interpretations in their entirety with this preliminary study, we believe that the present results can *best* be understood as supportive of an evolutionary interpretation. However, because these data involve attributions to strangers in a laboratory setting, they may not accurately reflect the attribution mechanisms that are at work after having learned that a family member or close friend has died. Study 2 was therefore conducted to test the hypothesis that the prosocial and morality-relevant traits of recently dead loved ones will be emphasized over other types of attributes (such as those that would be comprised in the achievement relatedness or social skills dimensions in the EOOQ) in posthumous descriptions of the decedent's personality.

STUDY 2

Materials and Procedure

Four-hundred-ninety-six paid death notices published in the *New York Times* between June 13 and October 31, 2003, were subjected to a content analysis of trait attributions to adult decedents of both genders (311 men, 185 women). This obituary archive was selected because of (1) its publicly accessible and searchable online records; (2) its trend in publishing obituaries authored by family members and close friends of the decedents, and thus including trait attributions to the decedents by those who knew them well; and (3) the publication's representation of an urban metropolitan area with a diverse religious, ethnic, and socioeconomic population

(however, it is also an economically biased sample in that the notices were paid). Because the hypothesis for the current study involved attributions to recently deceased individuals only, the content analysis did not include "In Memoriam" notices.

After controlling for those attributions that involved the author's subjective valuing of the decedent (e.g., "beloved," "adored") and selecting only attributions that reflected the perceived *qualities* that the decedent was envisioned as possessing (e.g., "loving," "adoring"), a total of 1,196 trait attributions were included in the analysis. In a few cases, it was necessary to classify these attributions through various phrases in the obituaries (e.g., "would drop everything for someone else in need") if one-word trait descriptors (e.g., "selfless") were not used by the obituary author. In addition, specific attributions occurring more than once in a single obituary (e.g., "loving") were scored only once per their occurrence in each notice.

Trait attributions were then independently classified by the first author and by a research assistant naïve to the purpose of the study as falling into one of the three subscales from the EOOQ (AR, KM, SS). Those variables that could not be classified as such were scored as "Other." Inter-rater agreement along the three subscales of the EOOQ was 83.2% (Cohen's $\kappa = 0.71$, indicating "good" inter-rater agreement; Altman 1991; Cohen 1960). Classificatory disagreements were resolved by appeal to the theory used to develop the EOOQ (Shapiro 1988).

Results and Discussion

Prosocial and morality-relevant traits of recently dead loved ones appeared more frequently than other types of attributes in obituaries written by those closest to the decedent. Of 744 traits categorized into one of the three subscales of the EOOQ, 58.6% were prosocial and morality-relevant (KM), 22.2% were achievement related (AR), and 19.2% made reference to the decedent's social skills (SS; $\chi^2_2 = 214.75$, $p < .001$). These results are consistent with the hypothesis that the prosocial and morality-relevant traits of recently dead loved ones will be emphasized over other types of attributes in posthumous descriptions of the decedent's personality. These results corroborate the results of Study 1 in a natural context and provide evidence that the operation of the relevant attributional mechanisms does not depend on one's relationship to the decedent.

The final study was designed to test the hypothesis that supernatural primes concerning dead agents serve to curb selfish intentions, with the potential to ultimately maximize long-term fitness effects by preserving reputation in situations where, historically, individuals underestimated the risk of detection of social transgressions (see also Fiske 2002).

STUDY 3

Participants

All of the 127 (53 men, 74 women) undergraduate participants in Study 3 (mean age = 20.62 ± 4.02) were enrolled in an introductory psychology class at the University of Arkansas and participated in exchange for course credit.

Test of Spatial Intelligence

Twenty-five items measuring spatial intelligence (including those assessing *kinetic imagery*, "the ability to manipulate or rotate an object in the imagination, imagining it as it changes position in space moving in any axis," and *dynamic imagery*, "the ability to manipulate elements within a 3D configuration") were selected from an interactive tutorial for Spatial Intelligence at the University of Limerick. According to the author of the original scale, these 25 items comprised the most advanced items in the tutorial and were designed for experienced users (high spatial intelligence ability). Thus, the level of difficulty was presumed to be very high. These mental rotation items were adopted for use in a specialized computer task created specifically for the current study. In addition to the 25 challenging items comprising the task, two additional mental rotation items, designated as "easy" by the tutorial designer, were used as training stimuli in the present study.

Procedure

Participants were misled about the true purpose of the study and were informed that they would be asked to complete a newly designed measure of spatial intelligence to test the validity of the items comprising the scale. Individuals were assured that their answers would remain anonymous and confidential, but were also told that they were competing for a $50 grand prize:

At the end of the study, the person who has scored the highest on the test will be awarded this prize. In the event of a tie for the highest score, a random drawing will determine the winner. Please note that this is a very difficult test and we ask only that you try your hardest when attempting to solve the problems.

Prior to the administration of the computerized test, the participants were asked to read and then reread the following written instructions (if necessary, the experimenter also iterated these instructions verbally):

> In a moment, you will begin the test on the computer. There are 25 multiple choice items on the test. For each problem, you will be shown a "target" figure (an image) and asked to mentally rotate that image in your head. You will then be asked to select from a group of figures that matches the target object. For example, you might be shown a square and asked how the square would look if it were folded a certain way. You will be given 2 practice questions and will have 30 min to complete this test.

Also included in the written instructions, and presented immediately beneath the foregoing details, was the following note:

> IMPORTANT NOTE: Because this is a new test, the computer program periodically malfunctions. In some instances, the correct answer may appear on the screen BEFORE the actual problem. If you see the word "ANSWER" at any time, this is a mistake (this is the correct answer to the following problem). **If this happens, please press the space bar immediately so that you can solve the problem honestly.** ONLY BY PRESSING THE SPACE BAR WILL THE SCREEN BE CLEARED. Thank you for your patience while we attempt to fix this problem.

Thus, by surreptitiously measuring the latency of response to press the space bar on such items, these data arguably served as objective indices of the participants' intentions to cheat at a competitive task when the risk of social detection was ostensibly low to absent. For these "glitch" items, participants could control the duration of their exposure to the correct answer, which, in all cases, was in the form of a complex image that could be matched to one of several similar images (i.e., possible answers) on the subsequent page.

Participants were randomly assigned to one of three testing conditions. Those assigned to the control group proceeded directly onto the spatial intelligence test. In contrast, participants who were assigned to the "In Memoriam" condition (hereafter IM), were asked to read the following brief statement prior to taking the test:

> In Memoriam: This test is dedicated to the memory of Paul J. Kellogg, who died unexpectedly in May 2004. Paul was a graduate student in the department, and his contributions to the development of this spatial intelligence test were invaluable.

Individuals assigned to the IM condition, therefore, received information about a dead agent but, like the control participants, they did not receive the attendant supernatural prime. Finally, participants who were randomly assigned to the "Ghost Story" condition (hereafter GS) also read the brief memorial to the fictive decedent. In addition, however, these people were told by the experimenter, as a casual but serious aside, that he/she had recently seen the ghost of the dead graduate student in the room where the participant was to be tested and that other people had made similarly eerie sightings of "Paul" there as well.

Participants were tested alone in a small laboratory room measuring approximately 6' × 8'. The door remained closed during the testing procedure and the experimenter waited outside in the hallway while the participant completed the test. No corrective feedback was provided to the participants following their answers to the problems. Participants left the testing situation without knowing either their final score on the test or whether they had successfully answered any given item.[3] On a randomly counterbalanced 5 of the 25 items, however, the alleged computer glitch occurred. In such cases, the correct answer was "accidentally" revealed to the

participant prior to the problem. As stated in the instructions, the only way for participants to avoid seeing the correct answer to the following problem was to immediately press the space bar, which served to advance the screen to the appropriate page.

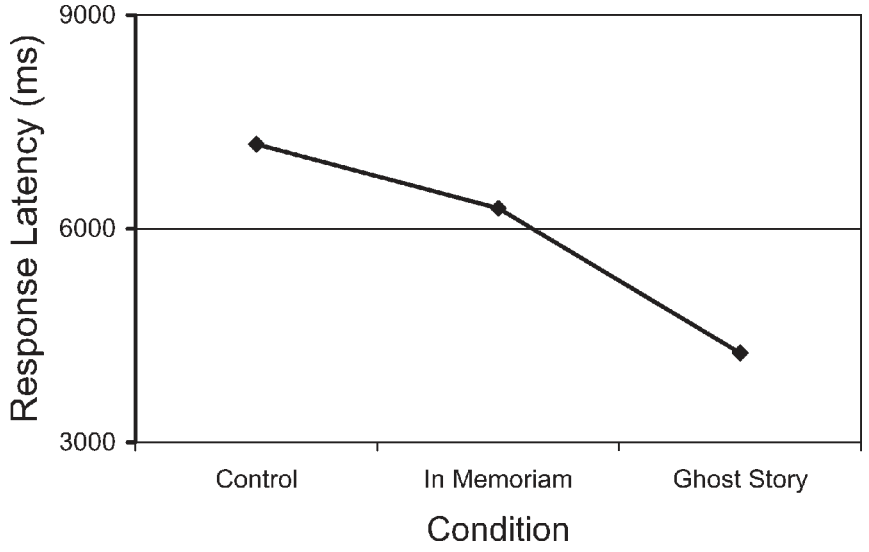
Results and Discussion

On the percentage of items correct overall ($N = 25$ items), a 3 (condition) × 2 (gender) analysis of variance yielded significant main effects of condition ($F_{2, 120} = 5.67$, $p < .005$ [control mean = 55.5%; IM mean = 52.6%; GS mean = 45.1%]), and gender ($F_{1, 120} = 12.13$, $p < .001$ [male mean = 56.7%; female mean = 47.2%]), but no significant interaction on this overall percentage correct measure. When the same analysis was performed while excluding the 5 targeted glitch items ($N = 20$ items), the pattern of findings was identical, with significant main effects of condition ($F_{2, 120} = 7.11$, $p < .01$), and gender ($F_{1, 120} = 10.24$, $p < .01$), but again no significant interactive effect. The gender differences are consistent with a multitude of findings showing that males tend to outperform females on most measures of spatial representation (see Voyer, Rodgers, and McCormick 2004), but are not central to the present hypotheses.

A similar 3 (condition) × 2 (gender) analysis of variance yielded no main or interactive effects for the percentage correct on the five targeted glitch items only. For these items, males (mean = 71.9%) were no more likely to answer correctly than were females (mean = 65.4%), and although control (mean = 72.4%) participants performed somewhat better on these problems than either IM (mean = 68.1%) or GS (mean = 63.8%) participants, the trend was not significant. Because several participants appealed to the experimenter for help when the first glitch item occurred, suggesting that they did not initially understand the instructions for correcting the problem by pressing the space bar, we subsequently decided to treat the first glitch item as a "practice" item. Even with this first glitch item excluded ($N = 4$ items), however, there were no main or interactive effects of gender (male mean = 72.1%; female mean = 65.2%) or experimental condition (control mean = 73.8%; IM mean = 65.5%; GS mean = 64.9%).

Latency of Response. As with the percentage correct measure, we treated the first glitch item as a "practice" item when analyzing the participants' latency of response data. We were therefore primarily interested in the amount of time it took for those assigned to the different experimental conditions to press the space bar on the remaining four glitch items. Nevertheless, when all 5 glitch items were included, a 3 (condition) × 2 (gender) analysis of variance yielded no significant main or interactive effects for latency of response. Exclusion of the first glitch item, in contrast, yielded the predicted significant main effect of condition $F_{2, 120} = 3.11$, $p < .05$ (control mean = 7015.3 ms; IM mean = 6144.4 ms; GS mean = 4302.9 ms), but no interaction or main effect of gender. Subsequent Tukey-Kramer post-hoc tests ($p <$

Figure 2. Response Latencies—Study 3. Average latency of response (in ms) for participants assigned to each of the experimental conditions to press the space bar on the four glitch items in Study 3.



.05) showed that control participants took significantly longer (mean = 7186.3 ms) to press the space bar than those who were assigned to the GS condition (mean = 4255.4 ms), but not to the IM condition (mean = 6287.7 ms) (see Figure 2). The difference between IM and GS participants' latency of response on these 4 glitch items was not significant, although it was in the hypothesized direction.

The findings from Study 3 show that participants who were exposed to the supernatural prime (in the form of hearing a "ghost story" about the haunted laboratory room) prior to taking the spatial intelligence test performed significantly worse overall than those who did not receive this prime. At the very least, this suggests that the ghost story served as a cognitive distraction that impaired the participants' ability to perform well on a competitive, challenging task (in the control condition, performance hovered around chance levels for both genders on the non-glitch items). Furthermore, it was not the death prime, per se, that seemed to disrupt performance, since participants who read the In Memoriam immediately before the test, but who did not hear the ghost story, performed equivalently to the control participants.

Although it is unclear what led participants from the GS condition to markedly differ on this task, fear of the ambient dead agent ("Paul J. Kellogg") seems a likely mediating factor. For example, two female participants in this condition agreed to participate only if the experimenter would leave the door partially ajar while they were being tested alone in the room. Another possible interpretation for the GS participants' relatively poor performance, however, is that the experimenter's casual remark about the ghost violated their expectations about the study; because the comment appeared to be a salient deviation from an otherwise automated method-

ological routine, this may have invoked an explanatory social cognitive search that interfered with the participants' ability to concentrate on the computer task. In other words, while taking the test, participants in the GS condition may have been cognitively burdened with the additional task of deciphering the researchers' motivation for sharing this atypical information with them, and this disrupted their overall performance. This explanation does not require that the GS participants believed in the veracity of the experimenter's tale of the ghost, only that they found the information to be puzzling.

If this were the case, however, then one might expect that GS participants' latency of response on the glitch items would actually be delayed compared with those assigned to the control and IM groups. This is because the dual-processing demands associated with reasoning about the experimenters' intentions while answering the test items should in principle hinder the efficiency of their cognitive processing on the task, thus slowing down their reaction time. The opposite pattern was actually found; as predicted, GS participants had a more rapid response rate in clearing the glitch items compared to control and IM participants. These findings appear to show, therefore, that supernatural primes dealing with dead agents genuinely reduce people's *willingness* to intentionally cheat on a competitive task where the risk of social detection appears low.

The fact that control and IM participants, despite their longer response latencies, were no more likely to answer the glitch items correctly than were GS participants is somewhat counterintuitive. After all, they presumably looked longer at the correct answer and had more of an opportunity to study the image. It is possible, however, that although these individuals were willing to study the correct images longer for selfish, strategic purposes, they still did not allow themselves enough time with each glitch item to benefit from them. In addition, because the images were complex and the multiple choice stimulus images were all highly alike (thus potentially sabotaging eidetic imagery), participants may have simply failed to profit from their uncooperative tactics despite their full intentions to do so.

CONCLUSION

Together, the present findings suggest that distinct psychological processes underlie people's reasoning about dead agents. These processes appear meaningfully *organized,* such as the tendency to make increasingly positive attributions of prosocial traits to both familiar and unfamiliar decedents, and *strategic,* such as people adopting a policy of social compliance, despite the temptation to cheat, when faced with the prospect of a supernatural agent in the immediate environment.

In both cases, these processes were possibly linked to adaptive behaviors in the ancestral past. If dead agents were even implicitly envisioned as vested partners in the moral framework, and were believed to retaliate against social transgressors, then supernatural primes dealing with these figures should have motivated prosocial or cooperative actions. Because human social systems are characterized by the rapid

transmission of social information between individuals, wherein knowledge of the self's selfish acts can spread in the community at an alarming pace, it is generally to the self's advantage to curb selfish intentions and instead to cultivate a "good" reputation—as someone who subscribes to the rules and refrains from cheating (Alexander 1987; Daly and Wilson 1994; Emler 1994; Frank 1988; Schelling 1960).

However, in some instances, the threat of social detection may appear deceivingly low, such that individuals are tempted to profit from cheating tactics without fear of social repercussions (castigation, imprisonment, execution, etc.). In such "no-one-will-ever know" cases, supernatural primes may serve to counteract these dangerous risk miscalculations, persuading the person to refrain from some act of social deviance and, subsequently, to preserve their genetic fitness. In a related study, Burnham and Hare (2006) report that, in anonymous and final interactions, participants contributed significantly more to a public good when "watched" by a robot with large, human-like eyes. Although their experiment was motivated by the hypothesis that human eyes would trigger unconscious mechanisms that gauge privacy, and thus serve to elicit prosocial behaviors, the presumed presence of a dead agent seems to similarly prime cooperative effort.

Furthermore, because the capacity to represent an afterlife is inseparably connected to the standard cognitive architecture of the human brain, the conditions under which the present mechanisms may have been subjected to evolutionary pressures are as ancient as the species itself (Bering in press). Certainly, in both hunter-gatherer and modern societies, the fear of ghosts is a common one (e.g., see Reynolds and Tanner 1995). Its frequency rivals such evolutionarily obvious fears as those of snakes and spiders, and, in children, it is even more resistant to treatment than fear of strangers (Gullone et al. 2000). Thus, despite its apparent sensationalism, the idea that ghosts and spirits (as well as gods) played an important role in the evolution of human sociality seems a biologically plausible one.

It is unclear whether explicit or culturally acquired concepts of "ghosts" or "spirits" are somehow facilitative of—or even underlie—the sort of psychological attributions to the recently dead reported here (cf. Barrett 2000; Boyer 2000). Future research should therefore seek to replicate the current findings with cross-cultural samples, particularly those that entertain highly discrepant views on the role of dead human agents in the affairs of the living (or on the fate of "souls" after death entirely). Evidence that morality-specific posthumous attribution shifts occur across such religiously diverse cultures would be evidence for the relative unimportance (and perhaps even epiphenomenal nature) of culturally acquired religious concepts in generating these sorts of responses. If the data are indeed borne out in future studies and are cross-culturally replicated, then it may be that dying is the ultimate way to win friends and influence people.

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NOTES

1. This perspective of religion as singly traceable to fear of death was shared by the cultural anthropologist Ernest Becker (1973); more recently, it is found in the writings of "terror management theorists" such as Pyszczynski, Greenberg, and Solomon (for a review, see Pyszczynski et al. 2004).
2. Data from four additional participants who received the wrong counterbalancing order as a result of experimenter error were also excluded from the analyses, such that a total of 61 participants were sampled.
3. As with the first study, in order to control for diffusion of treatment effects, an e-mail debriefing followed completion of the data collection for Study 3. At this time, the person with the highest score was also notified that he had won the $50 prize. However, no participant received their individual score on the spatial intelligence test.

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Testing Major Evolutionary Hypotheses about Religion with a Random Sample

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Theories of religion that are supported with selected examples can be criticized for selection bias. This paper evaluates major evolutionary hypotheses about religion with a random sample of 35 religions drawn from a 16-volume encyclopedia of world religions. The results are supportive of the group-level adaptation hypothesis developed in *Darwin's Cathedral: Evolution, Religion, and the Nature of Society* (Wilson 2002). Most religions in the sample have what Durkheim called secular utility. Their otherworldly elements can be largely understood as proximate mechanisms that motivate adaptive behaviors. Jainism, the religion in the sample that initially appeared most challenging to the group-level adaptation hypothesis, is highly supportive upon close examination. The results of the survey are preliminary and should be built upon by a multidisciplinary community as part of a field of evolutionary religious studies.

KEY WORDS: Adaptation; Evolution; Evolutionary religious studies; Group Selection; Religion

Evolutionary biologists typically employ a number of major hypotheses for the study of all traits. Perhaps the most important question is whether a given trait has evolved by natural selection and adapts the organism to its environment. If so, then more specific hypotheses are needed to identify the particular selective forces. For example, a social behavior can evolve by either within-group selection (increasing the fitness of the individual relative to others in its same group) or by between-group selection (increasing the fitness of the group relative to other groups in the total population). If the trait is not a product of natural selection, then another set of specific hypotheses is needed to explain its existence. Perhaps it is an ances-

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tral trait that does not vary within the lineage. Perhaps it was adaptive in past environments but failed to keep pace with environmental change. Perhaps it is a costly by-product of another trait that is a product of natural selection, and so on.

These hypotheses are not mutually exclusive. Evolution is a multifactorial process, and traits usually reflect a variety of selection pressures and constraints on natural selection. Nevertheless, the different hypotheses are still needed to determine the combination of factors that operate in any particular case. To pick a paradigmatic example, morphological, behavioral, and life history traits in guppies (*Poecilia reticulata*) are influenced by a variety of selection pressures, notably predation and female mate choice (Endler 1995). Predators are both larger and more numerous in the downstream portions of rivers than the upstream portions, resulting in a corresponding gradient of traits in guppies. Downstream guppies that are transplanted into upstream tributaries that lack predators quickly evolve the suite of traits characteristic of guppies in predator-free environments. One trait that does not change is live birth, which is shared by all members of the family to which guppies belong and does not vary within the lineage. Decades of research guided by evolutionary theory has led to a comprehensive understanding of guppies, even though the story is complex and includes numerous selection pressures and constraints on natural selection.

This way of forming and testing evolutionary hypotheses, which is familiar for the study of nonhuman species such as guppies, is increasingly being used to study the human phenomenon of religion (e.g., Bulbulia 2004; Hinde 1999; Irons 2001; Sosis and Alcorta 2003; Wilson 2002). Not only can it be used to guide current research, but it can also be used to reorganize past research that was conducted without evolutionary theory in mind. Table 1 presents a classification of major hypotheses about religion, past and present, from an evolutionary perspective. It begins with the basic distinction between adaptive and nonadaptive hypotheses, with more specific hypotheses under each heading. Starting with adaptation hypotheses, one possibility is that religions are designed to function for the benefit of the religious group. This hypothesis has a long history in the social sciences, including Durkheim's *Elementary Forms of Religious Life* (originally published in 1912). In modern evolutionary terms, it needs to be understood in terms of genetic and cultural group selection. A second possibility is that religions are designed to function for the benefit of some of its members (presumably the leaders) at the expense of other members (Cronk 1994). For example, the Protestant reformation was in part a reaction to abusive practices within the Catholic Church that were clearly benefiting the elites at the expense of the laity. In modern evolutionary terms, this hypothesis needs to be understood in terms of genetic and cultural within-group selection. A third possibility is that the cultural traits associated with religion can evolve to be like parasites, infecting minds without benefiting either individuals or groups. This is suggested by the modern concept of memes (Aunger 2002; Blackmore 1999; Dawkins 1976) but can also be found in earlier theories of religion that were not explicitly framed in terms of evolution (e.g., Durkheim 1995:49).

Table 1. Major Evolutionary Hypotheses about Religion

Religion as an Adaptation	Religion as Nonadaptive
• Group-level adaptation (benefits groups, compared to other groups)	• Adaptive in small groups of related individuals but not in modern social environments.
• Individual-level adaptation (benefits individuals, compared to other individuals within the same group)	• By-product of traits that are adaptive in nonreligious contexts.
• Cultural parasite (benefits cultural traits without regard to the welfare of human individuals or groups)	

Turning to non-adaptation hypotheses, the traits associated with religion might have been adaptive in past environments, when social groups were small and composed largely of genetic relatives, but not in the large groups of unrelated individuals that characterize modern religious groups (Alexander 1987). Alternatively, the traits associated with religion might be a costly by-product of traits that are beneficial in nonreligious contexts. Two versions of the by-product hypothesis deserve special mention because they are prominent in the current study of religion. Sociologists such as Rodney Stark and William Bainbridge interpret religion as a by-product of economic thought (Stark 1999; Stark and Bainbridge 1985,1987). The basic idea is that people use cost-benefit reasoning to obtain many benefits in nonreligious contexts. Some benefits cannot be obtained, such as rain during a drought or everlasting life, but that does not prevent people from wanting and trying to achieve them, so they invent supernatural agents with whom to bargain for that which they cannot have. Stated in evolutionary terms, religion is a functionless by-product of mental processes that are highly adaptive in nonreligious contexts.

More recently, evolutionary biologists such as Boyer (2001), Atran (2002), Atran and Noyenzayan (2004), and Guthrie (1995) have proposed a by-product theory of religion that differs from Stark and Bainbridge primarily in reliance upon evolutionary psychology rather than economics for the basic conception of the human mind. Instead of being general cost-benefit reasoners, humans are thought to employ numerous cognitive modules that evolved to solve specific adaptive problems in ancestral environments. These modules are adaptations, at least when they were expressed in nonreligious contexts in the past, but their expression in religious contexts, past and present, has no function. This modern evolutionary theory of religion differs from the modern economic theory in the basic conception of the human mind, but they are similar in regarding religion as a functionless by-product of traits that are functional in nonreligious contexts.

Two important insights can be derived from this classification of hypotheses about religion, even before we attempt to test them. First, all of them are plausible and might be true to some degree. Second, they make very different predictions that should be possible to test empirically. A religion designed for the good of the group

must be structured differently than a religion designed as a tool for within-group advantage, which in turn must be structured differently than religion as a cultural parasite good for nothing but itself, which in turn must be structured differently than a religion for which the word "design" is inappropriate, at least within a religious context. These various conceptions of religion are so different that it would be surprising if they could not be empirically discriminated from each other. In short, evolutionary theory can be used to achieve the same comprehensive understanding of religion that we have achieved for guppies (and the rest of life), even though the emerging story will be complex and will include numerous selection pressures and constraints on selection.

Darwin's Cathedral: Evolution, Religion, and the Nature of Society (Wilson 2002) presents my own attempt to explain the subject of religion from an evolutionary perspective. My central thesis is that religions are largely (although by no means entirely) group-level adaptations. In their explicit behavioral prescriptions, theological beliefs, and social practices, most religions are impressively designed to provide a set of instructions for how to behave, to promote cooperation among group members, and to prevent passive freeloading and active exploitation within the group. The features of religion that appear most irrational and which have always made religion such a puzzle to explain from a scientific perspective can be largely understood as part of the "social physiology" (to use a term employed by social insect biologists) that enables the religious group to function adaptively.

Before continuing, it is important to explain why I stress a single hypothesis (group-level adaptation) even though I also appreciate the multifactorial nature of evolution (as also emphasized by Hinde 1999). One reason is historical. Not only was group selection rejected by many evolutionary biologists during the middle of the twentieth century, but the related tradition of functionalism was rejected by many social scientists during the same period. Serious intellectual work is required to return the basic concept of groups as adaptive units to scientific respectability (comprising chapters 1 and 2 of *Darwin's Cathedral*), even before we can apply it to the subject of religion. Another reason is based on the distinction between religion as idealized and as actually practiced. People often behave selfishly in the name of religion, as in the case of the Catholic practices that led to the Protestant reformation. However, these practices are often regarded as a "corruption" of religion rather than part of the "true" religion that is more "purely" associated with the welfare of the group. The meaning of terms such as "ideals," "corruption," "true," and "pure" requires an analysis of cultural evolution from an evolutionary perspective, which provides part of the broad theoretical background for the study of religion along with the basic concept of groups as adaptive units. Ideals are phenomena in their own right that influence actual behavior, even if they are not completely successful. Theoretically, religious ideals could reflect any of the major hypotheses outlined in Table 1. The fact that they reflect the group-level adaptation hypothesis even more than actual behavior is worth noting.

When it comes to testing the major hypotheses outlined above, it is important to

recognize the importance of descriptive in addition to quantitative information. Darwin established his theory of evolution very successfully on the basis of descriptive information about plants and animals gathered by the naturalists of his day, most of whom thought they were studying God's handiwork. Traditional religious scholarship provides a comparable body of information about religious groups in relation to their environments that can be used to test evolutionary hypotheses about religion. Quantitative methods *refine* but do not *define* scientific inquiry. Thus, although I review the modern social scientific literature on religion in *Darwin's Cathedral,* I also draw heavily upon detailed descriptive accounts of particular religious systems in relation to their environments.

These accounts provide compelling evidence for the group-level benefits of religion, but they are also vulnerable to the criticism of selection bias. Couldn't someone else handpick examples that illustrate the nonadaptive nature of religion, such as the celibate Shakers or the suicidal Jonestown cult? Random sampling provides an effective solution to this problem. If the major hypotheses are evaluated for a sample of religions chosen without respect to the hypotheses, then (barring freak sampling accidents) the results for the sample will be representative of the population from which the sample was drawn.

In Chapter 4 of *Darwin's Cathedral* I initiated such a survey by selecting 25 religious systems at random from the 16-volume *Encyclopedia of Religion* (Eliade 1987). In this paper I provide a preliminary analysis of the survey, which has been expanded to include 35 religious systems. It is not the last word but rather the first step of a task that is best continued by a community of religious scholars who are qualified to evaluate in detail the "natural history" of the religions that are comprised in the sample. Even in its preliminary stage, however, it provides important insights about the nature of religion from an evolutionary perspective.

METHODS

The religions to be included in the sample were chosen by writing a computer program that selected volume numbers and page numbers within each volume at random. An entry located by this procedure was then evaluated by criteria listed below to see if it qualified for inclusion in the sample. If not, I paged forward until I encountered the first entry that met the criteria.

An entry qualified if it could be associated with a single religious system, defined as a recognizable group of people with beliefs and practices that can be distinguished from other beliefs and practices. All systems were assumed to be religious because they were included in an encyclopedia of religion. In other words, I based my definition of religion on the inclusion criteria of the encyclopedia rather than imposing my own definition. This is crucial to avoid my own selection bias, although the selection bias of the editors might well deserve scrutiny. A particular entry that met the criteria might be the name of a person who founded a new religious movement (e.g., Eisai, founder of the Rinzai school of Zen Buddhism in

Japan during the twelfth century), a god (e.g., Mithra, an Iranian deity and god of a Roman mystery religion), or the name of the movement itself (e.g., the Cao Dai cult that originated in Vietnam during the twentieth century). Minor religious movements within a larger religious tradition were included, since the larger traditions themselves started out as minor movements. Entries on general subjects such as "myth" or "polytheism" were excluded because they did not refer to a single religious system. Somewhat arbitrarily, I excluded religions associated with tribal groups that have no known starting date, even though I include them in *Darwin's Cathedral* and regard them as supportive of my main thesis.

This sampling procedure is not completely unbiased. Judgment calls were sometimes required to decide if an entry met the criteria, as described in more detail below. The procedure favors long entries over short entries. The major religious traditions might not be equally represented because some (e.g., Protestant) divide into separate movements more than others (e.g., Catholic). The entire encyclopedia might be biased in its inclusion criteria, contributors, and information available for different religions around the world and throughout history. State-level societies are probably over-represented. Nevertheless, the important point is that the religions were not chosen with the major evolutionary hypotheses in mind. The bias of choosing religions known to support a given favored hypothesis has been successfully avoided.

One potential bias deserves special mention. Religions that succeed in the sense of persisting and becoming large are more likely to be included in the encyclopedia than religions that remain small and quickly fail. This bias, if it exists, would reflect cultural evolution in action. The statement "most religions have secular utility" would not be false because it is based on a biased sample, but true because the encyclopedia reflects the winnowing process of cultural evolution. Correcting the "bias" would provide a more complete cultural "fossil record" that includes the ephemeral "losers" in addition to the persistent "winners," enabling the process of cultural evolution to be studied in even greater detail. As we shall see, the sample does include some religious "losers" in addition to "winners," which are highly instructive.

The encyclopedia was used to select the random sample and provided a small amount of information about each religion, but the main work of the survey involved gathering as much information as possible about each religion and evaluating it with respect to the major evolutionary hypotheses. This was accomplished with the help of 35 undergraduate students who enrolled in a 4-credit class entitled "Evolution and Religion." In addition to reading *Darwin's Cathedral* and discussing the general subject, each student was assigned a single religion to research over the course of the semester (which is why the size of the sample was expanded to 35), culminating in a bibliography and narrative answers to 32 questions addressing key issues (available upon request). A first draft of the answers was read in time to provide feedback for each student to correct shortcomings in the final draft. This

procedure insured that the students addressed the most important evolutionary issues and facilitated comparison among the religions.

This material provided the basis for my own analysis. I did not rely exclusively on the student analyses but rather used them as a guide to my own reading of the primary literature. As I have already stressed, the use of students to gather information and the descriptive nature of my analysis are only the first steps of an enterprise that ultimately should include the scholars who are the real "natural historians" for the religions in the sample.

DESCRIPTIVE ANALYSIS

Table 2 lists the encyclopedia entries that were included in the survey and a brief description of the religions that they represent. The major traditions of Buddhism, Taoism, Judaism, Christianity, and Islam are represented, although not Hinduism or Confucianism. Jainism and Zoroastrianism are among the oldest religions that are still being practiced today, albeit among a small minority of the world's population. Also included are a cult with African roots (M'Bona) a cult based upon an ancestor (Cinggis Khan), and two modern movements that are composites of the major religious traditions and other influences (Cao Dai and the Theosophical Society). The religions span the globe and range in time from the twenty-fifth century BCE to the present.

Most of the entries refer to religious movements, large or small, that clearly meet the inclusion criteria, but a few proved to be somewhat inappropriate in retrospect. The entry "cult of saints" refers to many cults within the Catholic religion rather than to a single cult, which makes it difficult to evaluate. Saint Catherine of Siena played an important conciliatory role in the Catholic Church during the fourteenth century, helping to prevent schism rather than promoting it. Ziya Gokalp was a political rather than a religious leader who was influential in the separation of church and state for the nation of Turkey. Agudat Yisra'el is not a religious movement in its own right but a political arm of a preexisting religious movement (Orthodox Judaism). Even though these entries marginally qualify for inclusion in the survey, they are instructive in ways that will be described in more detail below. It is important to keep in mind that none of the entries could have been included in the sample without first being included in the encyclopedia of religion. Thus, they are relevant to the subject of religion writ large (as defined by the editors of the encyclopedia) even when they don't constitute a specific religious system as defined by the inclusion criteria of the survey.

The religious systems identified by the entries differed greatly in the amount of available information. Even when information was available, authors differed in the degree to which they related theology to social and ecological context. Despite these problems, a number of preliminary conclusions can be drawn that are relevant to the major evolutionary hypotheses.

Table 2. 35 Religions Chosen at Random from the 16-Volume *Encyclopedia of Religion* (Eliade 1987)

Vol	Page	Entry	Description (dates CE unless specified otherwise)
1	149	Agudat Yisra'el	Orthodox Judaism, twentieth century
1	161	Airyana Vaejah	Zoroastrianism, Persia, tenth century BCE
1	211	Allen, R.	African Methodist Episcopal Church, nineteenth century
1	492	Atisa	Tibetan Buddhism, tenth century
3	72	Cao Dai	Composite of traditions, Vietnam, twentieth century
3	120	Catherine of Siena	Catholic church, Italy, fourteenth century
3	230	Chen-Jen	Chinese Taoism, third century
3	328	Chinggis Kahn	Ancestor cult, Mongolia, thirteenth century
3	333	Chinul	Korean Buddhism, thirteenth century
4	172	Cult of Saints	Catholic Church, general
4	200	Dalai Lama	Tibetan Buddhism, general
4	236	Dan Fodio, Usuman	Nigerian Islamic revivalist movement, eighteenth century
4	326	Dge-Lugs-Pa	Tibetan Buddhism, fifteenth century
5	72	Eisai	Rinzai school of Japanese Zen Buddhism, twelfth century
5	156	Eshmun	Phoenician healer god, fifteenth century BCE
6	66	Gokalp, Z.	Turkish nationalism, twentieth century
7	119	Iman and Islam	Islam, general
7	215	Indus Valley religion	Western India, twenty-fifth century BCE
8	104	Jodoshu	Pure land sect of Japanese Buddhism, twelfth century
8	423	Lahori, Muhammad Ali	Lahori branch of the Ahmadiyah movement, Islamic, twentieth century

The Secular Utility of Religions

According to the by-product hypothesis, human psychological and social processes are clearly adaptive in nonreligious contexts but are triggered inappropriately in religious contexts. We pray to God for everlasting life, not to convey us to work in the morning. We see faces in the clouds because our minds are wired for social interactions. Going to work and engaging in social interactions have clear practical benefits, whereas praying for everlasting life and seeing faces in the clouds do not. Regardless of whether this hypothesis is framed in terms of rational choice theory or evolutionary psychology, the expectation is that religions by themselves do not produce practical benefits.

The random sample does not support this expectation, even with the limited information available (see also Reynolds and Tanner 1995). The majority of reli-

Table 2. (*continued*)

Vol	Page	Entry	Description (dates CE unless specified otherwise)
9	128	Mahavira	Jainism (India), sixth century BCE
9	188	Maranke, J.	Apostolic Church of John Maranke (Africa), twentieth century
9	287	Maurice, F. D.	Christian Socialism (England), twentieth century
9	291	Mawdudi, Sayyid Abu Al-a'la	Indian Islamic revivalist movement, twentieth century
9	303	M'Bona	African territorial cult, nineteenth century
9	579	Mithra/Mithraism	Iranian deity and god of Roman mystery religion, ca. fourth century BCE
10	290	Nagarjuna	Indian Buddhism, second century
10	297	Nahman of Bratslav	Bratslav sect of Hasidic Judaism, Ukraine, eighteenth century
10	360	Neo-orthodoxy	Protestant revivalist movement, Europe and America, twentieth century
11	226	Pelagianism	Christian doctrine opposed by Augustine, fourth century
11	324	Pietism	Protestant reformation movement, Europe, seventeenth century
12	335	Rennyo	Pure land true sect of Japanese Buddhism, fifteenth century
14	38	Spurgeon, C. H.	English Baptist Church, nineteenth century
14	464	Theosophical Society	Composite of traditions, America, nineteenth century
15	539	Young, B.	Mormonism, America, nineteenth century

gions in the sample are centered on practical concerns, especially the definition of social groups and the regulation of social interactions within and between groups. The impetus for a new religious movement is usually a situation in which a constituency is not being well served by current social organizations (religious or secular) and is better served in practical terms by the new movement. This dynamic describes the origin of Christianity and Islam and more recent religious movements within all of the major religious traditions, including the following examples from the random sample:

- Within Judaism, Agudat Yisra'el was formed in the early twentieth century to "unite under one organizational roof representatives of Orthodox communities from Germany, from Russia, Poland and Lithuania, and from Hungary" (Eliade 1987:150). Its primary goal was preserve and advance an orthodox form of Judaism, compared to more secularized forms. Agudat Yisra'el is described as the political arm of Orthodox Judaism because so many of its objectives are utilitarian, such as the economic support of distressed communities.

- Within Islam, Sayyid Abu Al-a'la Mawdudi founded an Islamic revivalist movement in the early twentieth century whose purpose was to protect Muslim interests from Hindus, secular nationalism, and Western culture. This movement was explicitly intended to define and promote the survival of a minority group threatened by competing social organizations.
- Within Christianity, Mormonism arose as one of many new movements in America during the early nineteenth century but was special in its ability to create encapsulated cooperative groups, which were persecuted for their success before undertaking their spectacularly coordinated westward migration. Mormonism continues to grow at a rate that rivals early Christianity and Islam.
- Among Eastern religions, Jainism constitutes a small fraction of the Indian population but one that has persisted for several thousand years. This impressive longevity is based on practical benefits, not some mysterious connection to traits that have functioned in a nonreligious context for such a long period, as I will describe in more detail below.

Clearly, these religious systems are about more than seeing faces in clouds and praying for unattainable goals, such as everlasting life. They are about goals that can be achieved but only through the coordinated action of groups. The practical benefits of religion might seem so obvious that they don't need to be pointed out, but then why have so many by-product theories of religion been proposed over the decades, from "animism" and "naturism" in the nineteenth century to the economic and evolutionary by-product theories of today? Somehow these theorists have managed to interpret the practical benefits of religion as "incidental," in contrast to something more "fundamental" about religion that cannot be explained functionally. This rendering can accommodate occasional practical benefits associated with religion, but not the results of this survey based on a random sample. According to my assessment, *most* of the religions in the sample are thoroughly rooted in the practical welfare of groups. In addition, the beauty of random sampling is that results for the sample apply to the entire encyclopedia from which the sample was drawn. If my assessment is correct, then the nature of religion cannot be understood without acknowledging its "secular utility," as Durkheim put it.

The practical purpose of most religious groups explains why Ziya Gokalp, a political leader who helped to separate church and state for the nation of Turkey, was included in an encyclopedia of religion. According to Heyd (1950:56):

> To Gokalp, Allah (Islamic God) was no longer the personal God. Instead to him "God was society." The sanctity of human personality is explained by its being the bearer of the "collective consciousness," the soul of society taking the place of the religious conception of the divine spirit.

Despite the use of nationalistic rather than religious imagery, it is obvious that church and state were *in the same business* of organizing the lives of a group of people. A similar process took place for the separation of church and state in American history (Cousins 1958). Framers of the constitution such as Benjamin Franklin

and Thomas Jefferson realized that religions are good at organizing social life among their own members but became part of the problem with respect to the larger scale of social organization that they were trying to achieve. The separation of church and state was a remarkable piece of social engineering and the imagery of God was freely combined with the imagery of nationalism to bless the new enterprise. To summarize, religion is intimately involved with the practical commerce of life, which requires an adaptationist explanation.

The Proximate/Ultimate Distinction and the Otherworldly Aspects of Religion

If religions are so practical, then why are they also so otherworldly? Why do they flaunt the kind of practical reasoning associated with science and rational thought? Why the belief in Gods that cannot be empirically verified, costly and time-consuming rituals, and the rest? These are the elements of religion that drive theorists toward nonfunctional explanations (the right side of Table 1). However, evolutionary theory offers a robust alternative in the distinction between ultimate and proximate causation.

All adaptive traits require two complementary explanations: the environmental forces that favor the trait in terms of survival and reproduction (ultimate causation) and the mechanisms that cause the trait to exist in actual organisms (proximate causation). Most flowers bloom in spring because those that bloomed earlier were nipped by frost and those that bloomed later had insufficient time to grow their fruits (ultimate causation). The same flowers bloom in spring because they possess physiological mechanisms that are sensitive to day length (proximate causation). Both explanations are required to explain an adaptive trait fully, and one explanation can never substitute for the other.

Continuing this example, notice that day length by itself has no effect on survival and reproduction. It is merely a signal that reliably causes the flower to bloom at the best time with respect to other environmental forces. In general, a proximate explanation need bear no relationship whatsoever to the corresponding ultimate explanation, other than to reliably produce the trait that survives and reproduces better than other traits.

Returning to religion, a given belief or practice might exist because it enhances survival and reproduction—for example, by causing the group to function well relative to other groups—but this is only the ultimate explanation. A complementary proximate explanation is needed that need bear no relationship to the ultimate explanation, other than to reliably cause the trait to occur. Perhaps a religious believer helps others because she wants to help others, or perhaps because she wants to serve a perfect God who commands her to help others. As far as proximate causation is concerned, the particular psychological motivation makes no difference as long as the helping behavior is reliably produced.

The proximate/ultimate distinction has profound implications for the study of religions by providing a way to reconcile their functional and otherworldly aspects.

When trying to explain a given feature of a religion, the primary question is not "Is it rational?" or "Can it be empirically verified?" but "What does it cause people to do?" This is the *only* relevant gold standard as far as proximate mechanisms are concerned. If the feature motivates adaptive behaviors, then it is fully consistent with a functional explanation (the left side of Table 1) no matter how bizarre (to nonbelievers) in other respects. If it fails to motivate adaptive behaviors, then a nonfunctional explanation (the right side of Table 1) is warranted.

In *Darwin's Cathedral,* I attempt this kind of analysis for a few selected religions, especially Calvinism as it originated in the City of Geneva in the sixteenth century. I show that theological beliefs (such as original sin, predestination, and the nature of faith and forgiveness) and social practices (such as rules governing decision making, discipline, and excommunication) combine with explicit behavioral prescriptions to form an impressive self-reinforcing system for organizing collective behavior. The system is necessarily complex because adaptive behavior is necessarily context-sensitive. For example, adaptive forgiveness behavior cannot possibly be embodied in a rule as simple as "Turn the other cheek." Different rules of forgiveness are required for different situations and categories of people, which must somehow be specified by the religious system. These rules can appear contradictory and hypocritical (e.g., How can Christians be intolerant of various behaviors while preaching "Turn the other cheek"?) until their context-specificity is appreciated. Comparative and longitudinal studies of religion are especially helpful for revealing the adaptive nature of these proximate mechanisms. For example, early Christian communities appear to have altered their sacred stories in response to the demands of their particular social environments (Pagels 1995, 2003). In this fashion, the otherworldly side of religion can be largely explained in terms of proximate causation, rather than as forms of maladaptive behavior. I include the word "largely" because I do not claim that each and every nuance of religion is adaptive. Evolution is a messy and multifactorial process for religion in addition to the rest of life. My point is that the otherworldly side of religion does not by itself necessitate a rush to nonfunctional explanations (the right side of Table 1). The proximate/ultimate distinction provides a very robust alternative explanation, and empirical research is required to settle the issue for any particular feature of particular religions.

Readers can judge for themselves how well I have succeeded for my selected examples in *Darwin's Cathedral,* but in any case they are vulnerable to the criticism of selection bias. The random sample avoids selection bias but has other limitations, such as limited information for some of the religions and my own limited ability to evaluate the enormous amount of information for all 35 religions. Nevertheless, some preliminary observations will help set the stage for more detailed future analysis by others in addition to myself.

The otherworldly side of religion is richly represented in the random sample. Joseph Smith's encounter with heavenly messengers that marked the beginning of Mormonism is well known. Comparable examples include an encounter with the Supreme Being through a Ouidja board for the Cao Dai religion in Vietnam and an

ancient secret brotherhood of adepts for the Theosophical Society. Numerous religious leaders in the sample attracted a following by their exceptional piety and indifference to worldly values. St. Catherine of Sienna had a vision of Christ at age six and took a vow of virginity against her family's wishes. Nahman of Bratslav locked himself in his parent's attic for long periods of time in an attempt to gain nearness to God. His disapproval of secular desires went so far that he didn't even want a following, which only enhanced his reputation as an enlightened spiritual leader. The ascetics of Eastern religions give up all worldly belongings and at times even fast themselves to death. At a less extreme level, numerous religious movements in the sample were envisioned as a move away from worldly secular values to more pure religious values based upon God and his commandments or the achievement of enlightenment. Finally, numerous religious movements attracted followers on the basis of miraculous claims such as bringing rain and faith healing that (based on current scientific knowledge) have no basis in fact. In short, the random sample amply confirms that religious belief includes but also goes far beyond a direct motivation to help others. The question is, do these seemingly nonutilitarian beliefs reliably cause the members of religious groups to help each other and otherwise function as adaptive units?

By my assessment, the answer to this question is primarily "yes" for the religions included in the random sample and therefore the entire encyclopedia. Saint Catherine treated love of God and love of neighbor as "inseparable commandments" (Hilkert 2001). Similarly, the encyclopedia defines the word Islam as follows:

> A noun derived from the verb aslama ("to submit or surrender [to God]"), designates the act by which an individual recognizes his or her relationship to the divine and, at the same time, the community of all of those who respond in submission. It describes, therefore, both the singular vertical relationship between the human being and God and the collective, horizontal relationship of all who join together in common faith and practice (Eliade 1987 [vol. 7]:119).

The success of Mormonism in secular terms is as famous as its otherworldly beliefs. The Cao Dai religion similarly functions as an organizer of secular life for its believers. The spread of relics associated with Saints evidently played a major role in the Christianization of the West (Eliade 1987 [vol. 4]:172). Wills (2001) provides a detailed account of how the City of Venice had its own religion based upon Saint Mark that very successfully organized secular life, frequently in opposition to the Catholic Church in Rome. Although Buddhism is often portrayed as an individualistic quest for enlightenment, most versions of Buddhism in the sample were closely involved with the organization of society through the patronage of kings and other secular rulers. In the African M'Bona cult, a shrine is constructed in a way that deteriorates over time. Members of the cult must periodically rebuild the shrine, but only after resolving their secular disputes. When offered the opportunity to build the shrine out of more durable materials, they refused (Schoffeleers 1992:75).

Pelagianism provides an excellent example of competition among alternative religious belief systems. Pelagius was a Christian monk who disagreed with St. Augustine on fundamental religious doctrines. Whereas Augustine believed that humanity was sinful by nature and must rely on God's grace for salvation by converting to Christianity, Pelagius believed that the souls of all men were created by God and that even pagans could enter heaven by their moral actions. Both doctrines motivated other-oriented behaviors, but they were not compatible with each other and Pelagianism was condemned in 431 by the Council of Ephesus.

In a contest such as this, one contender is going to win even if they are evenly matched. Alternatively, they can coexist by fissioning into separate religions that fill different socioecological "niches." Although Pelagianism ceased to exist in its original form, its elements have resurfaced throughout Christian history, for example in the Quaker doctrine of an inner light that stands in contrast to the doctrine of original sin (Ingle 1994). Religious scholar Elaine Pagels (1995, 2003) has written extensively on competition among alternative versions of Christianity, leading to the accumulation of forms that are exceptionally good at creating and maintaining strong communities. She does not frame her argument in terms of evolution, but it strongly supports the proximate/ultimate distinction as a way to reconcile the otherworldly and practical dimensions of religion.

In this section I have tried to establish two major points. First, the proximate/ultimate distinction theoretically enables the otherworldly and practical dimensions of religion to be reconciled with each other. The key question is: *What do the otherworldly elements of religion cause people to do?* Second, I have made an empirical claim based on the survey that the otherworldly and practical dimensions of religion are indeed tightly yoked to each other. If I am correct, then the major hypotheses on the right side of Table 1 are not required to explain the otherworldly side of religion. However, there is a third major point that I have not addressed: Why can't the proximate mechanisms be more straightforward? Why don't we just help our neighbor rather than believing in a perfect God who commands us to help our neighbor? This is a fundamental question but it requires a comparison of religious systems vs. nonreligious systems, where the proximate mechanisms *are* more straightforward. It is therefore beyond the scope of this survey but has been discussed by myself and others elsewhere (e.g., Wilson 2002: chap. 7; Alcorta and Sosis 2005 [this issue]).

Group-level Benefits, Individual Benefits, or Cultural Parasites?

So far I have tried to establish that most religions in the random sample are rooted in practical concerns (the left side of Table 1) and that their otherworldly aspects can be understood largely in terms of the proximate/ultimate distinction. Now it is time to discuss the three adaptationist hypotheses in more detail.

As I have already stressed, religion is inherently group- and other-oriented, as practiced and especially as idealized. The benefits produced by religion are obvi-

ously enjoyed by members of the group, and are "selfish" in that sense, but they are usually not selfish in the sense of causing some members to profit at the expense of other members of the same group. Instead, the benefits of religion tend to be public goods whose production requires time, energy, and risk on the part of individuals. When we focus on the fitness *differences* required for natural selection to act, we find the same problem for religion as for public goods in general. Producing them decreases fitness relative to those within the same group who enjoy the benefits without the costs, a negative fitness difference. The positive fitness differences that favor public good production are primarily between groups. Very simply, groups that "get their act together" outperform other groups, and this advantage outweighs the disadvantages of being a public good provider within groups. Most elements of religion are designed to favor the production of public goods and to limit the disadvantages of public good production within groups. When these mechanisms fail, the self-serving behaviors performed by religious believers tend to be regarded as a corruption of religion rather than an aspect of the "true" religion. That is why between-group selection needs to occupy a central role in the study of religion, as I argue in *Darwin's Cathedral.*

This argument is strongly supported by the random sample. Most religions in the sample are as dedicated to the production of public goods as the selected examples in *Darwin's Cathedral.* In addition to those that have already been cited, Richard Allen founded the African Methodist Episcopal Church to address the needs of African Americans that were not being met by white-dominated churches. John Maranke founded the Christian Apostolic Church in Africa for the same reason. Frederick Maurice helped to establish Christian socialism as a religious version of the socialist movement in England. These examples might seem mundane when considered individually, but they gain significance as part of a random sample by establishing the group- and other-oriented nature of religious systems in general.

No social system, religious or secular, completely solves the problems of passive freeloading and active exploitation within groups, especially by the leaders. In *Darwin's Cathedral* I discuss two major ways that religions fall apart. The first is by becoming victims of their own success. Once a religion generates wealth by collective action, its members no longer need each other and leave or try to weaken the constraints on their behavior. John Wesley, the founder of the Methodist Church, was perfectly aware of this problem when he stated, "I do not see how it is possible, in the nature of things, for any revival of religion to continue for long. For religion must necessarily produce both industry and frugality. And these cannot but produce riches. But as riches increase, so will pride, anger, and love of the world in all its branches" (1976 [vol. 9]:529).

A second way that religions fall apart is by becoming exploitative, such that some members benefit more than others. When this happens, three outcomes are possible: The exploited members can work for reform, they can be forced or deceived to remain exploited, or they can branch off to form their own church. These possibilities illustrate that religions are *not* pure products of between-group selec-

tion. They always reflect a balance between levels of selection in which the disruptive effects of within-group advantage are present and in danger of escaping social control. The religious obsession with "sinfulness," "worldliness," "attachment," and "self-will" reflects this ever-present danger.

These conflicts are amply represented in the random sample. A substantial proportion of religions in the sample are based not on a new constituency (as for the African and African-American churches) or a new social need (such as Christian Socialism) but on the need to "purify" an existing church that has become "corrupted" by worldly values. For example, Usuman Dan Fodio founded an Islamic movement in Nigeria that, according to the student reviewing the material, was "distinguished by their refutation of those who had knowledge but failed to put it into practice; those who presented an appearance of compliance with the outward religious duties, but had not eliminated such characteristics as vanity, hypocrisy, ambition, desire for political office and high rank; those who presumed that they had the exclusive right to guide the common people and yet entered into unholy alliance with the sultans, thus encouraging the sultan's oppression of the people; those who engaged in jihad but only to obtain fame and wealth; and those scholars who used false methods, such as music, to lure people into spiritual practice." With the exception of music, this list clearly focuses on behaviors that are self-serving without contributing to the welfare of the group. The new, "purified" religion was rigidly structured to avoid these problems and to turn the community of believers into an encapsulated group. Great attention was paid to matters of dress, prayer, and ritual which appear to have no functional basis when taken out of context, but which make sense in terms of the proximate/ultimate distinction discussed in the previous section.

Even the famous Taoist indifference to worldly affairs makes sense as a way to prevent political corruption. Chen-Jen is a term used in the Chuang-tzu for a person who "does not refuse all contact with human society and politics, but if he should happen to 'get involved' he will not allow himself to 'feel involved'." During this period of Chinese history, "the feudal system of the Chou dynasty was in its final agony, and interstate relationships were characterized by ruse and violence." According to chapter 21 of the Chuang-tzu, Sun Shu-ao, an exemplar of Chen-Jen, had "thrice been named prime minister without considering it glorious and thrice been dismissed without looking distressed. 'Why should I be better than anyone else? When [the nomination] came, I could not refuse it; when it left, I could not keep it. Neither getting it or losing it had anything to do with me'" (all quotes from Eliade 1987 [vol. 3]:230–231). In a world full of vested interests, who better to choose for a leader than someone who has demonstrated a lack of vested interests (Irons 2001; Sosis 2004)?

In *Darwin's Cathedral* I stress that the *product* of natural selection is adaptation but the *process* of natural selection includes many failures for each success. Religious systems reflect a degree of intentional thought but in many respects they are unplanned social experiments, only a few of which succeed. A good cultural fossil

record of religions should include the failures in addition to the successes. Several religions in the random sample can be regarded as failures in the sense that they did not achieve a large following or succeed at their stated goal, such as the example of Pelagianism that I have already described. Frederick Maurice's effort to establish a form of Christian Socialism was well-meaning—no one could doubt its communitarian purpose—but never amounted to much and became a footnote to religious history. The Theosophical Society was based on a blend of science and occultism that made sense in the nineteenth century but attracts only a tiny number of followers today. Nevertheless, in its own way it provided "a new sense of purpose, mission, and service to others" (Campbell 1993:8). Thus, even the failures illustrate the fundamentally other- and group-oriented nature of religion.

Since natural selection is always based on fitness differences, group-level adaptations can evolve only by some groups contributing more to the gene-pool or culture-pool than other groups. Between-group competition can take the form of direct conflict but it can also take more benign forms, such as differences in economic efficiency. Darwin was careful to point out that natural selection at the individual level does not always take the form of nature red in tooth and claw. A drought-tolerant plant out-competes a drought-susceptible plant in the desert, even though they do not directly interact with each other. The same point needs to be made for natural selection at the group level. It is encouraging that *most* of the religions in the random sample and therefore the encyclopedia did *not* spread by violent intergroup conflict. Instead, competition among groups took place primarily through differences in recruitment, retention, and birth and death processes based on the ability of the group to function as an adaptive unit. It is undeniable that group selection sometimes takes the form of violent conflict, but the relatively small number of cases in the random sample adds a new perspective and makes it an open question whether religion per se increases or decreases the potential for violent conflict, compared with nonreligious human social organizations.

Our species is unique in its reliance on cumulative, socially transmitted information. The psychological and cultural processes responsible for the origin and spread of new traits are evolutionary in a broad sense but they differ from genetic evolution in many of their details. Even for purely genetic evolution, different traits are favored when the genes are autosomal (inherited through both parents), cytoplasmic (inherited only through the mother), or on the y-chromosome (inherited only through the father). Cultural evolution includes an even broader range of possibilities, in which a given trait can be transmitted via both parents, one parent, nonparent adults (teachers), peers, and so on. Each transmission mode is expected to favor a different set of traits, just as for purely genetic transmission modes. For these and other reasons, cultural evolution is not expected to produce exactly the same outcome as genetic evolution (Richerson and Boyd 2004).

Dawkins (1976) coined the term "meme" as a cultural analog of "gene." As he and others have developed the concept, memes can be regarded as autonomous life forms that have evolved exclusively to perpetuate themselves with no more interest

in the benefit of their human hosts than a tapeworm or the AIDS virus has. Religion is sometimes cited in support of this conception (e.g., Blackmore 1999), usually with the assumption that religion is so mystifying that it cannot be explained from any other perspective and that people would be better off without it, just as if we could eradicate the common cold.

The random sample provides virtually no support for the cultural parasite hypothesis. As I have already described, most of the religions in the sample are designed to promote the welfare of their members, and their otherworldly nature can be straightforwardly explained with the proximate/ultimate distinction. In addition, the basic concept of memes as independent agents can be faulted on theoretical grounds (Richerson and Boyd 2004).

A more sensible conception of cultural evolution is provided by Richerson and Boyd (2004). Not only have the parameters of cultural evolution evolved by genetic evolution to promote biological fitness on balance, but they have evolved to increase the efficacy of between-group selection relative to within-group selection. It is thanks to cultural processes that human groups are able to function as well as they do. Potential examples discussed in the theoretical literature include social transmission rules that increase variation among groups, low-cost mechanisms for detecting and punishing norm violations (such as gossip), and so on.

This conception of cultural evolution is far more theoretically plausible and consistent with the random sample than the parasitic concept. A good religion is awesome in the degree to which it organizes behavior and replicates itself through time. The mechanisms that enable all of this nongenetic information to be encoded, expressed under the right conditions, and faithfully transmitted must be very sophisticated indeed. Theoretical models of cultural evolution have not yet grasped this degree of sophistication and can benefit as much from the study of religion as the study of religion can benefit from the theoretical models.

Jainism: A Challenge and Its Resolution

Of all the religions in the random sample, the one that initially posed the greatest challenge to the group-level adaptation hypothesis was Jainism. As old as Buddhism, Jainism is famous for its ascetic values. Jain renouncers wear masks to filter the air that they breath, carry a broom to sweep the path in front of them, and have dozens of food restrictions to avoid killing any tiny creature. They are homeless and in some sects travel completely naked. Some even accomplish the ultimate ascetic act of fasting themselves to death. How can such beliefs and practices possibly contribute to the secular utility of either individuals or groups? Remarkably, they do. The following account is based on a detailed ethnography of a modern Jain community whose title says it all: *Riches and Renunciation: Religion, Economy and Society among the Jains* (Laidlaw 1995).

The ascetic renouncers constitute a tiny fraction of the Jain religion, whose lay members include some of the wealthiest merchants of India.

> As is generally the case among the Jains, these families are on the whole active and dedicated followers of the religion. This is especially so during periods when there are renouncers living among them, but even at other times the social mores of the community and the everyday lives of its members are shaped in profound ways by Jain religious values. The daily rites in local temples are well attended and local public events are almost all religious. Like the renouncers, members of Jain families engage in ascetic exercises and in periodic fasting.
>
> But this does not mean that lay Jain communities come to resemble renouncer orders. Nothing in the latter's strict regime would prepare one for the celebration and enthusiasm which attend Jain religious ceremonies, for the colour and opulence of their collective life, for their wealth, for their frank and cheerful pride in that wealth, or for the manifold ways it is linked with asceticism. Like most Jain communities, the Khartar Gacch and Tapa Gacch Jains of Jaipur are generally affluent, and their collective religious life is presided over by members of the most successful business families—in this case, for the most part, wealthy merchants who dominate the city's emerald-trading market, which is one of the largest in the world. It would be going too far to say that it is always the richest lay Jains who have the reputation for being the most religious; but it would only be going too far. In any case it is clear that the Jain religion provides for these families a medium in which to celebrate their worldly success, and to express and affirm the continuity of both family and local community. Yet the doctrine of the religion, as expressed by local teachers and by Jain renouncers themselves, is a soteriology—a project and a set of prescriptions for how to bring one's life to an end (1995:4).

Jainism has been religion of merchants throughout its history. The parallels with Judaism, another merchant religion, are remarkable. Jains lived in diaspora communities thoughout India and surrounding regions to organize trade, developed a sophisticated system of banking and merchant capitalism, formed alliances with nobility, engaged in debt-farming, and were persecuted by resentful lower classes. This economic niche requires a large degree of cooperation and is correspondingly vulnerable to exploitation. Laidlaw describes the modern Jaipur gem trade this way:

> The Jaipur emerald market is firmly oriented to international trade and connected, partly through diaspora Jain communities abroad, to markets overseas. . . . Speculative trading of stones within the market is very extensive, and there is an elaborate and active brokerage system. Emeralds are traded not only so that exporters can meet deadlines for large consignments of cut stones, but also in anticipation of the price fluctuations within the market which result from such highly time-dependent demands. The liquidity of the market depends on a system of informal banking, in which all the major gem firms participate, and which uses a version of the *hundi,* a type of promissory note used in India at least since Mughal times. Unsecured cash advances, which might have to be arranged at very short notice, are to be repaid after a fixed period of time, and this might in some cases be a matter of hours. The price at which a business can obtain money depends directly on its reputation for wealth, honesty, and prudent business practice and it depends beyond that on the public perception of its creditworthiness . . . (1995:353–354).

This reputation is based in part on status within the Jain religious community. The same beliefs that prescribe one code of conduct for the renouncers prescribes

another code for the lay members that is ascetic in its own way but fully consistent with secular values. Fasting in young women demonstrates mastery over their appetites and increases their marriage prospects. Men compete for the privilege of supporting community activities. The more extreme these demonstrations of religious devotion, the more they are publicized and raise the status of the family. The connection between religion and business is so close that family shrines include account books and tools of the gem trade along with religious artifacts.

The renouncers not only set a personal example and provide guidance through sermons, but they actually enforce religious observance through their food-gathering activities. The principle of nonaction dictates that the renouncers cannot prepare their own food or cause anyone else to prepare it for them. They must drop unexpectedly into many households and take only small amounts of food that will not be missed. In addition, they must be certain that the food is sufficiently pure, which goes beyond the details of preparation to the purity of the preparer.

> The purity of food depends perhaps most of all on that of the person who cooks it. . . . A loose or impious woman puts her family in moral peril, in part through the food she feeds them. Therefore it is particularly to the moral and religious standards of the women in the household that the renouncers look. Do they fast on the auspicious days of each month? Do they attend sermons? Does the household in general, and the women in particular, follow restrictions on what they will eat, and when, that at least come close to those they follow themselves? (Laidlaw 1995:304)

These matters are so important that the renouncers must inspect the entire household before they can accept a tiny amount of the food that the family has prepared for itself. Laidlaw describes a typical visit, which demonstrates the respect and even fear commanded by the renouncers.

> If renouncers are spotted approaching the house, a family will launch into a flurry of preparation, but their manner becomes instantly formal and elaborately graceful as soon as the renouncers actually appear. They perform *vandan,* and then invite them in as they would any honoured guests, "Come Maharaj Sahab, Come." And the renouncers are as curt and perfunctory as their hosts are ingratiating. Typically, they march straight through to the kitchen without acknowledging the family's bows and greetings. . . . The women answer renouncers' sometimes sharp and repeated questions about whether a dish is acceptable for them. . . . During the whole proceedings, the renouncers keep up a constant refrain, "Enough! Finish! No, we won't take that! No more of that! Enough!" The householders counter with assurances of the purity and quality of the food. . . . On leaving the house, renouncers say the words *dharma labh* as a blessing; but on most occasions when I have been present they had already turned away from their hosts and were on their way into the street by the time they called this out behind them (1995:309–313).

It is a mark of honor for a household to be included in the daily rounds of the renouncers and a mark of shame to be avoided. Men are expected to be more lax than women in their observance of these rules, in part because of the demands of

their businesses, but they have their own field of competition in the many opportunities that are provided to become financial patrons, including initiation ceremonies for new renouncers, which resemble lavish weddings. These events are so public that it would be impossible for a wealthy member of the Jain community to maintain his reputation without sharing his wealth with the community.

The high moral standards demanded for conduct within the Jain community are not always extended toward outsiders. Debt-farming "hovers between paternalism and naked exploitation" (1995:106). Questionable business practices outside the Jain community are tolerated (1995:342). Despite their obsessive efforts to avoid killing even tiny unseen creatures, Jains do not fit the Western conception of pacifists. Jain mythology includes a renouncer who converts a king to Jainism and persuades him to disinfect the arrows of his army to avoid killing invisible air-beings. No mention is made of using the arrows to kill people (1995:155). When Laidlaw asked a lay Jain about war, he received the following answer:

> No, Jain religion does not say that you should be a coward. Jains are heroes. Religion first teaches you about duty. So if it is part of your duty to go to the front in war, you should do that. It is different for renouncers, but laymen should do that duty (1995:155).

Any adaptive religion must be sufficiently flexible to prescribe different behaviors for different contexts. Jainism possesses this flexibility as well as the religions discussed in *Darwin's Cathedral.*

Even if Jainism is adaptive for the laity, isn't it clearly maladaptive for the renouncers in biological terms? It is important to think holistically when answering this question. All cultures include a fraction of individuals who do not reproduce, sometimes by choice but especially by virtue of circumstances. This is the raw material that cultural evolution has to work with for religions that include a nonreproductive caste. We can predict that the decision to become a renouncer (which is a lifelong commitment) is made primarily by people who do not have other attractive options, and that is exactly what we find. According to Laidlaw, "while non-Jain recruits are welcome as renouncers . . . access to the property, power, and prestige of lay Jain communities is not so readily extended" (1995:115). One Jain woman "was actively encouraged to seek initiation, so that her husband, as a 'widower' would be free to remarry; and the woman was happy to express her flight from 'this world of suffering' as a triumphant escape from an unhappy marriage" (1995:241). More generally,

> [In] Jainism men are much more heavily discouraged than women from entering an order. Dowry among Jains is high, and subject to a constant inflationary pull from richer sections of the community. I know of cases where young women from impoverished Jain families chose renunciation in a situation in which finding a respectable husband was proving very difficult. By contrast, the loss of a son is a financial, organizational, and emotional calamity for the typical Jain family (1995:241).

Another circumstance is age. Older men and women alike often devote more time to their religion when they can relinquish the duties of job and family to their grown children. Their commitment can rival that of the renouncers, but rather than becoming renouncers themselves they tend to adopt leadership roles in the lay religious community. To summarize, reproductive division of labor is not difficult to explain from an evolutionary perspective. It has evolved numerous times in the biological world, and cultures provide plenty of scope for individuals to contribute to the welfare of their society without themselves reproducing.

I have described Jainism in detail for a number of reasons. First, it perfectly illustrates the secular utility of religion that I have also stressed for the random sample as a whole. Second, it shows how the proximate/ultimate distinction can reconcile even the strangest religious beliefs and practices (to outsiders) with the functional side of religion. I cannot improve on Laidlaw's own wording:

> How then, is it possible to live by impossible ideals? The advantage for addressing this question to Jainism is that the problem is so very graphic there. The demands of Jain asceticism have a pretty good claim to be the most uncompromising of any enduring historical tradition: the most aggressively impractical set of injunctions which any large number of diverse families and communities has ever tried to live by. They have done so, albeit in a turbulent history of change, schism, and occasionally recriminatory "reform," for well over two millennia. This directs our attention to the fact that yawning gaps between hope and reality are not necessarily dysfunctions of social organization, or deviations from religious systems. The fact that lay Jains make up what is—in thoroughly worldly material terms—one of the most conspicuously successful communities in India, only makes more striking and visible a question which must also arise in the case of renouncers themselves (1995:7).

Third, this example shows how much progress can be made on the basis of careful descriptive studies of religious systems in relation to their environments. Jainism appears obviously dysfunctional based on a little information but becomes obviously functional based on more information. What exactly accomplished this transformation of the obvious? The most relevant facts are that the renouncers constitute a tiny fraction of the Jain religion, that lay Jains are impressively wealthy, that they occupy a particular economic niche, that the religion prescribes different (and more functional) behaviors for the laity than for the renouncers, that mechanisms of enforcement exist, and so on. Most of these facts are so basic that they are beyond dispute, once they are uncovered and put together, even if there is plenty of room for disagreement at a finer scale of analysis. This is the kind of "natural history" information that enabled Darwin to build such a strong case for his theory of evolution, and it can be used to build an equally strong case for an evolutionary theory of religion. Thanks to Laidlaw's detailed analysis of Jainism, the religion in the random sample that seemed to pose the greatest challenge to the group-level adaptation hypothesis now provides solid support.

The analogy between current religious scholarship and natural history informa-

tion during Darwin's time can be taken a step further. In both cases, the information was gathered by individuals who did not have evolution in mind. Laidlaw is a cultural anthropologist who describes his own perspective this way:

> This book begins from the observation that people may hold values which are in irreducible conflict, and that logical consistency in what we casually identify as a culture, is not something which is necessarily there to be found. It takes work to create, reproduce, and maintain it, and it is always partial. In so far as people manage, in particular cultural traditions and particular local communities, to create lives which are ethically and intellectually coherent, they are not just inheriting a ready-made, complete and integrated package, but sustaining and reproducing the achievement of culture. Jainism can be made to look like the ordered execution of a single doctrinal program, and as is the case perhaps in all cultural traditions, some of its greatest minds have always wished to make it so; but looking at Jainism as an enduring form of life, one is struck by a different achievement. It seems to provide its followers with ideas, institutions, relationships, and practices—a set of ways of going on—which together make conflicting values compossible, and impossible ideals compelling. This is a considerable achievement, and one that calls for elucidation (1995:21).

Laidlaw never uses the e-word, but his metaphorical use of phrases such as "enduring life form" and his practical focus on "a set of ways of going on" converges upon the evolutionary perspective. There is every reason to use the formal theoretical and empirical tools of evolutionary biology to guide future research on religion.

Summary of the Preliminary Analysis

The initial incentive for this survey was to address the problem of selection bias in *Darwin's Cathedral.* Is the *average* religion as adaptive at the group level as the ones that I chose for detailed analysis? Random sampling potentially provides a definitive answer to this question. It might sound naïve to talk about averages for a subject like religion. Aren't they too diverse for such a simple categorization? Religions are indeed diverse, in the same sense that organisms are diverse, but both can still be evaluated in terms of the major hypotheses listed in Table 1. Despite the preliminary stage of analysis, a number of conclusions can be drawn:

- Most religions in the sample have what Durkheim called secular utility.
- The practical benefits are inherently group- and other-oriented.
- In some cases the practical side of religion is so overt that it becomes indistinguishable from politics.
- In other cases the practical side is obscured by the otherworldly side of religion, but these can be largely reconciled through the proximate/ultimate distinction.
- Evolution is a multifactorial process with many constraints on natural selection, so all of the major hypotheses have some degree of validity. However, portrayals of religion as primarily nonfunctional or individually selfish (in the sense of benefiting some members relative to others within the same group) can be rejected on the basis of the survey.

- Religions are not autonomous cultural life forms that parasitize human individuals and groups, often to their detriment.
- Instead, religions demonstrate that the parameters of cultural evolution have themselves evolved to enhance between-group selection and restrict within-group selection.
- Between-group selection can take the form of direct conflict, but it usually takes other forms.

These conclusions are tentative, based on limited information and my own limited ability to evaluate the information. Ideally, every religion in the sample would be analyzed in relation to its environment with the same thoroughness as Laidlaw's analysis of Jainism. I invite others to join this effort. A thoroughly analyzed random sample can provide a reality check for all theories of religion from any theoretical perspective in addition to my own analysis from an evolutionary perspective.

In addition to a survey based on a random sample to guard against selection bias, other surveys are needed to ask more focused questions from an evolutionary perspective. For example, it would be fascinating to compare the religions of cultures that occupy the same economic niche, such as the merchant cultures of Jains in India and Jews in Europe. Numerous merchant cultures have existed around the world and throughout history, providing the basis for a study of convergent cultural evolution (Landa 1999; Wilson 2001). As another example, people from Christian cultures often assume that belief in a glorious afterlife is a feature of all religions and even one of its main functions—to allay the fear of death. Not only is a glorious afterlife absent from many non-Christian religions, but it is even muted in Judaism, the religious tradition from which Christianity was derived. One implication of the proximate/ultimate distinction is that *any* set of beliefs and practices that motivate adaptive behavior can serve as the proximate mechanism for a human social organization. A comparative study is needed to determine why belief in a glorious afterlife is featured in some religions more than others, and why it became more prominent in Christianity than in Judaism. At a finer grain of analysis, different branches of Christianity and Judaism almost certainly vary in their reliance upon belief in a glorious afterlife, which can be measured and related to historical, social, and environmental factors.

TOWARD A FIELD OF EVOLUTIONARY RELIGIOUS STUDIES

One theme of *Darwin's Cathedral* and this article is that religions and other human social organizations can be studied with the same theoretical and empirical tools that evolutionary biologists use to study the rest of life. As I mentioned earlier for the paradigmatic case of guppies, this enterprise is complicated but manageable. It is complicated because evolution is inherently a complicated process with multiple selection pressures and constraints on selection that vary from species to species, trait to trait, and place to place—even over a scale of a few meters in the case of guppies. It is manageable because the pressures and constraints that operate in any

particular case can be determined with enough hard work, and a very satisfying "big picture" can emerge for the system as a whole. This kind of enterprise requires a community of people who share the same set of theoretical and empirical tools that allow them to address a common set of issues. I will end this article by discussing how such a community can form around the subject of religion.

Ideally such a community would include people from evolutionary biology, traditional religious studies, and social scientists who are already using their own theoretical perspectives and empirical methods to study religion. The basic evolutionary principles and empirical methods are not difficult to learn. In general, the burgeoning study of human-related subjects from an evolutionary perspective is being conducted largely by people who received their formal training in other fields and picked up their evolutionary biology along the way. However, a number of major pitfalls need to be avoided.

The first is a belief that adaptationist hypotheses are hopelessly difficult to test and are destined to remain speculative "just-so stories." This belief is a pillar of skeptical arguments about evolution, as if evolution can be rejected for its difficulty rather than its falsehood. In any case, the belief is highly misleading. Functional hypotheses are as amenable to the scientific method as nonfunctional hypotheses, and in any case they cannot substitute for each other, since the proximate/ultimate distinction requires both mechanistic and functional explanations for everything that evolves by natural selection. Productive evolutionary scientists do not wring their hands about the difficulty of testing hypotheses but roll up their sleeves and get to work.

The second pitfall involves thinking about individuals and groups. Holistic conceptions of groups as being like organisms were widespread in both biology and the social sciences until the middle of the twentieth century, when individualism became the dominant intellectual tradition. Only now are evolutionary biologists achieving a middle ground that admits the possibility of adaptations at multiple levels of the biological hierarchy and provides the tools for determining the facts of the matter on a case-by-case basis. It is easy to portray a group-level adaptation as individually advantageous because groups of individuals who pull together do, after all, succeed as individuals. Identifying the appropriate level of selection requires locating the fitness *differences* that drive evolutionary change. There are no fitness differences in a win-win situation, so cooperation can increase in frequency in a large population only if groups that engage in win-win interactions out-compete groups that don't, even for a no-cost public good. To the extent that public good provision (including social control, which is a second-order public good) requires time, energy, and risk on the part of individuals, fitness differences arise within groups that weigh against cooperation, requiring even greater fitness differences among groups for cooperation to increase in frequency in the larger population. Comparing fitness differences within and among groups is as easy as riding a bicycle, once one gets the hang of it, but errors still abound in the past and present literature. A good example from the current study of religion is the idea of costly

commitment, in which religions promote group cohesion by requiring members to engage in behavior that is too costly to fake (Irons 2001; Sosis 2004). This is indeed an important and adaptive feature of religion, which is well represented in the random sample, but is it adaptive at the group or individual level? Often it is portrayed as an individual-level adaptation because it is successful in general. However, breaking costly commitment into its component traits and comparing fitness differences within and among groups reveals that group-level selection is required for its evolution (Bowles and Gintis 2003). It is essential for the field of evolutionary religious studies to reach a consensus on how to identify levels of selection based on fitness differences within and among groups.

There is already a sizeable community of social scientists who study religion from an economic perspective. Economic and evolutionary theory are similar and inter-translatable in some respects but not others, creating another set of pitfalls for social scientists who wish to enter the field of evolutionary religious studies, as I discuss at length in *Darwin's Cathedral.* Once these pitfalls are avoided, a very impressive body of literature and empirical methods can be applied to the evolutionary study of religion. A number of economists who are at the forefront of the study of human genetic and cultural evolution from a multilevel perspective should be consulted by those who are currently studying religion from an economic perspective (see Hammerstein 2003 and Henrich 2004 for useful introductions).

Ironically, the fewest pitfalls might exist for scholars who conduct detailed historical and present-day studies of religion without having any particular theoretical perspective in mind. The functional nature of religion speaks for itself as soon as particular religious systems are studied in relation to their environments. That is why the selected examples in *Darwin's Cathedral* and the random sample of religions discussed in this paper are so interpretable from an evolutionary perspective. As the natural historians of religion, these scholars can provide the foundation of empirical knowledge for asking a new set of questions organized by contemporary evolutionary theory.

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God's Punishment and Public Goods

A Test of the Supernatural Punishment Hypothesis in 186 World Cultures

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Cooperation towards public goods relies on credible threats of punishment to deter cheats. However, punishing is costly, so it remains unclear who incurred the costs of enforcement in our evolutionary past. Theoretical work suggests that human cooperation may be promoted if people believe in *supernatural* punishment for moral transgressions. This theory is supported by new work in cognitive psychology and by anecdotal ethnographic evidence, but formal quantitative tests remain to be done. Using data from 186 societies around the globe, I test whether the likelihood of supernatural punishment—indexed by the importance of moralizing "high gods"—is associated with cooperation.

KEY WORDS: Cooperation; Evolution of cooperation; Gods; High gods; Intentionality system; Religion; Sanctions; Standard Cross-Cultural Sample; Supernatural punishment; World cultures

> *Suspicion always haunts the guilty mind;*
> *The thief doth fear each bush an officer.*
> —Shakespeare, *Henry VI,* Part 3

> *From the study of past religions, primitive and developed, we shall gain the conviction . . . that every religion implies some reward of virtue and the punishment of sin.*
> —Bronislaw Malinowski (1935:viii)

Cooperation is difficult to achieve among self-interested individuals. Sometimes there are mutual advantages making even the most selfish prefer to cooperate

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(that is, when personal gains will exceed the costs of cooperation). However, many cooperative pursuits in human social life are fragile because free riders can exploit the benefits of public goods that others have contributed to achieving, without incurring any of its costs themselves. Under such conditions, cooperation will break down (Kagel and Roth 1995; Olson 1965; Ostrom 1990).

Collective action can, however, be achieved if there is a credible threat of punishment. Punishment can force the costs of free riding above the costs of cooperation, thus removing any incentive to cheat. Rewards help too but, while they might encourage many people to cooperate, they cannot deter all of them from cheating, so they have an intrinsically weaker leverage. The effectiveness of punishment for promoting and maintaining cooperation has been demonstrated in numerous theoretical and empirical scenarios (Boyd et al. 2003; Fehr and Gächter 2000; Ostrom et al. 1992; Sigmund et al. 2001; Yamagishi 1986). The continuing problem, however, is this: Who bears the cost of punishment?

Punishment itself therefore becomes a "second-order" public good (Heckathorn 1989). Individuals may contribute to the original public good and yet free ride on others' efforts to punish those who did not, putting us back to square one in achieving cooperation. The three main solutions to this conundrum are not credible for evolutionary explanations of human cooperation (Henrich and Boyd 2001): (1) punishment comes from state institutions (which are too recent); (2) punishment is not costly after all (punishment must yield some cost that, however small, makes non-punishment a better strategy over time); (3) second-order free riders (those who shirk from punishing others) are also punished (this leads to a requirement for the punishment of those who do not punish those who do not punish those, and so on, which merely paints the problem into the distance). A fourth possibility is that some group members are simply willing to incur the costs of punishment, as can occur in experimental games (Fehr and Fischbacher 2003; Fehr and Gächter 2002). Such "altruistic punishment" could have evolved via some form of cultural group selection (Boyd et al. 2003; Fehr and Fischbacher 2003). However, it remains to be shown that punishers in these empirical experiments do not expect some return benefit, let alone whether they would remain willing to punish in the non-anonymous context of real life, either today or in the past (Burnham and Johnson 2005; Johnson et al. 2003). So during human evolution, without any obvious incentives to punish, how did people achieve cooperation for public goods?

THE SUPERNATURAL PUNISHMENT HYPOTHESIS

One potential source of punishment that has not been considered in the literature on cooperation is supernatural agents (Johnson and Kruger 2004). Supernatural agents are often seen as the purveyors of moral codes and taboos, and many adherents feel obligated to cooperate with the community norms because of the threat of retribution these agents will exact upon them if they do not. That is, supernatural punishment exacted on them or their kin in everyday life, or in an afterlife. Whether

supernatural punishment is genuine or not is immaterial—as long as people fear it then we may expect them to modify their behavior accordingly. This follows the Thomases' dictum (Thomas and Thomas 1928:572): "If men define situations as real, they are real in their consequences." Once such beliefs are established, the costs of punishment are—in theory—partly offloaded onto a supernatural actor, offering a novel solution to the problem of second-order free riders.

Of course, other group members and leaders may punish as well under the auspices of local norms and laws, exacting social sanctions, fines, injury, starvation, imprisonment, ostracism, or death, sometimes on kin as well. Nevertheless, a concurrent threat of supernatural punishment makes the job of punishment easier if defections become rarer and retribution enjoys enhanced (religious) justification. Indeed, real-life sanctions are often meted out precisely in the name of supernatural displeasure. Elites can focus their energies on making sure people believe in supernatural punishment, instead of (or as well as) attempting to catch and punish people themselves.

In addition, other group members may gain personal payoffs by seeking to punish on their own if they are the ones who have been wronged. In the context of reciprocity or reputation effects, we may expect such moralistic aggression to be an adaptive trait bringing long-term benefits (Frank 1988; Trivers 1971).

Despite these other sources of worldly punishment, recent evidence suggests that religious beliefs also play an important role in the disposition to cooperate. An erroneous view has prevailed that, in cooperation experiments, people who hold religious beliefs behave identically to those who do not (Fehr and Gächter 2003). Recent work by Richard Sosis and others, however, has provided evidence that cooperation is significantly higher among those who are more devout (Sosis 2000; Sosis and Bressler 2003; Sosis and Ruffle 2003; Wilson 2002). Some such data are probably even rather conservative. The influence of a belief in supernatural punishment in low-stakes cooperation games for a few dollars is perhaps minimal; in real-life decisions of personal or social importance such beliefs are likely to play a much greater role. Clearly, supernatural punishment is limited by certain bounds. As Schneider (1957:798) put it, "A supernatural sanction which specifies that the criminal's left arm will fall off at high noon on the third day following the crime cannot be maintained for long except for such crimes as are practically never committed." More credible alternatives are often, however, still severe: disease and death are often cited, and represent inevitable occurrences at some point or other.

In summary, the fear of supernatural punishment offers a powerful mechanism that may have promoted cooperation toward public goods in our past, as it still does for millions of people today. Throughout, I focus on a single aspect of religion: the belief in supernatural punishment. The supernatural punishment hypothesis is not, therefore, exclusive of the possibility that other aspects of religion arose from other causes, such as cultural inventions, tools of elites to subjugate others, or by-products of humans' big brains.

THE ORIGIN AND UTILITY OF BELIEF IN SUPERNATURAL PUNISHMENT

Supernatural punishment offers a neat mechanism for the maintenance and reinforcement of norms if everyone already believes in it, but begs the questions of (1) how it originated in the first place; (2) why unbelievers who shirk the costs of supernatural beliefs would not do even better; and (3) what cognitive processes are involved to enable humans to entertain such costly beliefs. These are valid criticisms of many functional explanations of religion. Supernatural punishment, however, offers a novel response.

Throughout the evolution of the human lineage, selfish behavior would always have been selected for whenever the net (short- *and* long-term) benefits of action X outweighed its net costs, just as it would for slime moulds and zebras. Of course, selfishness may not pay off in the presence of kin, allies, mates, or dominant individuals, where self-interest at the expense of others can incur inclusive fitness costs or direct punishment (Clutton-Brock and Parker 1995; Hamilton 1964; Trivers 1971). But in most other situations, selfishness was always the best means to reproductive success and, when significant others were absent, uninvolved, or not looking, selfishness paid (Dawkins 1986). Our ancestors' life was therefore relatively simple in that social behavior could be selected (by both individual actors in real time and/or natural selection over evolutionary time) by the simple comparison of potential gains with potential costs. However, humans would later develop two extraordinary capabilities that would throw such simplistic calculations out the window.

The first extraordinary capability is the capacity to infer the contents of other minds. That is, humans developed a system which allowed them to envision the world from another individual's point of view, the so-called theory of mind. Of particular importance to the supernatural punishment hypothesis is one special component of this—the "intentionality system," a mental capacity geared towards identifying causal agents of events (Bering 2002; Bering and Shackelford 2004). In this new world, life became much more complicated with the knowledge that what one knows, others know too (and, conversely, knowing that others know what one knows oneself). There remains some debate about whether other species have some form of rudimentary intentionality system (see, for example, de Waal 1996; Povinelli and Bering 2002; Tomasello et al. 2003). In animals it is hard to separate out genuine inferences of others' mental states from alternatives. For example, evidence of anticipatory behavior may just as easily indicate learned associations between events as it does a true understanding of the agent's mental intention. As Tomasello acknowledges, whatever interesting cognitive abilities animals may have, even chimpanzees "clearly do not have a human-like theory of mind" (Tomasello et al. 2003:153). Even if some animals do have the capacity for complex mental inference, however, it has no bearing on my argument here.

The second extraordinary capability is unarguably human: language. When the human capacity for complex language developed, the significance of the intention-

ality system skyrocketed because not only could people now suffer from or manipulate other people's knowledge, people could suffer from or manipulate what other people *learn in absentia.* Information about person A could propagate via person B to person C, D, E, and so on, without end. This makes selfish behavior particularly dangerous because the probability and costs of social exposure increase rapidly with each newly informed individual (each person can tell several others). Even if B and C do not care, it may not be until person Z hears the news, or until *enough* people hear the news, or until some authority hears the news, perhaps weeks later, that punishment will come. The consequences of the spread of such information for reproductive success are significant: consider the impact of exposed crimes such as murder or adultery. Such events, and their social ramifications, would commonly have a major impact on fitness (Bering and Shackelford 2004). Providing new grist for evolution's mill, the more transparent social world of intentionality systems and language threw up a set of selection pressures that were entirely novel in the history of life.

Humans are both blessed and burdened with these cognitive innovations. At one end of the spectrum, Machiavellians could now perform behaviors not just because of the simple cost-benefit analysis of whether to do X or not, but with the added possibility to exploit others' knowledge about X. The potential for manipulation and deception would have suddenly come under significant selection pressure. Those who exploited this system effectively could enjoy significantly enhanced reproductive success. Those who did not would experience a comparative disadvantage. As an example, Bering and Shackelford (2004) argue that such behaviors as the murder of witnesses to crimes become the direct subject of natural selection, since this can preserve the self from social exposure.

At the other end of the spectrum, one would, for the first time in evolutionary history, have to be concerned about the dangers of this new social transparency. One's own selfish actions could reported, inferred, remembered, discussed, gossiped about, and reprimanded—even by absent third parties after long delays. Impulsive selfish desires would suddenly become hazardous because of the increased risk of exposure and the social sanctions, fines, injury, starvation, imprisonment, ostracism, or death that may result. Increased restraint would therefore be crucial to maximizing personal gain through measured self-interest that falls short of incurring excessive costs in the face of disgruntled group members. I therefore suggest that—at the individual level—restraints on self-interested conduct contributed to fitness because it put a brake on antiquated desires that were too blatantly selfish for the subtleties of the new social world. Selfishness still paid, but only in more careful moderation than before.

The question was how to generate such restraint. The very mechanism that generated a more transparent social world, I argue, also generated a causal link to supernatural punishment for transgressing within it. Clearly, an understanding of causation via the intentionality system would have lent strong selective advantages in predicting and exploiting the vagaries of hunting, gathering, social exchanges,

and so on in our environment of evolutionary adaptation (EEA). As a consequence of the mind's constant search for agency, however, Bering (2002) argues that even random natural events such as drought or illness came to more easily fit with a cognitive disposition that they happened *for a reason,* rather than simply by chance alone. It is not logical, but it appears to be human nature. From there, it is a small step to assign the cause to some supernatural agency, given that such events apparently lie outside any human's ability to instigate them.

The capacity for agency and intentionality may be prerequisites for belief in supernatural punishment, but they need not automatically give rise to such beliefs. However, a long evolutionary history of adapting to positive or negative feedback from social interactions may have provided a ready template for the newly evolved intentionality system to infer events as deliberate responses to our actions. Costly and memorable misfortunes, in particular, may have stimulated a search (or a selection pressure, if it helped to avoid such negative events again in the future) for attributing cause and effect. A belief in supernatural agency, therefore, may have become a natural consequence of human brains fearful of invoking the calamities of nature upon themselves as a result of their actions. For the Inca and Maya, for example, Hultkrantz reports that "diseases were supposed to derive from crimes in the past—above all, theft, murder, adultery, and false testimony" (Hultkrantz 1967:233). Murdock reported that every single one of the 186 societies in his analysis attribute illness to the malicious work of some supernatural agent or other (Murdock 1980), and "spirit aggression" was the single most important theory of illness causation (appearing in all cases but two).

Murdock also pointed out that when life was more nasty, brutish, and short in our past, there would have been plentiful misfortunes for which to attribute potential causes and effects. Certainly, in the preindustrial era that is of interest for understanding the evolution of cooperation, one must not underestimate the cogency of supernatural explanations for natural events that are now well-understood scientific phenomena. The role of social interactions would also be important in this regard: (1) other group members may systematically warn of supernatural consequences for moral transgressions; (2) other group members are likely to scaffold individual beliefs if one's own suspicions about others are "confirmed" through gossip, e.g., Mary is barren because she is an adulterous woman; (3) the social perception that misfortunes indicate wrongdoing is likely to make one ever more concerned to avoid them—whether it is true or not, the social consequences will unfold nevertheless.

Pure Machiavellians would do well by exploiting the intentionality system without any checks on pursuing personal gain. But those who believe in supernatural punishment can do better still, because a god-fearing Machiavellian would do better than an indiscriminate one if the latter suffers from a higher risk of detection and retaliation by others in the community (Johnson and Bering in prep.). Unbelievers run a greater risk than believers if: (1) they are less able to control selfish impulses; (2) they underestimate the true risk of detection; or (3) they *accurately* estimate the

true risk of detection but this leads to more mistakes than unbelievers who overestimate it, a situation that arises wherever the costs of exposure exceed the benefits of selfishness (see Nettle 2004).

The supernatural punishment hypothesis suggests a basis for human cooperative tendencies and, perhaps, an adaptive forerunner to morals and ethics. Since it identifies adaptive advantages for the individual, it could arise independently in multiple different contexts. Group selection may be at work as well (if supernatural punishment promotes cooperation, groups with it would do better than those without), but while certainly adding significantly to a selective process, group selection need not be relied upon for the mechanism to operate. The next step is to test the hypothesis.

In the remainder of this paper I present a pilot test of the supernatural punishment hypothesis. The research question is simple: Is supernatural punishment associated with human cooperation?

METHODS

Data

I used data from the Standard Cross-Cultural Sample (SCCS) of 186 human societies around the globe (Figure 1), devised by George Murdock and Douglas White (1969). Quantitative variables describing a large number of characteristics of these societies have been coded via extensive research on the primary ethnographic literature, by a number of different people (see, for example, Murdock 1967, 1981; Ross 1983; Tuden and Marshall 1972). This database has become a well-established resource for testing hypotheses about human behavior and ecology across different world cultures.

The 186 societies are a subset of a much larger database on 1,267 societies comprised in the *Ethnographic Atlas* (Murdock 1967). The SCCS subset was carefully selected, non-randomly, in an effort to provide a representative sample of societies capturing all of the world's regions and diversity, and which was not biased by the contagion effects known as Galton's problem (in which cross-cultural comparisons can generate spurious correlations if common attributes have spread between societies—groups would not then represent independent data). The sample also excludes societies recently descended from a single one, for similar reasons (the rule of thumb requiring a separation of around 1,000 years; so, for example, French Canadians and the French could not both be included). Obviously, societies that lack enough information are not included, but Murdock made it a goal to include data spanning the universe of cases, seeking to have a representative society from all areas of the world. To exclude certain areas would be to fail to represent the true population of world cultures. Murdock also believed that to exclude modern, historical or prehistoric societies would also arbitrarily truncate the data. This is where the SCCS diverges from the Human Relations Area Files (Lagace 1979), which

Figure 1. Distribution and coding of "high gods" across the Standard Cross-Cultural Sample (Murdock 1967). Coding levels are as follows: (1) absent or not reported; (2) present but not active in human affairs; (3) present and active in human affairs but not supportive of human morality; (4) present, active, and specifically supportive of human morality.

specifically excludes such societies. Murdock regarded this exclusion as "a thoroughly indefensible example of anthropological provincialism" because it advised rejecting data compiled by historians (Murdock 1981:6). SCCS sources also strive to glean data from the earliest descriptions of the societies, where possible, to reduce the likelihood of European influence on cultural characteristics (Murdock and White 1969).

Although much has already been done with the SCCS data to produce a statistically valid sample, I repeated all analyses using two variables to control for some of these possible confounds: (1) region of the world from which each society comes, to control for the possibility that variables tend to have certain values in particular areas of the globe (SCCS variable 200); and (2) type of religion, to control for the fact that some so-called "classical" religions (e.g. Christianity, Islam) have spread widely in recent history, which may compromise the statistical independence of each society's belief in high gods (713; both detailed in the appendix). There are a number of discussions of the SCCS database in the journal *World Cultures,* online, and elsewhere (e.g., Ember and Ember 1998).

The appendix lists all variables used in the analysis, their original code number in the SCCS database, their coded values, the number of societies corresponding to each value, and the original reference. They are discussed in detail below.

Measures of Supernatural Punishment

The ideal variable for this study would be a measure of *the extent of belief in supernatural punishment for selfishness* within each society. Unfortunately, no such variable exists in the SCCS database. Therefore, I used the existing variable "high gods" as a surrogate (238). As outlined by Murdock (1967:52), a high god follows the definition of Guy Swanson (1960: chapter III and appendix 1) as "a spiritual being who is believed to have created all reality and/or to be its ultimate governor, even though his sole act was to create other spirits who, in turn, created or control the natural world" (I have included both authors' exact definitions and coding in Table 1). The salient feature for this study is that high gods vary in their activity in human affairs and their concern with human morality. The SCCS data codes high gods for each society as: (1) "Absent or not reported," (2) "Present but not active in human affairs," (3) "Present and active in human affairs but not supportive of human morality," and (4) "Present, active, and specifically supportive of human morality" (Divale 2000).

The logic behind using this variable is that, on average, over the whole sample, the importance of high gods should be associated with the extent to which moral codes are imposed by a supernatural source, and the likelihood that a deity is believed to exact supernatural punishment on transgressors who flout them. As originally developed by Swanson, the variable "high gods" includes the key feature of how much gods "seem to care whether virtue triumphs or the wicked go unpunished" (Swanson 1960:57). Hence, I simply suggest that the four levels of this vari-

Table 1. Exact Definitions and Coding Descriptions of the Variable "High Gods" from All Sources

Source	Definition	*Coding*			
		1	2	3	4
SCCS database (Divale 2000)	None given	"Absent or not reported"	"Present but not active in human affairs"	"Present and active in human affairs but not supportive of human morality"	"Present, active, and specifically supportive of human morality"
Ethnographic Atlas (Murdock 1967:52)	"A high god is defined, following Swanson [1960; chapter 3 and appendix 1], as a spiritual being who is believed to have created all reality and/or to be its ultimate governor, even though his sole act was to create other spirits who, in turn, created or control the natural world"	"A high god absent or not reported in substantial descriptions of religious beliefs"	"A high god present but otiose or not concerned with human affairs."	"A high god present and active in human affairs but not offering positive support to human morality"	"A high god present, active, and specifically supportive of human morality"
Swanson (1960:209–210)	"Refers to a spirit who is said to have created all reality and/or is reality's ultimate governor. Includes spirits whose sole act was to create the other spirits who, in turn, produced the natural world"	"None"	"Present—otiose"	"Present—active in human affairs but no specific support to human morality"	"Present—active in human affairs and gives specific support to human morality"

able index the likelihood of supernatural punishment from high gods as: (1) zero, (2) low, (3) medium, and (4) high.

Some caveats are in order at the outset. Even if the variable "high gods" precisely equated with the extent of belief in supernatural punishment from them (which it probably does not), it cannot be a perfect index of expected punishment for norm transgressions as a whole. This is because among the diversity of world cultures: (1) not all high gods are expected to punish all transgressions; (2) not all supernatural punishment is attributed to high gods (it is sometimes expected in addition, or instead, from other supernatural agents, such as dead ancestors, spirits, or witches); and (3) not all punishment, of course, is supernatural: transgressors may suffer worldly punishment from real people as well (see Figure 2). However, this does not constitute any flaw in the analysis. These other possibilities will add noise to the data, but if there is a link between high gods and cooperation, we can nevertheless test for the predicted statistical correlation between them even with these other sources unaccounted for. If anything, it will serve to ensure a conservative analysis of the hypothesis under test, given that the explanatory variable is limited to a single form of punishment when others are possible too (Type II errors, finding no relationship when there is one, will increase). If we are to find correlations between high gods and cooperation, then they would have to represent an especially powerful effect to emerge despite such noise in the data. Note that this also depends on *how* alternative sources of punishment vary with high gods: (1) if randomly, then they just constitute noise; (2) if negatively, then they work *against* the proposed hypothesis so finding high gods to be important would be evidence of a strong relationship; (3) if positively, then this may be problematic as they could themselves account for cooperation, rendering the relationship with high gods spurious. Other studies are clearly needed to test for relationships between cooperation and the other sources of punishment in Figure 2. "High gods" is not a perfect variable. But on the other hand, it and the SCCS data provide an extraordinary resource for a first test.

Measures of Cooperation

I examined the 2,000 variables currently available in the SCCS database for potential measures of cooperation (Divale 2000). None stand out as ideal or direct measures of the propensity to cooperate. Nevertheless, several surrogate measures may serve to indicate the extent to which the society is composed of cooperatively inclined citizens that are geared towards contributing to the public good. These variables are detailed in the appendix and are predicted to vary as follows. I hypothesized that societies in which high gods are more active and concerned with human morality will be:

1. Larger, since their success in achieving cooperative pursuits will have allowed them to expand, avoid fission, and compete successfully with other societies (SCCS variables 63, 235, 237; see also Alexander 1987; Roes and Raymond 2003)

Figure 2. Sources and inevitability of punishment. The use of the variable "high gods" as an index of supernatural punishment implies (shaded): (1) high gods always punish and (2) no other sources punish. However, in some societies, high gods do not always punish while other supernatural agents and group members sometimes do punish. As explained in the text, however, the prediction holds despite these sources of noise.

		Inevitability of punishment	
		Punish	Do not punish
Source of punishment	High gods	Implied	Possible
	Other supernatural agents	Possible	Implied
	People	Probable	Implied

2. More compliant with social norms and decisions (775)
3. More able to lend money and use abstract media of exchange, since this requires high degrees of trust and guarantees (17, 18; see discussion of this in Swanson 1960: chapter IX)
4. More loyal to the local and wider community (778, 779)
5. More sharing with food (1718; though this may also vary with ecological circumstance)
6. Have centralized enforcement and sanctioning systems, since the society will be more likely to accept and share a common system of "God-given" morals that identify inalienable rights and wrongs (90, 776, 777, 1743)
7. More likely to pay taxes, since people may be more willing to contribute to the public good (784; of course, taxes are often collected coercively by elites, so I do not expect them to solely reflect willing cooperation)
8. Less likely to experience internal conflict, if common moralizing regulations bind the society together in common cause (1649, 1748, 1749, 1750, plus a composite averaging six other internal conflict variables, following Roes and Raymond 2003)

Data Reliability

SCCS data come from a variety of sources, and although they follow similar general principles, they vary in the methods and people involved in coding them. Swanson's (1960) original classification of high gods in his sample of 50 societies provided a test of reliability. He reported a significant correlation between his own coding and that of two research assistants for a subset of 20 cases ($r = 0.81$; $p < 0.01$), based on examination of the same monographs. The larger SCCS database of 186 societies now has 168 with a classification for high gods. Swanson's work was

extended in a global study by Davis (an unpublished Ph.D. dissertation, discussed in Peregrine 1995a), and a study of native North American societies by Peregrine (1995a, 1995b). Both Davis and Peregrine had trouble replicating many of Swanson's operational definitions and findings. They did, however, both replicate Swanson's findings regarding high gods, suggesting that the coding for that variable at least (one of several) was consistent with Swanson's original definitions.

Variables indexing cooperation also have some indications of reliability, ranging from the variable police (90), which had high (but unspecified) correlations for inter-coder reliability (see Tuden and Marshall 1972:452–453), to the variable compliance (775), which was deemed by the researchers to have been very difficult to code (see Ross 1983:172). For the latter, I double-checked my test results with a reliability rating from the same study (see Table 2). Ross (1983) also reports little evidence that the order in which societies were coded had any influence on values assigned. He did, however, find that ratings of data quality were occasionally correlated with values coding "presence" or "high levels" of the target variable, implying that data richness might lead to certain values rather than others. However, the direction of cause and effect was unclear: more prominent features might have led to higher subjective confidence in the coders' ratings of data quality (whereas finding nothing or little evidence for the same features might give the impression of a lack of data). For some SCCS variables there are no specific discussions of reliability, whereas other variables are extensively reexamined and recoded by subsequent researchers (e.g., 1649). It is worth noting that one of the virtues of the open-access SCCS database is that it undergoes regular scrutiny, revisions, and updates (Divale 2000). While lauding the remarkable efforts of the SCCS data compilers over the years, my solution to the various potential problems was, where possible, to test hypotheses using several similar variables (e.g., three measures of society size: 63, 235, 237).

Statistics

For the basic results I used Kendall's tau-b statistic to assess relationships between SCCS variables, given that they mostly represent ordinal data (see appendix; the control variables, region (200) and religion (713), are nominal and therefore treated as factors in multivariate tests). Kendall's tau-b has advantages over Spearman's rank correlation coefficient, especially with small sample sizes and where there are ties in the rankings, when *p*-values for Spearman's ρ can be misleading (Sokal and Rohlf 1995).

Because I test a number of correlations, some may reach statistical significance by chance. I therefore applied a sequential Bonferroni technique for multiple comparisons, which controls for the increased number of Type I error rates (false rejections of the null hypothesis) in a posteriori multiple significance testing (Rice 1989). Standard Bonferroni tests (where the significance level is simply divided by the number of tests) are not adequate, because they increase Type II error rates where

Table 2. Results of Correlations between the Variable "High Gods" and Various Indices of Societal Cooperation. See Table 1 and the appendix for further details of these variables. Also included are significance tests controlling for (A) multiple inference testing, using sequential Bonferroni corrected significance levels ("X" = remains significant), and, using ordinal regression models, (B) region of the world from which the societies come (200), (C) classical, mixed, or pre-classical religion (713), and (D) both region and religion. Note that predicted directions hinge on SCCS coding; higher numbers do not always mean higher levels of the variable (see appendix).

						Controlled for			
SCCS No.	Variable	Predicted direction	Kendall's tau-b	*N*	*P* (2-tailed)	A	B	C	D
17	Money (media of exchange) and credit	+	+0.234	167	<0.001 ***	X	+*		
18	Credit source	+	+0.218	155	0.002 **	X			
63	Community size	+	+0.140	168	0.027 *				
90	Police	+	+0.216	164	0.002 **	X		+	
								(p = 0.06)	
235	Mean size of local communities	+	+0.179	139	0.01 **				
237	Jurisdictional hierarchy beyond local community	+	+0.283	167	<0.001 ***	X	+*		
775	Compliance of individuals with community norms	–	–0.005	81	0.958 †			–*	–**
776	Formal sanctions and enforcement for community decisions	–	–0.189	85	0.047 *		–*	–*	–*
777	Enforcement specialists (police, tax collectors)	–	–0.042	84	0.666				
778	Loyalty to the local community	–	–0.028	78	0.775				
779	Loyalty to the wider society	–	+0.067	79	0.489				
784	Taxation paid to community	–	–0.271	80	0.006 **				
1649	Frequency of internal warfare (resolved rating)	–	–0.045	139	0.524 ‡				
1718	Sharing of food	+	–0.153	72	0.123				
1743	Sanctions	+	+0.303	74	<0.01 **	X	+**		
1748	Frequency of internal warfare	–	+0.289	36	0.046 *			+*	+
									(p = 0.08)

Table 2. (*continued*)

SCCS No.	Variable	Predicted direction	Kendall's tau-b	*N*	*P* (2-tailed)	*Controlled for* A	B	C	D
1749	Frequency of internal warfare involving non-territorially organized groups within unit of maximal political authority	–	+0.095	36	0.516				
1750	Frequency of violent conflict between groups within local communities	–	+0.093	65	0.41				
—	Mean of six internal conflict variables (see appendix)	–	–0.036	64	0.717				

* Significant at $p < 0.05$ level.
** Significant at $p < 0.01$ level.
*** Significant at $p < 0.001$ level.
† Also not significant when omitting level 3 "highly variable," and when controlling for a data-quality variable available for that study (797; ordinal regression, estimate: –0.016, $p = 0.93$).
‡ Also not significant when controlling for a reliability coding of this variable (1652; ordinal regression, estimate: –0.120, $p = 0.39$).

more than one component hypothesis is false (i.e., they reduce power in detecting significant results). Test results are therefore reexamined under newly derived significance levels (column A in Table 2), judged by a test of $P_i \leq \alpha / (1 + k - i)$ where all original *P*-values are ranked in ascending order (P_1, P_2 . . . P_i) for k tests. The adjustment thus gives a different critical *P*-value for each test.

I used ordinal logistic regression (1) to double-check relationships while controlling for potentially confounding variables, and (2) to build a multivariate model testing the effects of several independent variables at once.

RESULTS

Table 2 details the results of the statistical analysis. High gods were significantly associated with 10 of the 19 independent variables tested, and 14 of the relationships were in the predicted direction. All but one of the 10 significant results (frequency of internal warfare, 1748) were in the predicted direction. Five of these remained significant following Bonferroni corrections for multiple inference testing (column A of Table 2). Ordinal logistic regressions were conducted to double-check all relationships while controlling for the variable region (200; column B), religion (713; column C), or both (column D), with any significant relationships and their direction reported in Table 2 (note that the effective sample size is reduced in these multivariate analyses). Below, I summarize the results in order of the predictions outlined in the Methods section, on pp. 420–421.

All measures of society size were significantly related to high gods, but only jurisdictional hierarchy (237) following Bonferroni corrections, and when controlled for region. None of the other society size variables was significant in any controlled test. Roes and Raymond (2003) found similar results using an earlier version of the SCCS and variable 237 (for which they report Kendall's tau = 0.29, $n = 167$, $p < 0.0001$) and when using the larger, *Ethnographic Atlas* database (they report Kendall's tau = 0.37, $n = 724$, $p < 0.0001$).

Compliance with community norms (775) was not significant in the basic test, nor when removing the coding level 3 (for "highly variable") given Ross's (1983) comments on the difficulty of coding this variable. However, the original variable did become significant in two of the controlled tests.

Lending of money and media of exchange (17, 18) were both significantly related to high gods, including after Bonferroni corrections, as well as lending of money when controlling for region. Neither was significant in any of the other controlled tests.

Loyalty to the local or wider community (778, 779) was unrelated to high gods in either basic or controlled tests, as was sharing of food (1718).

Centralized enforcement and sanctioning systems were significantly related to high gods in three of the four cases (90, 776, 1743, but not 777). Police (90) and sanctions (1743) remained significant following Bonferroni corrections and in one controlled test each (although police was only of borderline significance). Formal

sanctions (776) was significant in all controlled tests (except the Bonferroni test), and enforcement specialists (777) in none.

Payment of taxes to the community (784) was significantly associated with high gods, but not in any controlled test.

Finally, none of the internal conflict variables was significantly associated with high gods (1649, 1749, 1750, plus the composite of six other internal conflict variables) except one: frequency of internal warfare (1748), which held significant in one of the controlled tests. This relationship was in the opposite direction to that predicted, such that increasing importance of high gods was associated with more warfare.

Multiple Regression Model

Finally, I conducted an ordinal regression with high gods as the dependent variable. I included as independent variables all those that remained significant in the individual tests after Bonferroni corrected significance testing (as in Table 2). Region and religion were once again entered as control factors. This resulted in a significant model containing all five variables ($\chi^2 = 111.78$, d.f. = 78, $p = 0.007$; Cox and Snell $R^2 = 0.76$). Coefficients for each of the variables in the equation (that is, their effect on the model given the simultaneous influence of all the other included variables) indicated that none were significant as independently contributing factors, largely because they are intercorrelated (all $r > 0.40$, all $p < 0.0001$). Nevertheless, controlling for region and religion, these variables were together able to explain a large amount of variation in the variable "high gods."

DISCUSSION

Among a representative sample of 186 human societies, high gods are significantly associated with societies that are larger, more norm compliant in some tests (but not others), loan and use abstract money, are centrally sanctioned, policed, and pay taxes. In the one instance of a significant relationship conflicting with predictions, high gods were associated with more internal conflict (though only one of five such measures). Inasmuch as increasing levels of high gods tend to threaten negative consequences for those who disregard the norms of the community, this provides some support for the notion that supernatural punishment may be associated with cooperation among human societies. Theories that hold that religion is an arbitrary by-product of big brains or culture do not predict any relationship between indices of cooperation and whether moralizing gods are present or not.

It must be noted that cause and effect remain obscure. For example, it is possible that, as societies become larger and more regulated within larger political structures, elites increasingly encourage the institutionalization of moralizing gods to authenticate their power and subjugate the populace (Cronk 1994). In addition, both high gods and better cooperation may occur among societies that are more ad-

vanced politically (Swanson 1960), economically (Underhill 1975), or technologically (I found that high gods are associated with SCCS variable 158.1, "Sum of cultural complexity": Kendall's tau = 0.246, $N = 168$, $p < 0.0001$). Therefore, it is possible that high gods and some of the independent variables tested in this paper are simply associated on account of their common occurrence in more "modern" communities. Certainly, high god concepts are often assumed to be a feature of modern religions, rather than of early forms (Swanson 1960; Weber 1978). However, in the SCCS data, high gods is *negatively* associated with variable 713 "religion," meaning that high gods are actually more commonly represented among "pre-classical" religions than among the more recent, "classical" ones (such as Christianity and Islam; Kendall's tau = –0.319, $N = 85$, $p = 0.001$).

While bearing in mind the possible conflation with modernity, it is interesting to consider the possibility that one reason societies were able to develop cultural complexity in the first place is partly on account of the cooperative benefits attained through a belief in moralizing gods. In a similar vein, the handful of very successful religions to which most of Earth's population subscribe (in particular, Christianity and Islam) have expanded in part as a result of the successful spread of ideas (and, of course, the sword) across populations that were formerly otherwise inclined. One could speculate that the success in and apparent pertinence of these religions to so many diverse communities and ecologies may not be coincidental with their stress on supernatural punishment (as well as their great rewards; Coward 2003). If supernatural punishment has indeed been an important factor in overcoming the challenge of human cooperation, one would predict that monotheistic religions stressing sin and salvation may have become the more successful as a result.

The analysis presented here does not distinguish among competing adaptive theories of religion, and it therefore offers complimentary evidence for other theories that predict a relationship between high gods and cooperation. Many "social-solidarity" theories, while they stress different underlying mechanisms, concur with the idea that religious beliefs—for a variety of proposed reasons—enhance group cooperation (Sosis and Alcorta 2003). Therefore, while I claim to provide support for the supernatural punishment hypothesis (inasmuch as high gods is a good index for this), the results presented here are not inconsistent with other adaptive theories of religion. For example, if "costly signaling" via rituals is the driving mechanism behind religion (as suggested by Irons 2001 and Sosis 2003), then we may also expect a relationship between high gods and the indices of cooperation in Table 2, since high gods may also be associated with more costly rituals. We therefore need to extend and develop these kinds of empirical analyses in more exacting ways to tease apart different adaptive theories.

Two unexpected results are worth exploring briefly. The one instance of a significant (positive) relationship between high gods and internal conflict (1748) may be spurious given the fact that four other measures were unrelated. However, the relationship held in two of the controls. There are a number of possible interpretations of how high gods might influence internal disputes, and it is possible to imag-

ine conditions in which one may expect more such conflict. Firstly, factions that wage internal violence against rivals may be religiously motivated. They may even be fighting to enforce religious observance. Secondly, as Roes and Raymond (2003) suggest, moralizing gods may only exert an effect on subduing internal conflict when the society faces a common threat. At other times internal disputes may persist, for a number of other reasons, regardless of the presence of high gods.

Although there was no relationship between high gods and sharing of food, other factors may dominate such activities. In a recent study of cooperation in 15 small-scale societies, Henrich et al. (2004) found that two societies that both shared food extensively nevertheless demonstrated very different levels of underlying cooperation when playing a simple economic exchange called the "ultimatum game" (Kagel and Roth 1995). The Ache of Paraguay are humble in their sharing of food, even avoiding advertising their hunting success, to the extent that they and their kin do not benefit from greater individual hunting success. The Ache were highly cooperative in the ultimatum game. In contrast, the Hadza of Tanzania share food, but only grudgingly, and commonly try to avoid doing so at all. The Hadza were much less cooperative in the ultimatum game and also commonly punished uncooperativeness. According to the authors, "cooperation and sharing is enforced by a fear of punishment that comes in the form of informal social sanctions, gossip, and ostracism" (Henrich et al. 2004:40). Hence, correlating high gods with the amount of food sharing per se may conceal two things: (1) underlying differences in dispositions towards cooperation, and (2) a key alternative source of punishment (as in Figure 2).

Avenues for Future Empirical Tests

There are several clear opportunities for follow-on studies. Firstly, measures of supernatural punishment were imprecise. More explicit data on beliefs in supernatural punishment are clearly needed, and a newly coded SCCS variable indexing the extent of belief in supernatural punishment would be the ideal. Measures of cooperation were also imprecise. Explicit experimental tests such as those of Henrich et al. (2004) would index baseline dispositions towards cooperation more effectively (though data collection would be extremely labor intensive). They would also (1) avoid masking effects such as in the food sharing example above, and (2) allow one to account for *individual* variation in both (*a*) the level of cooperation and, if surveyed at the same time, (*b*) the extent of belief in supernatural punishment. Tying these together in individuals rather than as aggregates among groups may be a much more effective method of analysis (individual variation may obscure any between-group differences).

Secondly, as was made clear in Figure 2, high gods do not account for all punishment. Therefore, future empirical tests should also test whether cooperation varies with (1) alternative sources of supernatural punishment and (2) real punishment by other people. Multivariate tests pitting such different explanatory variables—high

gods, other sources of supernatural punishment, and real-world punishment—at the same time against dependent variables indexing cooperation would indicate which of these sources of punishment holds greatest explanatory power.

A powerful test of the supernatural punishment hypothesis would combine studies of each of Tinbergen's (1968) four levels of explanation of behavior: (1) function (how it impacts on survival and reproduction), (2) causation (the proximate stimuli and recent learning), (3) development (necessary conditions for development and change with age), and (4) evolutionary history (its occurrence in similar species and possible phylogenetic origins).

Functional studies, for example, could collect specific life history data on members of preindustrial cultures and identify links between their individual beliefs in supernatural punishment and their reproductive success.

Causation studies could identify whether supernatural primes trigger more cooperation in laboratory experiments (Bering et al. 2005 [this issue], for example, found people were less likely to cheat in the purported presence of a ghost). Brain imaging studies might serve to test for links between these conditions and brain areas associated with the intentionality system and theory of mind.

Developmental studies could identify whether, when, and how children develop and/or learn to connect supernatural agency with cooperative behavior. Some work has been done along these lines (Bering 2004; Bering and Bjorklund 2004), but further studies specifically targeting cooperation behavior are needed.

Evolutionary history studies could work to resolve the controversial issues surrounding the degree of mental inference possible among primates and humans, as well as the similarities and differences in the role of punishment in their cooperation behavior. Identifying more precisely *when* humans developed the prerequisite mental capacities for entertaining supernatural ideas would help to identify the plausibility and consequences of the theory.

A further string to the bow of the supernatural punishment hypothesis is that it also offers an explanation for some *non-religious* forms of supernatural beliefs, including cults, folklore, common superstition, and just-world beliefs, all of which can in theory promote cooperation in precisely the same way as described for supernatural punishment. Each invokes the intentionality system in assigning cause and effect (though this may be less obvious than inferring actions of specific supernatural agents). Many of these other types of supernatural beliefs do not have rituals, however, whereas others do, raising the possibility that these differences might allow a test to tease apart theories of costly signaling and supernatural punishment. And yet, it is clear that the supernatural punishment hypothesis need not be mutually exclusive of other explanations for religious behavior. For example, belief in supernatural punishment may be a necessary corollary to make religious rituals appear worthwhile to adherents, facilitating their perception of low costs for the same costly activities that deter unbelievers who could otherwise join the club for free (Sosis 2003). Or, public or ritualized displays of a belief in god's punishment may itself represent a hard-to-fake signal that facilitates cooperation with others (a

convincingly god-fearing person might make a trustworthy trading partner, for example). At the least, the intentionality system may be a key predisposing factor that led to the development of rituals surrounding the causation of natural events, such as rains, droughts, or illness.

Additional Empirical Support for the Supernatural Punishment Hypothesis

The supernatural punishment hypothesis comprises five components (Figure 3): Ancestral selfishness (A) was compromised by the evolution of the intentionality system and language (B), which increased costs of social exposure (C). The resulting novel selection pressures favored a belief in supernatural punishment (D) (a belief itself requiring the intentionality system), which increased levels of cooperation to minimize perceived (supernatural) and actual (group-member) costly punishment (E). The empirical analysis presented here was restricted to the relationship between D and E. Below, I briefly outline some recent support for other aspects of the theory.

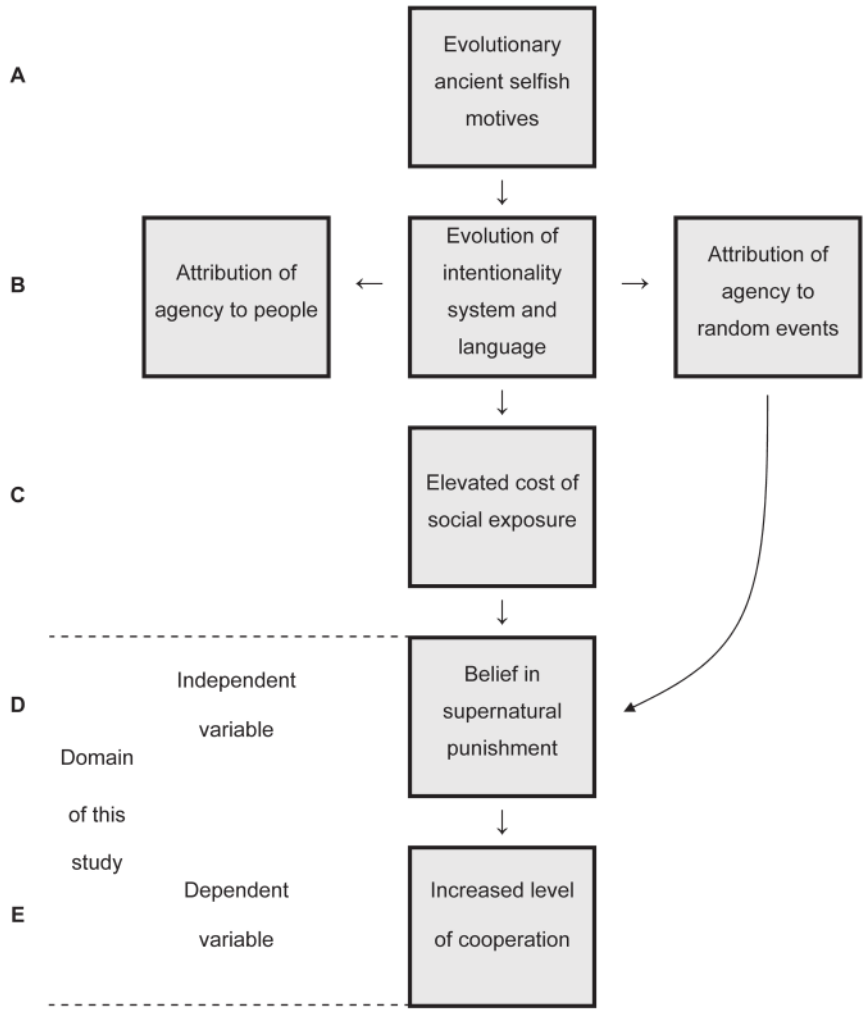
Component A: Ancient Selfish Motives. The idea that selfish motives are evolutionarily ancient is implicit in evolutionary biology and behavior (Krebs and Davies 1993; Wilson 2000). Although apparent unselfish behavior may emerge in some situations from the indirect effects of cooperation with kin, allies, mates, dominant individuals, and so on (Alexander 1987; Clutton-Brock and Parker 1995; Hamilton 1964; Trivers 1971; Zahavi 1995), the fundamental rubric is that behavior is usually selfish (Dawkins 1986).

Component B: Evolution of the Intentionality System. The origins and consequences of the intentionality system have been extensively developed both theoretically and empirically elsewhere by Bering and colleagues (Bering 2002, 2004; Bering and Bjorklund 2004; Bering and Johnson 2005; Bering and Shackelford 2004). I therefore will not expand on it here.

Component C: Costs of Social Exposure. This component is discussed by Bering and Shackelford (2004). Here I add some recent support. The supernatural punishment hypothesis predicts that, assuming there is some variation in disposition among individuals, cheats will tend to underestimate the probability and/or cost of exposure (implicating the utility of a corrective mechanism, such as law-abiding or god-fearing). A recent survey by Robinson and Darley (2004) suggests precisely this. Among contemporary criminals, those caught and convicted tend to downplay (1) capture probability and (2) punishment cost, and it is this that contributes to their decision to commit the crime. This implies (but of course does not prove) that people who accurately estimate or overestimate these factors are less likely to cheat and thereby avoid the costs of punishment.

Secondly, the supernatural punishment hypothesis predicts that if selfishness rep-

Figure 3. The key components (A–E) of the supernatural punishment hypothesis.



resents an evolutionarily ancient motivation with which the intentionality system has come into competition, then we should see examples of ancient selfish motives that endanger social status in our cognitively sophisticated, modern society. Terry Burnham (2001) has popularized the many possible ways in which ancient pleasure pathways lead us into socially costly behavior, such as addiction and infidelity. Another example is "crimes of passion," antisocial behaviors driven partly by emotional arousal that are hard to control even among normally law-abiding citizens (Goldstein 2002). A number of neurological studies are intriguing too. Violence, for example, has well-understood neural pathways that some individuals cannot control as well as others (Davidson et al. 2000). Another study of choices among

immediate versus future rewards found that people experience the directly conflicting activation of two brain regions. Evolutionarily older regions of the limbic system favored immediate over delayed rewards whereas newer regions of the cortex were neutral between them (McClure et al. 2004). Those with more cortex activation were more restrained.

Component D: Belief in Supernatural Punishment. The supernatural punishment hypothesis predicts that a fear of supernatural punishment will be a common theme among all humans' brains, even if manifested in diverse ways. In other words, although I looked at *variation* in such beliefs in this study, if the theory is correct, we might expect selection to have established these specific beliefs widely. Cross-cultural studies support the widespread prevalence of some form of supernatural agent capable of exacting punishment for norm transgressions. Although only 23.8% of 168 societies in the SCCS data and 24.2% (of 748) in the *Ethnographic Atlas* have moralizing high gods (i.e., high gods coded as level 4; Murdock 1967), other supernatural sources are clearly important even where high gods are not. For example, 100% of SCCS societies attributed a supernatural source of one kind or another as a "predominant" or "important" cause of illness (Murdock 1980). Swanson's (1960) study of 50 societies reported 48.7% with high gods present (15.4% as level 4); 67.3% with "active ancestral spirits" that influence the living in some way; and 26.0% with "reincarnation." Also prevalent in his study were supernatural sanctions, "rewards or deprivations from supernatural sources (spirit or mana) which are believed to affect an individual because he harmed or helped other members of the same society" (Swanson 1960:212). A number of his societies believed such supernatural sanctions to affect people's health (42.0%), afterlife (27.7%), or some other aspect of life such as accidents, misfortunes, or mishaps (62.5%; these three figures for supernatural sanctions are minimums, because 0 was coded as absent *or* no data). What is critical, given that supernatural punishment may be effective regardless of its source, is that at least one of the above six beliefs appeared in 92.0% of Swanson's societies.

Link between D and E: Swanson (1960: chapter IX) found that among the 50 societies in his study, supernatural sanctions were significantly associated with high levels of interpersonal relations especially subject to stresses and strains, where he hypothesized the solidarity of group members would be most tested. He found significant associations with the incidence of debts, social classes, individually owned property, and primogeniture (sole inheritance by the oldest child). His conclusions that supernatural sanctions and moral behavior are tightly linked rejected earlier assertions that primitive religions were unassociated with ethics (Tylor 1948 [1871]), and favored the converse view of Malinowski cited at the beginning of this article. Swanson's variables indexing supernatural sanctions were never extended to the full 186 SCCS societies (Peregrine 1995a).

CONCLUSIONS

While empirical tests to convincingly demonstrate the supernatural punishment hypothesis, as well as to test it against competing alternatives, have yet to be undertaken, the hypothesis appears to offer a mechanism that avoids many of the pitfalls of evolutionary explanations of religion. By virtue of its foundation on specific cognitive processes (the intentionality system), and on the individual selective advantages it is suspected to confer (reducing the risks and costs of exposure in a socially transparent, mentally sophisticated, gossiping society), the supernatural punishment hypothesis offers a plausible origin for such beliefs, unreliant on (though perhaps augmented by) group selection, and offers a mechanism to promote cooperation while avoiding the "second-order" public good problem outlined at the beginning (about who bears the costs of punishment) that remains problematic for scholars of human cooperation (Bering and Johnson 2005; Johnson and Bering in press; Johnson and Kruger 2004).

The problem of second-order free riders remains an important one. My view is this: People do not bear the cost of punishment, at least *not for the sake of the group.* Social transgressions typically have a victim—either directly if hurt, betrayed, cuckolded, or stolen from, or indirectly if the cheat takes resources otherwise available to others. It can therefore be in the interests of the wronged party to seek personal punishment on the cheat if this will bring reciprocal benefits or maintain a reputation (Frank 1988; Trivers 1971). Ganging up with kin or allies can further reduce the costs of doing so (Wrangham 1999). Such a view is supported by recent evidence of an emotional and neural basis for the punishment of unfairness or betrayal (de Quervain et al. 2004; Fehr and Gächter 2002; Sanfey et al. 2003). Because of the costs of such interpersonal retaliation exacted upon cheats (greatly heightened by the intentionality system), people may be better off avoiding transgressions in the first place. Certainly, they need a system to balance their evolutionarily ancient but ever-present triggers for selfish behavior. The threat of supernatural punishment is one mechanism that might have led to such a disposition.

Supernatural punishment appears to have been an important influence on a great many people's behavior both in the present and the past, as noted by Bronislaw Malinowksi 70 years ago. Recent theory and evidence suggest that this has significant implications for understanding the evolution of cooperation (Bering in press; Bering and Johnson 2005; Johnson and Bering in press; Johnson and Kruger 2004). Shakespeare's notion of the guilty mind on high alert takes on a powerful meaning in light of the selective effects of the human intentionality system. If a fear of god added new caution over our deeply rooted selfishness, our enhanced cooperative tendencies may have given us a selective advantage over those who were less prudent in their selfishness.

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APPENDIX
VARIABLES IN THE ANALYSIS (DIVALE 2000)

SCCS No.	Variable	*N*	Code	Code Description	Reference
17	Money (media of exchange)	3		Missing data	Murdock and
	and credit	77	1	No media of exchange or money	Morrow 1970
		12	2	Domestically usable articles as media of exchange	
		26	3	Tokens of conventional value as media of exchange	
		42	4	Foreign coinage or paper currency	
		26	5	Indigenous coinage or paper currency	
18	Credit source	17		Missing data	Murdock and
		113	1	Personal loans between friends or relatives	Morrow 1970
		26	2	Internal money lending specialists	
		23	3	External money lending specialists	
		7	4	Banks or comparable institutions	
63	Community size	1		Missing data	Murdock and
		28	1	< 50	Wilson 1972
		28	2	50–99	
		45	3	100–199	
		32	4	200–399	
		29	5	400–999	
		15	6	1,000–4,999	
		5	7	5,000–49,999	
		3	8	> 50,000	

SCCS No.	Variable	*N*	Code	Code Description	Reference
90	Police	6		Missing data	Tuden and Marshall 1972
		124	1	Not specialized	
		4	2	Incipient specialization	
		4	3	Retainers of chiefs	
		6	4	Military	
		42	5	Specialized	
158.1	Sum of cultural complexity (149–158)			Sum of scores for: Writing and Records, Fixity of Residence, Agriculture, Urbanization, Technological Specialization, Land Transport, Money, Density of Population, Political Integration, Social Stratification	Murdock and Provost 1973
200	Region	28	1	Africa (Exclusive of Madagascar and the Sahara)	Murdock 1962–1971
		28	2	Circum-Mediterranean (North Africa, Europe, Turkey, Caucasus, Semitic Near East)	
		34	3	East Eurasia (including Madagascar and islands in Indian Ocean)	
		31	4	Insular Pacific (including Australia, Indonesia, Formosa, Philippines)	
		33	5	North America (indigenous societies to the Isthmus of Tehuantepec)	
		32	6	South America (including Antilles, Yucatan, Central America)	
235	Mean size of local communities	38		Missing data	Murdock 1962–1971
		31	1	Fewer than 50	
		29	2	50–99	
		24	3	100–199	
		17	4	200–399	

		12	5	400–1000	
		4	6	1,000 without any town of more than 5000	
		10	7	One or more towns of 5,000–50,000	
		21	8	One or more cities of more than 50,000	
237	Jurisdictional hierarchy beyond local community	2		Missing data	Murdock 1962–1971
		82	1	No levels (no political authority beyond community)	
		48	2	One level (e.g., petty chiefdoms)	
		23	3	Two levels (e.g., larger chiefdoms)	
		19	4	Three levels (e.g., states)	
		12	5	Four levels (e.g., large states)	
238	High gods	18		Missing data	Murdock 1962–1971
		68	1	Absent or not reported	
		47	2	Present but not active in human affairs	
		13	3	Present and active in human affairs but not supportive of human morality	
		40	4	Present, active, and specifically supportive of human morality	
—	Mean of 6 main indices of internal conflict			Mean of six variables below (shaded)	Roes and Raymond 2003
666	Moderate or frequent interpersonal violence†	55		Missing data	Sanday 1981
		43	1	Absent	
		88	2	Present	
767	Conflict (social or political) in the local community	96		Missing data	Ross 1983
		4	1	Endemic: a reality of daily existence (e.g., physical violence, feuding, bitter factionalism)	
		20	2	High: Conflict present but not a pervasive aspect of daily life	

SCCS No.	Variable	*N*	Code	Code Description	Reference
		46	3	Moderate: Disagreements and differences do not result in high violence or severe disruption	
		20	4	Mild or rare	
768	Conflict between communities of the same society	97		Missing data	Ross 1983
		25	1	Endemic: High physical violence, feuding, and/or raiding occur regularly	
		23	2	Moderately High: Often involving physical violence	
		21	3	Moderate: Disputes may occur regularly but tend to be managed in a more or less peaceful manner	
		20	4	Mild or rare	
770	Resort to physical force by disputants in settling disputes, exclusive of police or institutionalized force	96		Missing data	Ross 1983
		34	1	Often used	
		32	2	Sometimes used	
		24	3	Rarely or never used	
773	Internal warfare (between communities of same society)	101		Missing data	Ross 1983
		31	1	Frequent, occurring at least yearly	
		14	2	Common, at least every five years	
		10	3	Occasional, at least every generation	
		30	4	Rare or never	
891	Frequency of internal war	26		Missing Data	Wheeler 1974
		17	1	Continual	
		54	2	Frequent	
		89	3	Infrequent	

713	Religion	93		Missing data	Whyte 1978
		14	1	Preclassical	
		31	2	Mixture of classical and preclassical	
		48	3	Classical religion (Christianity, Islam, Hinduism, Buddhism)	
775	Compliance of individuals with community norms and decisions	100		Missing data	Ross 1983
		43	1	High	
		31	2	Moderate	
		12	3	Highly Variable	
776	Formal sanctions and enforcement for community decisions	96		Missing data	Ross 1983
		23	1	Great sanctioning power available	
		32	2	Some	
		35	3	Little or none	
777	Enforcement specialists (e.g., police, tax collectors)	97		Missing data	Ross 1983
		29	1	Present	
		21	2	Not specialized but done by leaders who do other things as well	
		39	3	Absent, or carried out by social pressure of wider community	
784	Taxation paid to community (e.g., in agricultural produce, labor, finished goods)	101		Missing data	Ross 1983
		31	1	Regular and non-negligible taxes to community	
		20	2	Only in special situations or at a modest level	
		34	3	None	
778	Loyalty to the local community	103		Missing data	Ross 1983
		30	1	Especially high	
		33	2	High	

SCCS No.	Variable	*N*	Code	Code Description	Reference
		14	3	Moderate	
		6	4	Low	
779	Loyalty to the wider society	102		Missing data	Ross 1983
	(in some cases indistinguishable	11	1	Especially high—uniformly high across groups	
	from the local community)	16	2	High for the most part across groups in the society	
		33	3	Moderate—some noticeable variation across groups in society	
		24	4	Low—not terribly salient or rarely important as a concern	
1649	Frequency of internal warfare	23	0	No resolved rating (original code 0) [removed from analysis]‡	Ember and
	(resolved rating)	60	1	Internal warfare seems to be absent or rare (original code 1)	Ember 1992
		4	2	original code 1.25	
		5	3	original code 1.5	
		4	4	original code 1.75	
		7	5	Internal warfare seems to occur once every 3 to 10 years (original code 2)	
		3	6	original code 2.25	
		5	7	original code 2.5	
		2	8	original code 2.75	
		4	9	Internal warfare seems to occur once every 2 years (original code 3)	
		3	10	original code 3.25	
		6	11	original code 3.5	
		2	12	original code 3.75	
		8	13	Internal warfare seems to occur every year, but usually only during a particular season (original code 4)	
		1	14	original code 4.25	

		10	15	original code 4.5	
		1	16	original code 4.75	
		27	17	Internal warfare seems to occur almost constantly and at any time of the year (original code 5)	
		11	88	Don't know or unclear (original code 8) [removed from analysis]‡	
1718	Sharing of food	97		Missing data	Lang 1998
		7	1	Sharing of food among nuclear family	
		14	2	Sharing of food among kin residing in local community	
		9	3	Sharing of food among kin, not restricted to local community	
		4	4	Sharing of food among non-kin within local community	
		21	5	Sharing of food among all members of local community	
		24	6	Sharing of food among groups within unit of maximal political authority or ethnic group	
		10	7	Sharing of food among other than mentioned groups [removed from analysis]‡	
1743	Sanctions	88		Missing data	Lang 1998
		17	0	No formal political office present (variable 1740 coded as 1) (original code 88) [removed from analysis]‡	
		26	1	No or few means of coercion	
		17	2	Restricted means of coercion, e.g., only for certain types of decisions	
		38	3	Coercive means to enforce all decisions	
1748	Frequency of internal warfare; i.e. between local communities within unit of maximal political authority	96		Missing data	Lang 1998
		51	0	No political office above the level of the local community (variable 1740 coded as 1, 2, or 7) (original code 88) [removed from analysis]‡	
		15	1	Rare or never	

SCCS No.	Variable	*N*	Code	Code Description	Reference
		11	2	Occasional	
		11	3	Often	
		2	4	Permanent	
1749	Frequency of internal warfare involving non-territorially organized groups within unit of maximal political authority	96		Missing data	Lang 1998
		51	0	No political office above the level of the local community (variable 1740 coded as 1, 2, or 7) (original code 88) [removed from analysis]‡	
		20	1	Rare or never	
		9	2	Occasional	
		7	3	Often	
		3	4	Permanent	
1750	Frequency of violent conflict between groups within local communities	114		Missing data	Lang 1998
		51	1	Rare or never	
		12	2	Occasional	
		7	3	Often	
		2	4	Permanent	

† These levels were reversed in constructing the mean, since this variable ranks violence in the opposite direction to the other five variables.
‡ Coded values that do not represent any ordinal value were removed from all analyses.

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