SIGNALING, SOLIDARITY, AND THE SACRED: THE EVOLUTION OF RELIGIOUS BEHAVIOR

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Anthropologists have repeatedly noted that there has been little theoretical progress in the anthropology of religion over the past 50 years (Evans Pritchard 1965; Geertz 1966; Glazier 1997; Guthrie 1993; Preus 1987; Steadman and Palmer 1995; Wax 1984). By the 1960s Geertz had pronounced the field dead. Recently, however, evolutionary researchers have turned their attention toward understanding the selective pressures that have shaped the human capacity for religious thoughts and behaviors, and appear to be resurrecting this long dormant, but important, area of research (Cronk 1994; Irons 1996a,b,c; Kurland 1999; Ludvico and Kurland 1995; Masters 1993; McClendon 1997, 2002; Roele 1993; Sosis 2000a; Wilson 2002). This work, which focuses on ultimate evolutionary explanations, is being complemented by advances in neuropsychology and the growing interest among neuroscientists of how ritual, trance, meditation, and other altered states impact brain functioning and development (Austin 1998; d’Aquili and Newberg 1999, McNamara 2002; Newberg and d’Aquili 2001; Shaver and Rabin 1997; Winkleman 1986, 2000). This latter research is providing critical insights into the evolution of the proximate mechanisms responsible for religious behavior. Here we review these literatures and examine both the proximate mechanisms and ultimate evolutionary processes essential for developing a comprehensive evolutionary explanation of religion.

Several challenges confront evolutionary scholars of religion. First, patterns of religious behavior, like other areas of human social behavior, have undergone significant change over our evolutionary history. Evans Pritchard (1965) argued that dramatic historical changes in religious behavior render it impossible to generalize across categories of religions (e.g., tribal, chiefdom, contemporary world religions). Evolutionary theories of religion, however, necessarily assume generalizability across time and space. Second, the multiple roles and complex functions and determinants of variation in religion render it difficult to capture within a single theoretical approach. Indeed, examining the origins of religion, the development of religious institutions, the ecological determinants of religious behavior, and whether religion is currently adaptive constitute separate areas of inquiry requiring different methodological tools. Third, even when analyses are restricted to a specific time and place, there is an extensive range of phenomena that fall under the rubric of religion, including myth, ritual, taboo, symbolism, morality, altered states of consciousness, and belief in non-corporeal beings. Concomitantly, there exists enormous cross-cultural variance within any one of these phenomena.
Religious behavior also poses a genuine challenge for those who employ optimization, rational choice, or other egoistic-based models to explain human behavioral variation since religious behaviors often entail significant proximate costs, such as time, energetic, and material costs, as well as physical and psychological pain, which appear greater than any derived benefits. Researchers have sought to unravel this dilemma by positing somatic, reproductive, and psychological benefits conferred by religious behaviors on their practitioners that could outweigh these costs. Realized benefits include improved health, survivorship, economic opportunities, sense of community, psychological well-being, assistance during crises, mating opportunities, and fertility (see Reynolds and Tanner 1995 for a review). Various scholars have independently concluded that religious communities are able to offer many of these benefits because religions solve significant communication problems inherent in human life (Deacon 1997; Iannaccone 1992, 1994; Irons 2001; Rappaport 1999). Although our understanding of how religion solves such problems is still incomplete, recent theoretical and empirical findings offer intriguing clues to religion’s evolution and efficacy.

WHAT IS RELIGION?

While there are countless definitions of religion in the anthropological literature (see Klass 1995; Spiro 1966; Steadman and Palmer 1995), belief in the supernatural (i.e., non-corporeal beings) is probably the most commonly offered definition (Frazer 1922; James 1905; Lowie 1952; Norbeck 1961; Radin 1937; Spiro 1966; Tylor 1873; van Baal 1981). This definition captures the ineffable and unknowable aspects of religion that separate it from ordinary perceptual experience; however, it does not distinguish supernatural beliefs associated with ritual practices from unverifiable paranormal beliefs that do not elicit such behaviors. Nearly a century ago Durkheim offered a definition of religion that may serve as a valuable bridge between anthropological and neurobiological approaches to the evolution of religion. He proposed that religion is “a unified system of beliefs and practices relative to sacred things…that unite into one single moral community…all those who adhere to them” (1995 [1915]:62). Durkheim’s definition emphasizes that religion is a communally accepted distinction between natural or profane things, and things that are supernatural, or sacred. Numerous subsequent researchers have noted the importance of this distinction (Douglas 1966; Eliade 1957; Otto 1959; Rappaport 1999; Turner 1967; Wilson 2002). Although beliefs are not directly observable and
thus cannot serve as the foundation of an operational definition of religion, belief in the sacred is indirectly observable through the behaviors that such beliefs elicit. Sacred ideas and objects evoke shared responses among adherents, both conscious and voluntary, and unconscious and autonomic. Thus, the sacred/profane construct has particular utility for evolutionary theories of religion because it shapes and directs individual behaviors.

Sacred things have been described as “set apart and forbidden” (Durkheim 1995 [1915]), “pure and dangerous” (Douglas 1966), “enduring and powerful” (Eliade 1957), “unquestionable and unfalsifiable” (Rappaport 1999). They incorporate powerful emotional charging which renders them impervious to time and logic. As noted by Boyer (2001), attribution of the sacred is frequently counterintuitive in relation to the actual object involved (e.g., undrinkable holy water, inedible totemic animals, crying wooden statues). Because sacred things are defined by their emotional charging rather than by their intrinsic properties, their existence depends on the shared creation and evocation of emotionally valenced symbols. Ritual actualizes these symbols and thus creates and defines the sacred within a community (Bloch 1989; Douglas 1966; Durkheim 1995 [1915]; Eliade 1957; Rappaport 1999; Turner 1967; VanGennep 1960). While specific beliefs and rites exhibit enormous cross-cultural variance, it is the enduring framework of religious ritual that universally defines the sacred and separates it from the profane.

EVOLUTION OF RITUAL

To understand the evolution of human religious ritual many researchers have looked to nonhuman ethological studies for comparative data (e.g., Deacon 1997; Laughlin and McManus 1979; McClenon 2002). Some have argued that mammalian ritual provided the seeds for the development of more elaborate human rituals and have drawn the link between mammalian and human ritual as the phylogenetic origins of religion (Laughlin and McManus 1979; Smith 1979). Anthropologists (Leach 1954; Rappaport 1979, 1999; Wallace 1966) and ethologists (Lorenz 1966; Moynihan 1970, Tinbergen 1952) have independently reached several common conclusions about ritualized behavior, most notably that it is a form of communication. The recurrent components of ritual, including exaggerated formality, sequencing, invariance, and repetition, have been selected to facilitate communication by eliciting arousal, directing attention, enhancing memory, and improving associations (Hinde 1974; Rowe 1999). While these features of ritual improve message reception, retention, and understanding, the encoded
informational components of ritual, which vary widely across species, elicit specific response behaviors in the receiver.

Early ethologists argued that ritualized signals develop out of common behaviors when there are benefits to be gained through coordination of the signaler and receiver (Bradbury and Vehrencamp 2000; Smith 1977). Like Darwin (1872), these researchers (e.g., Lorenz 1966; Tinbergen 1952; von Frisch 1950) viewed ritualized signals as essentially mutualistic and designed to communicate honest information about a signaler’s emotions and motivational state. By allowing clear communication of intent, ritual signals were seen to promote coordination and reduce the costs of agonistic encounters, thus laying the foundation for the development and stability of social groups (Smith 1979).

SOCIAL SOLIDARITY THEORIES

Many anthropologists reached a similar conclusion about human rituals, although they focused their attention on the collective nature of human ritual ceremonies, in contrast to the dyadic ritualized signals of primary interest to ethologists. These authors maintained that one of the primary functions of religion was the promotion of group solidarity (e.g., Douglas 1966; Durkheim 1995 [1915]; Radcliffe-Brown 1952; Turner 1995 [1969]). They argued that collective rituals enable the expression and reaffirmation of shared beliefs, norms, and values, and are thus essential for maintaining communal stability and group harmony. Durkheim claimed that the “effervescent” state of ritual performance minimizes individual distinctions and emphasizes the unity of the group. Turner (1995 [1969]), too, viewed this “effervescent” state as central to ritual’s efficacy. He observed that the temporary removal of adolescents from society during rites of passage increased a sense of communitas, which he characterized as a strengthening of social bonds and heightened solidarity among ritual performers.

These early social solidarity theorists focused on the mutualistic function of religious ritual in creating and maintaining intra-group solidarity and in perpetuating the social order. With the emergence of an ecological perspective in the 1960s and 1970s, this homeostatic function of religious ritual was extended to encompass ecological parameters as well (Harner 1977; Harris 1966, 1974; Rappaport 1979; Vayda and McKay 1975). These researchers viewed religion as the medium through which communities interact with their environment, and they examined how religious practices maintain stable ecologies (e.g., Harris 1974; Rappaport 1984...
Religious beliefs and practices were viewed as “‘positive-functioned’ and probably ‘adaptive’ processes of the ecological system of which they are a part” (Harris 1966:51). Harris’s writings on food taboos (1966, 1974), Harner’s research on cannibalism (1977), and Rappaport’s analysis of Maring kaiko ceremonies as resource regulators (1984) all sought to identify the ecological utility of the seemingly “irrational, non-economic and exotic aspects” (Harris 1966:51) of religion. These researchers did not negate the importance of religion in creating and maintaining social solidarity; rather, they expanded its role to encompass ecological parameters as well. In so doing, they situated social groups within a larger ecological and evolutionary context.

In contrast to earlier ecological theorists who focused on ritual regulation of inter-group boundaries, Hayden (1987) proposed that religious behaviors have been favored by selection because of their ability to promote inter-band alliances. Arguing that intermittent resource shortages throughout human evolution have selected for mechanisms capable of creating and maintaining inter-group alliances, he suggested that such mechanisms are provided by religious ecstasy, since “religious emotions served to cement bonds between groups” (1987:84). Hayden further claimed that ecstatic states lead directly to the development of transcendental concepts such as deities and spirits. Using data from a sample of societies coded in the HRAF database, he demonstrated that celestial deities are most common in societies facing resource stress. Subsequent HRAF work by Snarey (1996) has further shown that societies facing severe water scarcity are much more likely than societies with an abundance of water to believe in supreme deities concerned with human morality. Snarey argues that moralizing supreme deities promote prosocial use of scarce resources, thus enhancing societal survival. Roes and Raymond (2003), also employing HRAF data, recently showed that larger societies are more likely to control valuable resources, engage in high levels of external conflict, and possess moralizing deities. All of these researchers provide empirical support for a relationship between ecological parameters, social dynamics, and religious beliefs.

While the scope of inquiry for social solidarity theorists has shifted over the past century, these theorists share a view of religion as a mechanism that enhances a group’s longevity. Whether positing the function of religion to be fostering social cohesion, preserving the social order, or maintaining population-resource homeostasis, all of these researchers interpret religion from a group perspective. The most recent proponent of this view, David Sloan Wilson (2002),
also argues that religion functions to enhance social solidarity. In contrast to the implied group selection of previous theorists, Wilson explicitly embeds this solidarity function of religion within an evolutionary framework in which groups operate as adaptive units. Noting that many resources can be acquired only through the coordinated action of several individuals, he argues that human groups form to acquire these resources. He contends that such groups are able to function as adaptive units because they have moral systems, expressed through religious imagery and symbolism, which regulate behavior. Adaptive features of religion are posited to have evolved through an ongoing process of cultural group selection – some religious experiments and ideas survive, others do not. Wilson convincingly argues that religious teachings are aimed at encouraging adherents to behave for the benefit of the group. Wilson, like Alexander (1987), maintains that because religion serves to enhance cooperation within groups, it provides a selective advantage in competition between groups. Wilson views such inter-group competition as the driving force for the evolution of religion.

RITUAL AS DECEPTION

Behavioral ecologists have sharply challenged both the mutualistic view of ritualized behaviors implicit in the work of the social solidarity researchers and the group selection theories with which they are associated (Dawkins and Krebs 1978; Krebs and Dawkins 1984; Maynard Smith 1974; Maynard Smith and Parker 1976). They have argued that evolution is a competitive process in which selection occurs at the individual, rather than the group level. As a result, this process should not favor organisms that signal their honest intentions if greater gains may be achieved through deception. Selective pressures will favor deceptive strategies when individuals can exploit others group members for individual advantage. Thus, interactions between signalers and receivers should escalate in an evolutionary arms race in which signalers attempt to influence the behaviors of receivers to their own advantage, and receivers attempt to recognize deception and resist manipulation that is not in their best interests. The result of such escalation would be increasingly complex ritual behaviors as senders attempt to deceive receivers and receivers seek to determine the truthfulness of the sender’s signal.

Cronk (1994) applied this reasoning to explore human moral systems cross-culturally. In contrast to previous work that emphasized how moral systems enhance cooperation within groups (e.g, Alexander 1987), Cronk observed that despite the benefits of mutualism, there are
still conflicts of interests within groups. As a result of these conflicts, moral statements can be used to manipulate others to benefit the signalers at a cost to the receivers. Cronk argues that religion can be used by elites to maintain social control. He rightly notes that this claim is supported by Swanson’s classic cross-cultural study (1960), which found inegalitarian societies to be more likely to believe in moralizing and punishing gods than egalitarian societies. Cronk follows Krebs and Dawkins (1984) who claim that cooperative signals should be simple, whereas manipulative signals should be more elaborate with greater repetition. Thus, he expects religious communities concerned with conquest, control, and conversion to have more elaborate and repetitive displays than communities with little interest in “convincing any nongroup members of their correctness” (1994:92).

WHY THE SACRED IS A SACRIFICE: THE COSTLY SIGNALING THEORY OF RITUAL

A number of researchers have observed that the hypothesized “arms race” between deceivers and receivers does not always occur. For example, when a direct link between signal and underlying condition exists, as between physical size and vocal signal frequency, deception is precluded (Johnstone 1998). Zahavi (1975) further proposed that even in the absence of such direct physical linkage, it is possible to ensure signal reliability if signals are differentially costly to produce. In other words, signals expressing phenotypic condition can be honest if the costs to lower quality organisms of imitating the signals of higher quality organisms outweigh the benefits that can be achieved (Gardiner and Morris 1989; Grafen 1990; Zahavi 1975, 1977). This may result from differential costs or benefits faced by high and low quality signalers. For example, Zahavi and Zahavi (1997) argue that stotting, or jumping behavior, which is observed among springboks and Thompson gazelles is an honest signal to predators of physical condition, and hence ability to evade capture, because springboks and gazelles in poorer condition cannot imitate the behavior.

Various researchers have proposed the application of costly signaling theory to religious ritual (Berman 2000; Cronk 1994; Iannaccone 1992, 1994; Irons 1996a,b,c, 2001; Sosis 2000, in press; Sosis and Bressler in press). Like the social solidarity theorists, these researchers view religion’s ability to promote solidarity as its primary function. They recognize that social bonding is not an end in itself; by increasing solidarity religion facilitates intra-group cooperation. Indeed, Irons posits that the primary adaptive benefit of religion is its ability to
promote cooperation and overcome problems of collective action that humans have faced throughout their evolutionary history, including cooperative hunting, food sharing, defense, and warfare. When faced with the conditions of collective action, the incentive to falsely claim that one will cooperate is especially high since individuals can achieve their greatest gains by refraining from cooperation when others cooperate. Although everyone may gain if all group members invest in the cooperative goal, attaining such large-scale cooperation is often difficult to achieve without social mechanisms limiting the potential to free-ride on the efforts of others (Olson 1965; Dawes 1980). Therefore, whenever an individual can achieve net benefits from defection, the only credible signals of cooperative intentions are those that are “costly-to-fake.” If commitment signals are not costly-to-fake, they can easily be imitated by free-riders who do not intend to invest in the cooperative pursuit. The costly signaling theory of ritual posits that religious behaviors or rituals are costly-to-fake signals that advertise an individual’s level of commitment to a religious group. Preferred signalers are those who are highly committed to the goals and ideals of the group and are thus likely to be cooperators.

Observers of religion have long noted the costliness of religious obligations. For example, many populations require males and females to undergo initiation rites that include beatings, genital mutilations, exposure to extreme temperatures, tattooing, isolation, food and water deprivation, consumption of toxic substances, and death threats (e.g., Tuzin 1982; Whiting et al. 1958; Young 1965). In literate societies, religious legal codes (e.g., Laws of Manu, Talmud, etc.) outlining appropriate behavior tend to be formalized and regulate a wide range of activities including food consumption, work, charitable commitments, and dress, as well as defining the frequency and structure of ritual ceremony and prayer. Although there may be physical or mental health benefits associated with some ritual practices (see Levin 1994; Reynolds and Tanner 1995), the significant time, energy, and material costs involved in imitating such behavior may serve as an effective deterrent for anyone who does not accept the teachings of a particular religion. Therefore, religions often maintain intra-group solidarity by requiring costly behavioral patterns of group members. The performance of these costly behaviors signals commitment and loyalty to the group and the beliefs of its members. Thus, trust is enhanced among group members and they are able to minimize costly monitoring mechanisms that are otherwise necessary to overcome free-rider problems that typically plague collective pursuits.
The performance of religious obligations may be differentially costly for performers if they have varying opportunity costs, such as potential economic gains that would be limited if stigmatized by religious requirements. Sosis (in press) has argued that even when the performance of rituals is not differentially costly, believers are likely to perceive the costs of ritual performance to be less than nonbelievers, or perceive the benefits to be greater, for example, by attaining a pleasant afterlife. Only believers perceive net gains of ritual performance and therefore pay these short-term costs in order to achieve the long-term benefits offered by religious communities. Their willingness to perform costly religious behaviors is thus a reliable signal of their beliefs and commitment to the group.

By way of example, consider Ensminger’s (1997) argument that the spread of Islam throughout Africa resulted from the economic advantages of religious conversion. Ensminger claims “Islam was a powerful ideology with built-in sanctions which contributed to considerable self-enforcement of contracts. True believers had a non-material interest in holding to the terms of contracts even if the opportunity presented itself to shirk” (1997:8). In other words, by accepting supernatural sanctions, such as eternal hell, the short-term gains that could be achieved from defecting on a trade agreement were outweighed by the perceived costs. Consequently, believers were considered trustworthy trading partners enabling Muslims to overcome the collective action problems of long distance commerce. Conversion to Islam increased trust among traders, which reduced transaction costs making trade more profitable. In addition, high levels of trust among Muslim coreligionists allowed for greater credit to be extended facilitating further trade expansion. Ensminger contends that the steep initiation costs of entry into Islam, such as daily prayer, abstaining from alcohol, fasting during Ramadan, and the pilgrimage to Mecca, served as the means for establishing a reputation among traders for trustworthiness. These rituals and taboos functioned as costly signals of commitment that prevented free-riders from achieving the benefits of more efficient trade.

Over the past few years Sosis and colleagues have conducted various studies on religious and secular communes in order to empirically evaluate the costly signaling theory of ritual. Since the economic success and thus survival of communal societies is dependent upon solving the collective action problem posed by cooperative labor, they offer an opportunity to directly assess religion’s influence on intra-group cooperation. Results of this research have been largely supportive of the costly signaling theory of religion (see Box 1 & 2), although some findings
suggest the need for additional theoretical development. As is shown in Box 1, it is clear that costly constraints positively impact religious commune longevity, suggesting that increases in the level of sacrifice imposed on members enhances group-commitment. However, it is equally apparent that costly signaling has no effect on secular commune longevity.

Yet, common experience suggests that costly secular rituals can promote cooperation and intra-group commitment. Pledges undergoing a fraternity hell week and recruits in a military boot camp offer two clear examples. Moreover, numerous animal species engage in non-religious ritual behaviors that appear to enhance trust and cooperation. For example, Watanabe and Smuts (1999) recently argued that greetings among male olive baboons are a ritual that signals trust and commitment among former rivals. If baboons and fraternity pledges are able to establish trust through fairly simple ritualized interactions, why is it necessary for human religious rituals to be so mysterious, elaborate, and infused with supernatural elements?

WHY SACRIFICES ARE SACRED: THE NEUROPSYCHOLOGY OF RITUAL

Imbuing rituals with sanctity seems to be critical for their success in promoting long-term solidarity. As Rappaport states: “…to invest social conventions with sanctity is to hide their arbitrariness in a cloak of seeming necessity” (Rappaport 1971:36). Although secular rituals can generate a sense of community and obligation toward group members, the bonds forged through secular ritual do not appear to create the long-term trust and commitment achieved by religious ritual. In explaining the reasons for this difference, Rappaport has argued that religious ritual provides more stable referents than those of secular rituals because religious rituals sanctify unfalsifiable postulates that are beyond the vicissitudes of examination. Steadman and Palmer (1995; Steadman 1994) also maintain that performing religious rituals is *de facto* accepting a claim that cannot be verified, namely the untestable cosmological justifications for the structure and necessity of performing the ritual itself. Rappaport claims that since religious beliefs and behaviors cannot be verified logically, adherents verify them “emotionally” through the “religious experience” (James 1961 [1902]; Otto 1959), the truth of which “seems to the communicant to be sufficiently demonstrated by its mere occurrence” (Rappaport 1971:31). This ability of religious ritual to evoke such an experience differentiates it from both animal and secular ritual and lies at the heart of its efficacy in promoting and maintaining long-term group cooperation and commitment (Sosis and Bressler in press).
Over the past several decades a growing body of research on the neurophysiological correlates of religious ritual has emerged. Initial studies focused on the psychological and physiological changes associated with differing types of altered states of consciousness and included examination of the physiological effects of various ritual behaviors (see Winkelman 1986 for a review). This research demonstrated that rhythmic drivers, such as singing, dancing, and ritualized speech -- behaviors noted by Bloch to be “distinguishing marks of ritual” (1989:21) -- were found to have significant impacts on brain wave patterns and autonomic nervous system functioning (Gellhorn and Kiely 1972; Lex 1979; Mandel 1980; Neher 1962; Walter and Walter 1949). Subsequent studies corroborated these findings and demonstrated selective involvement of specific brain cortices and nuclei in conjunction with religious cognition and behavior (Austin 1998; Bear 1979; Bear and Benson 1981; D’Aquili 1975, 1978, 1979, 1982, 1983, 1985; D’Aquili and Newberg 1993, 1999, 2000; Davidson 1976; Geschwind 1979; Kasamutsu and Harai 1966; MacLean et al. 1997; Newberg et al. 2001; Saver and Rabin 1997; Wallace and Benson 1980). Predominant among these are: (1) the hypothalamus, which controls autonomic nervous system responses; (2) the amygdala and cingulate cortex, which activate and regulate affective responses; (3) the hippocampus, which encodes episodic memory; (4) the temporal lobe, which is specialized for the analysis of both auditory and visual information (Kolb and Whishaw 1996); and (5) the prefrontal cortex, which is critical in the conditioned association of both internal and external stimuli with affective valencing and “plays a major and specific role in response to selection processes” (Robbins 1998:128).

Specific components of religious ritual selectively activate these various brain areas. In contrast to secular ritual, the exaggerated formality, binary oppositions (e.g., sacred/profane), and incongruent inversions that typify religious ritual (Boyer 2001; Rappaport 1999) engage the “alerting” systems of the brain, thereby eliciting arousal and focusing attention. The non-semantic elements of religious ritual, including chanting, singing, and dancing induce autonomic responses, thereby evoking emotional states (Damasio 1994, 1998). While semantic language centers are predominantly located in the brain’s left hemisphere, speech processing of prosody and tone for emotional content constitute right hemisphere functions, as does musical processing (Blonder and Heilman 1991; Borod 1992; Cardinal et al. 2002; Damasio 1994; Ley and Bryden 1979, 1982; Newberg et al. 2001; Wittling and Roschmann 1993). Additionally, both metaphorical understanding (as in myth), and gestalt cognition (implicit in the paradigm shifts of
revitalization movements), constitute predominantly right hemisphere tasks (Dolan 2000; Gazzaniga and LeDoux 1996; Kolb and Whishaw 1996). By shifting relevant stimuli from left to right hemispheres, religious ritual engages unconscious emotional processes involved in both perception and social judgment (Adolphs et al. 1998; Morris et al. 1998).

Rappaport’s (1999) observation that religious ritual requires performance ensures that participants directly experience the somatic affects induced by the elements of ritual. The elicitation of these physiological states through religious ritual provides a means whereby specific stimuli can be emotionally valenced (Damasio 1994:156). Rites of passage that separate initiates from sources of security and expose them to novelty, danger, hunger, and pain are clear illustrations of this process. Such rites result in “a collection of changes in body state connected to particular mental images that have activated a specific brain system” (Damasio 1994:144). These “secondary emotions”, forged and weighted through the ritual process, impact subsequent individual social judgments and decision-making. Association of these emotions with sanctified symbolic stimuli, such as totems or flags, may provide a catalyst for emotionally anchored social solidarity.

Levenson has noted that emotions are critical in their ability to “alter attention, shift certain behaviors upward in response hierarchies, and activate relevant associative networks in memory” (1994:123). Since emotions are generated by the autonomic nervous system and are thus beyond voluntary control, they also provide honest signals of a sender’s physiological and motivational state. The ability of emotions to “rapidly organize the responses of different biological systems including facial expression, muscular tones, voice, autonomic nervous system activity, and endocrine activity” (Levenson 1994:123) ensures that emotionally motivated signals are both visible and reliable. Since such states are generated from limbic cortices that are out of conscious control, they cannot be “faked” (cf. Adams 2001). Ekman and others (1983, 1993, 2002) have shown that 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). As a result, facial expressions and body language generated by emotion differ from those under voluntary control (Damasio 1994; Darwin 1872; Ekman 1992, 2002; Frank 1988). The ability of religious ritual to elicit emotions makes it difficult for non-believers to imitate. As a result, ritual practices promote trust and commitment among adherents, thereby providing a foundation for cooperative group enterprises.
RITUAL HEALING THEORY

Religious rituals, like related symbolic systems of music, art, and language, are unique to humans. Although such rituals clearly share functional and evolutionary relationships with animal and secular rituals, they differ in a critically significant way. While animal and religious rituals evoke specific autonomic nervous system responses, only religious rituals intensify, entrain, and conditionally associate these responses with abstract stimuli. The ability of religious ritual to entrain participants, i.e., to elicit congruent autonomic states, ensures equivalent emotional valencing of stimuli associated with such states. This creation of “secondary emotions” (Damasio 1994; Russell 1991) and their conditioned association with abstract stimuli shifts triggering mechanisms from the indexical to the symbolic level. Various authors have noted the importance of this shift for the evolution of other symbolic systems, such as language (Deacon 1997; Rappaport 1999). What remains unclear, however, is how such symbolic entrainment could have initially benefited its practitioners.

McClenon (1997, 2002) offers an intriguing theory of the evolution of religion that relates directly to this question. He notes that ancestral primates undoubtedly used rudimentary rituals to alleviate social stress. Social grooming in non-human primates, as well as the ritualized hand gestures of hominoids (de Waal 2002) and the ritualized hand gestures of hominoids (de Waal 2002) and the chimpanzee “rain dance” described by Goodall (1986) all constitute such rituals. McClenon argues that hominids developed more complex rituals that produced therapeutic altered states of consciousness. He claims, citing Winkelman, that shamanic healing “was present in all regions of the world at some time in their hunting and gathering past” (Winkelman 1992:50). According to McClenon, those who were most suggestible in our evolutionary past would have benefited most from shamanic healing ceremonies, resulting in lower morbidity and mortality rates. Accepting the efficacy of shamanistic healing would have been particularly valuable to birthing mothers, thus directly contributing to reproductive success. He concludes that suggestibility and hypnotizability confer adaptive advantages on those who possess these traits.

McClenon’s theory integrates several critical features of religion and suggests a linkage between proximate neurophysiological mechanisms of religious ritual and evolutionary causation. First, it addresses what most believe to be the earliest form of religion, shamanism (Eliade 1956; Harner 1973; Shultes and Hoffman 1992; Winkelman 1992; 1997; 2000).
Although Irons (2002) has shown how Yanomamo shamanistic religion and beliefs can be understood as costly signals of commitment, the costly signaling theory of religion does not account for why shamanistic religion should focus on healing. Indeed, the second important contribution of the ritual healing theory is that it accounts for why religion is universally associated with health and healing practices. There is an extensive literature showing a negative relationship between religious practice and belief and morbidity and mortality rates (Ferraro and Albrecht-Jensen 1991; Francis and Kaldor 2002; Hummer et al. 1999; Levin 1994; Matthews et al. 1998; Murphy et al. 2000; Ross 1990; Strawbridge et al. 2001). The ritual healing theory of religion offers possible insights into this relationship. Frecska and Kulcsar (1986) have noted ritual’s ability to elicit endogeneous opioid peptides. Noting that such peptides decrease pain perception, enhance thermoregulation, affect immunocompetence, and impact symbiotic bonds, these authors propose both health and social benefits from ritual participation.

Although McClenon (2002) rejects social solidarity theories of religion, it is clear in his writings and in others (Howells 1993; Steadman and Palmer 1994; Turner 1964) that, in addition to their role as healers, shamans actively maintain social cohesion in their communities by solving disputes and easing tensions among conflicting parties. Shamans may actually gain the trust and commitment of community members through various costly practices such as sexual abstinence, accepting food taboos, and consumption of dangerous substances. The training and regular responsibilities of shamans are described in various ethnographies as physically demanding and challenging (Chagnon 1997; De Laguna 1972; Shirokogoroff 1935). A shaman’s willingness to make sacrifices and put himself at risk of attack (De Laguna 1972) may allow him to achieve the status of a fair arbiter unselfishly committed to the community. Of course, as Cronk (1994) notes concerning all religious leaders, shamans are also likely to manipulate conditions for their own self-interest and their activities may consequently diminish social cohesion. In some communities, such as the Washo (Siskin 1983) and Jivaro (Harner 1973), shamans are feared because it is believed that they can use their powers to harm others. In addition, shamanic contests occurring in various groups (e.g., Athapaskans, Kwakiutl, Tlingit) can be socially disruptive and result in the death of one or more shamans (De Laguna 1972; Siskin 1983).

COSTLY RITUALS AND INTERSEXUAL RELATIONS
Deacon (1997) has proposed an alternative evolutionary theory of religion that situates the origins of human religious ritual in our unique social structure. Observing that humans are the only pair-bonded primate with significant paternal investment to live in large multi-male groups (Rodseth et al. 1991), he notes that the inherent difficulty of maintaining pair-bonds when females are in close proximity to other potential mates probably accounts for its rarity across species. Deacon further argues that the risk of cuckoldry is compounded by the human foraging ecology: males cannot continually mate guard during periods of high female fertility because male and female resource acquisition often occurs separately. Deacon proposes that symbolic culture arose as a response to this dilemma in order to represent a social contract for which prior indexical communication (e.g., calls, display behaviors) was insufficient. He argues that rituals allowed a shift from indexical signs that connect abstractions with objects to signs that connect two abstractions. Religious ritual achieves this by inducing new “gestals” and binding abstractions through emotions. For example, marriage rituals link the abstraction of future behaviors regarding sexual fidelity to the community, and are sanctified through emotional associations. Deacon, similar to Rappaport (1999) and Burkett (1996), maintains that ritual is the foundation of the human social contract and enables the extensive reciprocal relationships that make human life, as we know it, possible.

Deacon’s hypothesis positing hominid pair bonding as the fundamental impetus to the evolution of religious ritual is necessarily speculative. Understanding how ritual is used as a commitment mechanism in intersexual relations, however, is an area of research that holds much promise. Spousal relationships, as noted by Deacon, face significant trust and free-rider problems. It should, therefore, not be surprising that religious rituals have emerged to signal female fidelity and commitment. The costliness of these rituals can range from the extreme pain and health hazards of genital mutilation ceremonies (Lightfoot-Klein 1989) to the more benign regular attendance of church, which in some communities is interpreted by males as a signal of fidelity (Irons 2001). Variance in severity may be explained by variance in both paternal investment expectations and relatedness among signalers. The few studies that have explored spousal commitment signals have found these signals to be reliable and honest. For example, Boster et al. (1999) have shown that Jewish priests (kohenim) exhibit the highest levels of paternity certainty recorded. Boster and colleagues attribute this to the laws of sexual purity
adhered to by Jewish women. Performance of these laws, such as attending a ritual bath (\textit{mikveh}), can be understood as a costly signal of commitment to sexual fidelity.

In one of the only observational studies on ritual behavior conducted by an evolutionary ecologist, Strassmann (1992) argues that menstrual taboos among the Dogon are an anticuckoldry strategy that males impose on females. By attending the menstrual hut females are signaling their reproductive status to their husbands. Since other women also attend the menstrual huts, including related kin of a menstruant’s husband, it is difficult for a woman to falsely signal the timing of her menstruation. Nonetheless, Strassmann notes that “the threat of supernatural sanctions is crucial for enforcement” (1992:126), a sentiment also shared by Dogon informants. These supernatural sanctions are apparently effective. Using hormonal data collected among 93 Dogon women, Strassmann (1996) demonstrates that visits to the menstrual huts are reliable signals of a female’s reproductive status; women attend the menstrual hut only when they are menstruating.

**IS RELIGION ADAPTIVE?**

Although here we have focused on adaptive explanations of religious behavior, various scholars have recently offered nonadaptive explanations for the origins of religion. Some authors have argued that while religion may have been adaptive in the environment in which it originally evolved, in novel environments it may be maladaptive (e.g., Roele 1993; Wenegrat 1990). Others maintain that religious beliefs are a byproduct of psychological mechanisms that were shaped by selective pressures to solve other ecological problems unrelated to religion (Barrett 2000; Boyer 2001; Gould 1991; Guthrie 1993; Kirkpatrick 1999; Mithen 1996, 1998; Pinker 1997). One basic point that seems to be lost in all of these discussions, however, is that traits are only adaptive with respect to a particular set of selective pressures (Reeves and Sherman 1993). Adaptationists study traits within specific ecological contexts and evaluate whether a current trait produces the highest reproductive success given the alternative strategies available. This has yet to be evaluated for any religious trait. Nor have researchers examined religions’ ability to respond to the selective pressures of diverse ecological contexts, which may explain its universality and endurance. Thus, it is premature to assume that religious behaviors are maladaptive because they are costly; indeed, costly signaling theory suggests that costliness may be a critical adaptive feature of religious behavior.
DIRECTIONS FOR THE FUTURE

This is an exciting time for the nascent field of evolutionary religious studies as there is much work to be done. Research that addresses the most basic adaptive questions is still desperately needed: What are the fitness benefits of a particular religious practice? How is such behavior related to life course events? How does this behavior contribute, if at all, to fitness maximizing goals? What are the ecological determinants that can explain the variation in this behavior within a population? And what are the ecological determinants that can explain the variation in this behavior across societies? At the moment we have little understanding of what costs and benefits are involved in the human investment in religious behavior, although empirical observational studies are beginning to address this gap in our knowledge.

Outside of academia, evolutionary studies of religion will be judged by their relevance to contemporary issues. Identifying the determinants of such phenomena as modern religious fundamentalism and its distribution across varying ecologies, as well as large-scale religious trends, such as the stability of religious belief and practice in the U.S. (Iannaccone 1998) and the significant decline of religiosity across Western Europe (Schühly and Mueller 1997), requires an understanding of both ultimate and proximate causes of religion. Anthropology must now focus on the short-term goals of data collection and rigorous evaluation of the many competing theories of religion. It is only through such work that the long-term goal of a comprehensive theory of religion capable of explaining origins, identifying the selective pressures that have shaped the capacity for religion in humans, and interpreting current intra- and inter-cultural variation in religious practices can be achieved.

ACKNOWLEDGEMENTS
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BOX 1
All communes inherently face collective problems that must be overcome if the community is to survive. Sosis (2000) argued that if religious practices foster commitment and loyalty among individuals who share those practices, then communes that were formed out of religious conviction should survive longer than communes that were motivated by secular ideologies, such as socialism. Using a dataset of two hundred 19th century U.S. communal societies, Sosis found a highly significant difference in the longevity of religious and secular communes (Figure 1; log rank T statistic = 40.14; df = 1; p < .00001). Logistic regression analyses showed that religious communes were about four times more likely to survive in every year of their life course than their secular counterparts (odds ratio = .255; p < .0001). Although these results suggested a strong relationship between a group’s religiosity and its ability to overcome the problems of collective action inherent in communal life, the analyses did not examine the impact of costly ritual requirements on this relationship. Sosis and Bressler (in press) predicted that those communes that required a higher number of costly rituals and taboos would more effectively deter free-riders and promote cooperation, and therefore survive longer than communes that had less demanding requirements. Using 37 secondary sources on 19th century communal life, they collected information on the number of constraints that eighty-three communes imposed on their members (30 religious, 53 secular). All data were collected using blind coding. The costly requirements and restrictions used in their analyses are listed in Table 1. They found that religious communes imposed more than twice as many costly requirements on their members as secular communes (religious mean = 7.0, n = 30; secular mean = 3.0, n = 53, t = 1.69, df = 36, p < .0001). Overall, number of costly requirements was positively correlated with commune longevity, after controlling for population size and revenue (F = 48.84, n = 83, p < .0001). However, further analyses showed that this effect only existed among religious communes (Figure 2); religious communes with more costly requirements survived longer than those that had fewer requirements (F = 16.42, n = 30, p < .001), whereas there was no relationship between costly requirements and secular commune longevity (F = 1.03, n = 53, p = .31).
Figure 1: Survivorship curves of 19th century U.S. secular and religious communes.
Table 1: Commune costly requirements

Figure 2: Religious and Secular Commune Duration by Number of Costly Requirements

\[ y = 4.1174x + 6.641 \]
\[ R^2 = 0.3697 \]

\[ y = -0.4992x + 9.2052 \]
\[ R^2 = 0.0198 \]
BOX 2

Costly signaling theory predicts that ritual performance will be designed to assure honest signals of commitment to the community, and thereby enhance intra-group cooperation. However, for signals to be useful they must be observable by the intended audience (e.g., Smith and Bird 2000; Sosis 2000b). One way to ensure this is for rituals to be performed collectively. In contrast, privately performed rituals are not expected to impact intra-group cooperation, as they appear to be a form of communication with oneself (Rappaport 1999; Sosis in press).

To evaluate whether collective ritual impacts prosocial behavior, Sosis and Ruffle (2002) conducted experiments on Israeli kibbutzim that were aimed at measuring individual cooperative decision-making. The kibbutz offers natural conditions to evaluate how variation in collective ritual performance impacts cooperative behavior since kibbutz members vary in their frequency of collective ritual performance. Members of religious kibbutzim engage in collective ritual much more frequently than members of secular kibbutzim, and within religious kibbutzim, males engage in collective ritual more frequently than females. Most notably, thrice daily communal prayer, which cumulatively lasts 1.5-2 hours, is a religious obligation only incumbent upon males.

Sosis and Ruffle designed an economic game that captured the notion of cooperation relevant to the social conditions of the kibbutz, whose members regularly face common-pool resource dilemmas such as the consumption of communal food, water, electricity, and the use of communal cars. The game involves two members from the same kibbutz who remain anonymous to each other during and after the experiment, and who make their decisions in the game independently of each other. Each player is told that there are 100 shekels (~25 U.S. dollars when the experiments were conducted) in an envelope to which both members have access. Each participant simultaneously decides how much of the 100 shekels to withdraw from the envelope and keep. If the sum of the requests to keep money exceeds 100 shekels, then neither member receives money and the game is over. If the total requests are less than or equal to 100 shekels, then each player keeps the amount he or she requested. In addition, the amount that remains in the envelope increases by 50% and this amount is divided in half and given to each participant. The amount of money taken out of the envelope provides a measure of a player’s cooperativeness. The more one cooperates by exhibiting self-restraint in one’s request, the greater the level of total resources available to be divided.
There are four main results shown in Table 2: 1) religious males remove significantly less from the envelope (i.e., exhibit higher levels of cooperation) than religious females, secular males, and secular females; 2) religious kibbutz members remove significantly less than secular kibbutz members; 3) religious male synagogue attendance is negatively correlated with amount removed from the envelope and largely accounts for the observed difference between religious and secular kibbutz members; and 4) religious males who did not attend synagogue daily and religious females do not claim significantly different amounts from the envelope. Overall, these results provide strong support for the thesis that a costly collective ritual, such as thrice daily communal prayer, can promote cooperation.
This table does not include the control variables used in the original analyses (for full results see Sosis and Ruffle 2002). In Column 1, three of the four subpopulations are represented with dummy variables, with religious males as the base category. Controlling for significant predictors (not shown), religious males take out approximately 5 shekels less than religious females, 11.8 shekels less than secular males, and 9.5 shekels less than secular females. The results in Column 2 indicate that religious kibbutzniks on average take out over 7 shekels less than secular kibbutz members. Column 3 shows that this is largely a result of males who attend synagogue regularly: when male synagogue attendance is included in the regression the religious dummy variable is only marginally significant, whereas the male synagogue attendance interaction term is highly significant. For each successive increase in synagogue attendance (from Sabbath and holidays only to several times per week to daily), males claim on average 2.25 shekels less from the envelope. Column 4 includes dummy variables for secular males and females while the religious male population is divided between those who attend synagogue daily and those who do not; religious females are the base category. Religious males who attend synagogue daily removed on average 6.4 shekels less than religious females, whereas there was no significant difference in the amounts claimed by religious females and those religious males who did not attend synagogue daily.

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<td>-2.25 (0.85)**</td>
<td>-6.43 (2.56)**</td>
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<td>4.78 (3.91)</td>
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</table>

n = 497 497 497 497
adjusted $R^2$ = 0.256 0.252 0.259 0.263

*p < .10
**p < .05
***p < .01
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