SCARS FOR WAR:

EVALUATING ALTERNATIVE SIGNALING EXPLANATIONS FOR CROSS-CULTURAL VARIANCE IN RITUAL COSTS

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ABSTRACT

While males in many societies endure traumatic and painful rites, in other societies male rites are mild or completely absent. To explain these cross-cultural differences, we use data collected from eHRAF to test two sets of hypotheses derived from signaling theory. If costly male rites serve to signal mate quality, they would be expected to correlate with the intensity of mating competition. If they serve to signal group commitments, they would be expected to be associated with the importance of overcoming problems of collective action. Our results support the latter set of hypotheses: males in societies that engage in warfare endure the costliest rites. Moreover, we show that who wars are fought against (within the cultural grouping or against other cultural groups) is an important determinant of whether or not male rites result in permanent visible marks, such as ritual scars. We argue that costly male rites emerge to signal commitment and promote solidarity among males who must organize for warfare.

Key words: cooperation, costly signaling theory, ritual, religion, warfare

Evolutionary researchers have increasingly turned their attention toward understanding the adaptive significance of religious beliefs and behaviors (for reviews see Bulbulia 2004a; Sosis and Alcorta 2003). One of the significant challenges these scholars face is explaining the willingness of religious adherents to perform acts that appear to entail significant somatic and reproductive costs. These costs seem particularly acute among male rites, which can include tortures such as repeated subincisions, skin-hangings, exposure to fire, and teeth pullings (e.g., Glucklich 2001; Tuzin 1982; Whiting et al. 1958). However, not all communities impose such demands on their boys and men; some are totally devoid of male rites and others may require nothing more than the acquisition of clandestine teachings (e.g., Eliade 1958; Young 1965). Why do societies vary so broadly in the ritual costs they inflict on their males and what are the determinants of this variance?

Several researchers have previously tested evolutionary hypotheses aimed at explaining the cross-cultural distribution of various initiation and puberty rites, including scarification and tattooing (Low 1979; Ludvico and Kurland 1995; Singh and Bronstad 1997). Motivated by the logic of sexual selection and Zahavian signaling theory (Hamilton and Zuk 1982; Zahavi 1975), these studies examined whether males and females use scarification as a form of mating competition in which performers signal their resistance to pathogens, willingness to endure pain, or overall genetic quality. Their results, however, are largely unsupportive or inconclusive suggesting the need to explore alternative explanations. We concur with these researchers that ritual is a form of communication, as others have also claimed (e.g., Leach 1976; Rappaport 1999; Wallace 1966). However, we argue that costly male rites do not serve to signal mate quality, but rather function to communicate group commitments.

Anthropologists have long maintained that one of the primary functions of ritual is the promotion of group solidarity (e.g., Douglas 1966; Durkheim 1995 [1915]; Radcliffe-Brown 1952; Turner 1995 [1969]; Rappaport 1999). Some researchers have argued that social bonding is not an end in itself but a means to facilitate intra-group cooperation. Indeed, Irons (2001) posits that the primary adaptive benefit of religious behavior is its ability to foster cooperation and overcome problems of collective action that humans have faced throughout their evolutionary history. He emphasizes that the costliness of ritual actions enables them to serve as honest signals of commitment to the group because only those who are committed to the group's beliefs and goals will be willing to incur the time, energetic, and opportunity costs of ritual performance. In other words, individuals pay the costs of ritual performance, but by doing so they demonstrate their commitment and loyalty to the group and can thus achieve a net benefit from successful collective action.

Building upon Irons's ideas and Cronk's (1994) original insights, several researchers have employed recent developments in costly signaling theory to explain the emergence and stability of ritual behavior under broad environmental circumstances (Bulbulia 2004b; Sosis 2003, 2004). To evaluate these arguments Sosis and colleagues (Sosis 2003; Sosis and Bressler 2003; Sosis and Ruffle 2003, 2004) examined the role of ritual behavior in overcoming the inherent collective action problems of cooperative labor that communal societies confront. Their results showed that the frequency of participation in costly ritual behavior was correlated with individual levels of cooperation, and among religious communes, commune longevity was correlated with the costliness of ritual demands. While these studies focused on how communities overcome the free-rider dilemmas surrounding cooperative resource acquisition and consumption, throughout our evolutionary history individuals have faced an array of other

collective action problems, most notably warfare and defense. Research has yet to untangle the relative importance of these various collective action problems in providing the ecological stimulus that favored the selection of costly ritual behavior. Nor has research begun to evaluate alternative signaling explanations of ritual behavior, namely whether rituals serve to advertise mate quality or intra-group commitment. Here we take the first step toward rectifying both of these deficiencies in the literature. In contrast to the pioneering studies by Low and colleagues (cited above), we focus solely on males and examine a broad spectrum of rituals that they perform across societies. We defer an analysis of female rites for future research because we assume that the determinants of ritual costs vary according to the ecological problems that rituals emerge to solve. Distinct mating strategies and gender roles in activities such as resource acquisition and inter-group conflict suggest that the salient ecological problems for males and females are likely to differ. Indeed, we argue that the primary impetus in the evolution of costly male ritual behavior is solving the collective action problems men confront when they attempt to organize for warfare.

WHAT DO MALE RITES SIGNAL?

Group Commitment

Bliege Bird and Smith (submitted) outline four necessary conditions for the evolutionary stability of a costly signal in a population: (1) there is within-group variance in some unobservable attribute; (2) observers can benefit from reliable information about this variance; (3) higher-quality signalers can benefit from accurately broadcasting this information, but lower-quality signalers have the potential to achieve benefits at the expense of recipients through deception; and (4) the cost or benefit to the signaler of sending the signal is correlated with the

signaler's quality. Sosis (2003) has argued that religious behaviors meet these conditions: (1) the intensity of religious beliefs varies within communities and this variance is unobservable; (2) individuals benefit from accurate information about this variance because intensity of belief is related to one's commitment to the group and its goals, committed members being more likely to be cooperators and thus preferred social interactants; (3) religious groups offer various benefits for members that are mutually provided and are at risk of exploitation by those not committed to group goals; and (4) the perceived cost or benefit of ritual performance, which can include payoffs received in an afterlife, is correlated with intensity of belief. Thus, religious behavior can be understood as a costly signal that reliably advertises the unobservable condition of religious belief and group commitment. The time, energetic, material, and opportunity costs of religious activity serve to deter those who lack sufficient belief from displaying the signal.

As Irons (2001) notes, if religious behaviors signal commitment to the group, individuals who have the greatest need to signal their group loyalties should be the ones who exhibit the highest intensity of ritual performance. Consequently, those groups composed of individuals who face the greatest risk of exploitation by free-riders, presumably because they offer substantial benefits for group members, should exhibit the highest levels of ritual costs. In other words, if facilitating cooperation is the general ecological problem that rituals emerge to solve, those groups that confront the most significant challenges of collective action (i.e., they are at considerable risk of exploitation by free-riders) will require the most demanding rituals of their community members in order to deter free-riders from exploiting the benefits of collective action.

If male rites serve to signal group commitment and enhance male solidarity, we would expect population size and genetic relatedness to independently impact the costliness of ritual

activities. Specifically, larger populations will face greater free-rider problems (Olson 1965) and they will therefore experience increased selective pressures favoring costlier rites that can deter free-riders. *Ceteris paribus*, we expect groups composed of related male kin, such as patrilocal societies, to have less pressure favoring costly male rites than communities composed of unrelated males. The impact of these variables on the costliness of male rites should be considerable regardless of the types of cooperative activities that males must pursue.

Irons (1996) mentions two primary categories of collective action problems that religious behaviors may have evolved to solve: resources and warfare. Cooperative hunting and concomitant band-wide food sharing pose widely recognized free-rider problems. Indeed, most anthropological research on food sharing has been aimed at explaining how groups overcome these problems (Gurven 2004). However, this literature has not examined the possibility that collective rituals might facilitate these activities by enhancing intra-group trust and commitment. If costly ritual actions promote cooperation, we may expect the costliness of male rites across societies to be correlated with the importance among males of cooperative resource acquisition and consumption.

Warfare and group-defense likely pose even greater free-rider problems than these collective activities. As Pinker notes, “A war party faces the problem of altruism par excellence. Every member has an incentive to cheat by keeping himself out of harm’s way and exposing others to greater risk” (1997:626). The ethnographic literature on warfare is replete with examples of men who defect en route to an attack or raid (e.g., Chagnon 1997). Each individual that defects on a warring party places the remaining members at greater risk of injury or death. Thus, when warfare is frequent within a society reliable signals of intra-group commitment, such as ritual performance, should be highly favored by selective mechanisms.

The types of rituals that will be favored as signals of commitment will depend upon the nature of warfare prevalent within a society. In societies in which internal warfare (fought within a cultural grouping) is common, communities continually fission and fuse; thus an enemy one day may be an ally the next (Ember and Ember 1992). Because of the mobility of individuals across kin groups and consequent shifting of alliances, individuals within communities that engage in frequent internal warfare should not be willing to submit to rituals that leave permanent markers, such as tattoos or scars, which can signal group identity. Such markers might hinder their ability to create or join new groups, or at least minimize their credibility amongst new group members. Warfare fought against other cultural groups, referred to as external warfare, poses an alternative problem. Groups engaged in external warfare are concerned about uniting unrelated males and fielding as large a combat unit as possible. However, when imbalances of power occur within a region, smaller groups are at risk of their members defecting to larger and more powerful groups. For these communities, permanent markers would serve to minimize the ability of men to abscond to another group.

Although all warfare is dangerous, we believe that external warfare ultimately poses greater risks than internal warfare. Internal warfare threatens the lives of individuals; external warfare threatens the continuation of one's entire kin-group and community. Because of the greater inclusive fitness costs associated with defection in external warfare, as well as the costliness of permanent markers, we expect external warfare to elicit costlier signals of commitment than internal warfare. Societies that engage in both internal and external warfare will face tradeoffs in the costliness of their commitment signals, especially their willingness to submit to permanent markers, and we therefore expect them to maintain rites at an intermediate level of costliness between societies with only external or internal warfare.

We summarize our discussion of male rites as signals of group commitment by suggesting the following hypotheses:

1. The costliness of a society's male rites will be positively correlated with community size.
2. Patrilocal societies will have less costly male rites than societies in which males reside among unrelated men.
3. The costliness of a society's male rites will be positively correlated with the importance of male cooperative resource acquisition.
4. The costliness of a society's male rites will be positively correlated with the frequency of warfare.
5. The type of warfare a society engages in will be a significant predictor of the costliness of male rites. Societies with external warfare only will have the costliest male rites, followed by societies with both external and internal warfare, then societies with internal warfare only, and societies without warfare will maintain the least costly male rites.
6. Societies with external warfare will require their males to bear more permanent markers than societies without external warfare.
7. Societies with internal warfare only will require their males to endure more non-permanent markers than societies without internal warfare only.

Mate Quality

As mentioned above, rather than signaling group commitment, male rites may serve to advertise mate quality. If we return to Bliege Bird and Smith's conditions for the evolutionary stability of a costly signal, it is clear that if ritual behaviors signal mate quality, or characteristics associated with mate quality, they also meet these necessary conditions. For example, consider

the argument that scarification or tattoos signal pathogen resistance: (1) males vary in their resistance to pathogens; (2) since this variance is likely to be heritable and impact survivorship females benefit from accurate knowledge about this variance; (3) males who have high pathogen resistance can increase their mating opportunities by accurately broadcasting this information, but men who are less resistant can benefit if they are able to deceive females about their level of resistance; and (4) the cost to males of exposing themselves to pathogens through ritual tattoos and lacerations is correlated with their resistance to pathogens. Alternatively, male rites may also be signaling ability to endure pain, attractiveness, or overall genetic quality.

If male rites signal mate quality we expect the intensity of these rites to increase as the competition for mates increases. Societies that permit polygyny offer males greater potential reproductive success than monogamous societies and consequently there is greater competition for female parental investment. In stratified polygynous societies, this competition will be manifested in resource displays and wealthy males are likely to out-compete poorer males. However, in non-stratified polygynous societies, where males do not compete through resource competition, ritual signaling is likely to be a more important mechanism to communicate mate quality.

These arguments suggest the following hypotheses:

1. Males in polygynous societies will perform costlier male rites than males in non-polygynous societies.
2. Males in non-stratified polygynous societies will perform costlier male rites than males in polygynous stratified societies.

METHODS

To examine variation in the costs of male rites we used the Probability Sample File found in eHRAF, the web-based version of the Human Relations Area Files. The database, which contains ethnographic literature on 60 societies, is designed to offer a broad temporal and geographic sample of world cultures that controls for cultural contact between societies (Ember and Ember 1998).

Sixteen undergraduate anthropology majors at the University of Connecticut were recruited to collect data on male ritual behavior. They were randomly assigned cultures from eHRAF and instructed to read the appropriate ethnographic literature on each society to determine the presence or absence of 19 male rites, including tattooing, scarification, piercing, circumcision, subincision, teeth pulling, body painting, and learning secret knowledge. We did not limit data collection to puberty or initiation rites; students documented all rituals that were exclusively performed by males. All students were blind to the hypotheses being tested.

From these data we wrote brief descriptions of the male rites performed in each society. We offer two examples of society descriptions representing the extreme ends of the costliness distribution:

Eastern Toraja: In this society, boys are subincised (a cut along the bottom of the penis) yearly beginning at 6 years old and ending at 15. Around age 12, boys are circumcised in a public ritual. Young boys have their ears pierced by their mothers. There is a public initiation rite into manhood where boys are cut on their arms, hands, and legs, as well as, burned on the torso and arms. Boys cannot show any pain during the public ceremonies. Men paint their bodies daily.

Pawnee: Men paint their faces in this society.

A panel of four graduate students rated each society description, assigning a score of 1 to the societies with the least costly rites and 4 to those societies whose males engage in the costliest rites (average Spearman $r = 0.72$). Graduate students were also blind to the hypotheses, as well as blind to the names of the societies they were rating. A composite score was calculated by summing the ratings of the graduate students and subtracting by three to produce a score ranging between 1 and 13 (mean = 7.38, SD = 4.86). The Eastern Toraja received the maximum composite score of 13 (all students rated as 4) and the Pawnee received the minimum composite score of 1 (all students rated as 1). Figure 1 presents the distribution of costliness rankings for the 60 societies in our sample.

Students also collected data on all of the independent variables employed in our analyses. All coding schemes, as well as variable transformations, are described in Table 1. To maintain consistency with other cross-cultural studies, we followed previously established coding schemes when available and cross-checked our data on those societies that appear in other standard cross-cultural samples. However, due to our small sample size and our lack of confidence about the ability of HRAF materials to accurately offer fine distinctions (e.g., whether war occurred once every year or once every two years), we tended to reduce our original data to binary variables.

The frequencies of external and internal warfare were coded for five levels following Ember and Ember (1992). For reasons discussed above data were collapsed to create variables for the presence and absence of internal and external warfare respectively. Data were also recorded on the time period during which the original author collected information on warfare and whether or not the rituals described in the files occurred during the same observation period.

Our descriptions of male ritual activity within each society describe the time period for which we have warfare data.

There are no previously established HRAF codes on cooperation during resource acquisition and production. In the only HRAF study on cooperative resource acquisition of which we are aware, Poggie (1995) examined the relationship between socialization for cooperation and resource periodicity. He argued that societies should socialize for cooperation when resource periodicity is high (primary resources available once per year) because high levels of cooperation will be required. We followed Poggie's coding schema for socialization for cooperation and resource periodicity. We assume that when resource acquisition and consumption are cooperative within a community, it will be important to instill values of cooperation among their young. While societies were coded for four levels of socialization for cooperation (following Poggie's schema), these codes were collapsed to create a dichotomous variable.

To test our hypotheses, we conducted ANOVAs with the costliness rating of each society as the dependent variable. The primary data used in our analyses are presented in Table 2.

RESULTS

Patrilocality and Community Size

Contrary to our expectation, non-patrilocal societies do not have costlier male rites than patrilocal societies ($N = 59$, $df = 1$, $F = 0.27$, $p = .61$).[1] As a related hypothesis, we examined whether patrilineal descent was associated with the costliness of male rituals, but also found no relationship ($N = 60$, $df = 1$, $F = 0.40$, $p = .53$). Figure 2 shows a non-significant negative trend

[1] In a few analyses N is less than 60 because some societies were not coded on the independent variable.

(opposite of our prediction) of the natural log of community size estimates in our sample and the costliness of male rites ($N = 60$, $df = 3$, $F = 1.25$, $p = .30$).

Socialization for Cooperation and Resource Periodicity

Neither socialization for cooperation ($N = 59$, $df = 1$, $F = 0.12$, $p = .73$) nor resource periodicity ($N = 60$, $df = 2$, $F = 1.75$, $p = .18$) are predictors of the costliness of male rites. Poggie (1995), however, seems to have incorrectly assumed that group-level periodicity would be associated with cooperation. Among foragers, although game is often available year-round (i.e., low periodicity), there is usually considerable variance in daily meat returns for individuals and concomitant high levels of cooperation to overcome this variance. Therefore, subsistence type may be a better proxy of cooperative resource acquisition and consumption than resource periodicity or socialization for cooperation. We assume that foragers maintain higher levels of cooperation than agriculturalists, pastoralists, and horticulturalists. Figure 3 shows that foragers exhibit much costlier ritual signals than non-foragers ($N = 60$, $df = 1$, $F = 6.63$, $p = .01$).

Warfare

Overall warfare frequency is the most significant predictor of ritual costs in our dataset ($N = 60$, $df = 1$, $F = 12.47$, $p < .001$; Figure 4). Not surprisingly, the costliness of male rites for societies in which warfare is present is significantly higher than societies without warfare ($N = 60$, $df = 1$, $F = 7.33$, $p = .009$); this relationship holds for both external warfare ($n = 43$, $df = 1$, $F = 11.49$, $p = .002$) and internal warfare ($n = 39$, $df = 1$, $F = 5.95$, $p = .02$). Figure 5 indicates a trend in the predicted direction: males in societies that engage in external warfare only perform the costliest rites, followed by societies that engage in external and internal warfare, internal

warfare only, and lastly no warfare (N = 60, df = 3, F = 5.36, p = .003). However, the differences between internal warfare only, internal and external warfare, and external warfare only are not significant. Table 3 shows that there is an interaction effect between internal and external warfare; when internal warfare is present the presence of external warfare does not impact the costliness of rituals.

We predicted that societies with external warfare would have costlier rites than societies with internal warfare because we expect permanent markers (which are assumed to be very costly) to be more prevalent among societies with external warfare and nonpermanent markers to be more prevalent among societies with internal warfare only. Our data offer four categories of permanent markers: genital mutilations (circumcisions and subinscisions), tattoos, scarifications, and piercings.[2] Figure 6 shows that with the exception of tattooing (which is in the predicted direction), these permanent markers are significantly more prevalent when external warfare is present in a society than when it is not. Our data offer three categories of nonpermanent markers, or specifically, ritual activity which does not leave a permanent visible result: body and face painting, ingestion of toxic substances, and periods of isolation. Figure 7 shows that all of these nonpermanent markers are more prevalent in societies that engage in internal warfare only, than those that do not.

Polygyny

Polygynous societies have costlier male rites than non-polygynous societies (N = 60, df = 1, F = 6.01, p = .017) and non-stratified societies have costlier male rites than stratified societies (N = 60, df = 1, F = 6.85, p = .011). There is no interaction effect between these variables (F =

[2] We did not include teeth pulling in the analysis because although the removal of teeth is permanent, those who did not witness the ritual would be unable to distinguish natural teeth loss from the ritual act. In addition, only five societies ritually pulled teeth.

.06, p = .81). Polygyny, however, does not remain a significant predictor of ritual costs when controlling for subsistence type (F = 1.03, p = .31) or overall warfare frequency (F = 1.60, p = .21). Social stratification remains significant when controlling for warfare (F = 10.26, p = .002) but not subsistence type (F = 0.76, p = .39).

DISCUSSION

Our results suggest that non-stratified foraging societies that engage in warfare maintain the costliest male rites. Moreover, the types of warfare in which communities engage influences the costs and variety of rituals performed. External warfare is associated with permanent markers, whereas internal warfare is associated with ritual activities that do not leave permanent visible signs. While polygynous groups exhibit costlier rites than non-polygynous groups, this relationship is not maintained when subsistence type or warfare frequency are included in the model, suggesting that male rites do not vary as a function of mating competition. Ember and Ember (1992) have shown that warfare frequency is a predictor of polygyny. Nonetheless, among polygynous societies in our sample warfare frequency remains a significant predictor of the costliness of male rites (n = 47, df = 1, F = 5.24, p = .027). Among non-polygynous societies high levels of warfare is also associated with costlier rites (average costliness rating 7.5 vs. 4.1; n = 13, z *two-tailed* = 1.96, p = .08).

Contrary to predictions derived from the costly signaling theory of ritual, patrilocality and community size are not significant predictors of variance in ritual costs. Small communities may actually have costlier rites than larger ones (F = 3.39, p = .07), although when controlling for overall warfare frequency this relationship is not significant (F = 1.52, p = .22). Future work will need to examine the relationship between ritual costs, community size, and political systems.

Societies such as nation-states and chiefdoms, which tend to have large community sizes, can coerce participation in warfare or other collective activities through legitimate punishment threats, such as imprisonment. Contrary to our original prediction, because these communities can impose negative consequences on defectors they should be less dependent on ritual signs of commitment than small egalitarian societies.

Socialization for cooperation and resource periodicity were also not significant predictors of variance in ritual costs. However, foragers exhibit costlier rites than non-foragers, even controlling for overall warfare frequency ($F = 3.27$; $p = .07$). Future work will need to collect cross-cultural data on the extent of cooperation during resource acquisition and production to determine whether ritual costs are related to levels of cooperation. Nonetheless, we do not expect collective foraging and food sharing to require the same intensity of ritual signaling as warfare since an alternative mechanism, namely reciprocity, is generally employed to prevent free-riders from accruing long-term benefits. In contrast, the life and death stakes men face during each act of warfare or defense demands a commitment mechanism, such as costly rituals, that does not solely rely on expectations of future cooperation.

We believe that costly male rites are an adaptive response that emerges among warring communities to reduce free-riding and promote cooperation during warfare. However, our analyses cannot entirely eliminate alternative hypotheses, and indeed, it would be imprudent to assume that one causal variable is responsible for a set of behaviors as complex as religious ritual. Even if warfare is the primary impetus for the emergence of costly male rites, the solidarity achieved through ritual actions may also impact other collective endeavors. Likewise, although our results did not support the hypothesis that costly male rites serve to signal mate

quality, male rites may be one of the many arenas in which females evaluate males even if this is not their main function.

We interpret the relationship between ritual costs and warfare in our data as support for the claim that free-riding during warfare is the foremost collective action problem that costly male rites emerge to cope with. However, it alternatively could be argued that male ritual violence is actually a cause, rather than a consequence, of warfare. In other words, rather than a mechanism to create male solidarity, ritual violence during childhood produces violent men, and one manifestation of this violence is warfare. In several cross-cultural studies, Chick and colleagues (Chick et al. 1997; Chick and Loy 2001) found an association between socialization for aggressiveness, including combative sports, and warfare frequency, although no causal relationship could be determined in these studies either. One limitation of this argument, however, is that it cannot account for the relationships we predicted and found between external warfare and permanent ritual markers and internal warfare and rituals that do not leave permanent visible marks. Future work should aim to distinguish between these causal interpretations, possibly exploring whether ritual costs are correlated with the frequency of male intra-group violence against women or other men, as would be expected if ritual violence engenders aggressive men.

This discussion raises an additional question: If ritual violence is not a cause of warfare (but the converse, as we believe), why are male rites so violent? Rituals can require time, energy, and materials costs; yet in addition to these costs male rites are often physically and psychologically painful. To appreciate why male rites are frequently traumatic we need to understand the proximate mechanisms that underpin these behaviors. Anthropologists have long recognized ritual's ability to create strong emotional bonds between individuals (e.g., Durkheim

[1912] 1995). As we and others have argued, rituals are also a form of communication that signal commitments (Irons 2001; Paige and Paige 1981; Rappaport 1999). Less attention, however, has been given to the relationship between these two functions of ritual. The efficacy of rituals as honest and reliable signals is partially a consequence of the emotional experience of performers that simultaneously creates strong social bonds and imbues symbols with meaning (Alcorta and Sosis submitted; Sosis and Alcorta in press). Ritual costs without compelling emotional commitments appear to be ineffective at facilitating sustained cooperation (e.g., Sosis and Bressler 2003); however, not all emotional commitments are equally effective at engendering trust and cohesiveness.

Rituals elicit both positive and negative affective responses. There is a wide literature testifying to the sense of unity ritual performers achieve through music, dance, chanting, and drug use (e.g., Dobkin de Rios 1990; Huron 2001; Juslin and Sloboda 2001). In contrast to the positive affect induced by ecstatic religious ritual, the male rites described in our data evoke intense negative affective responses, including fear, pain, and awe. The neuropsychological impacts of these different ritual forms offer some insight as to why male initiation, puberty, and other rites are emotionally startling rather than pleasing. By triggering neurophysiological responses related to fear and danger, male rites create a powerful and indelible neurophysiological substrate for the emotional conditioning of religious symbols (Alcorta and Sosis submitted). Increased activation of the amygdala through fear, pain, and alterations in body state, can result in the conditioned association of arbitrary stimuli with heightened emotional significance (Bear et al. 1981; Damasio 1994; Geschwind 1979). Through frightening and painful rites, religious symbols can acquire deep emotional significance that subsequently unite individuals who shared the experience. Interestingly, the ability of such amygdala conditioned

symbols to motivate individual behaviors derives not from positive, but from negative emotional learning, which may explain why cultures have repeatedly created and maintained such traumatic rites. The emotional impact of these rites, many of which occur during critical developmental stages, have profound long-term effects on memory and are motivationally powerful (Alcorta and Sosis submitted; Whitehouse 2000). It is possible that the superior ability of traumatic rituals to create enduring emotional bonds explains why, in contrast to positive-affect rituals such as dancing and meditation, individuals do not perform them repeatedly throughout the life course. Alcorta and Sosis (submitted) argue that the association formed via ritual performance between emotions and abstract religious symbols enables individuals to extend communication and coordinate collective action across space and time. These emotions are honest indicators enabling ritual participation to be a reliable, difficult-to-fake signal of group commitment. Our data suggest that the importance of such signals is a function of the prevalence of warfare within a society. We believe this relationship exists because costly rituals generate strong emotional bonds of solidarity between men and serve as reliable indicators of group commitment, thus reducing the likelihood that men will defect when the necessity of war arises.

CONCLUSION

This study is a modest step toward understanding cross-cultural variance in the costs of male ritual behavior. Future work will of course need to extend these analyses to female ritual behavior, which we suspect often signals commitments to mates rather than the larger group (e.g., Boster et al. n.d.). In addition, evolutionary research on religion must further examine how individuals weigh various ritual costs across currencies, a problem that has also arisen in other tests of the costly signaling theory of ritual (e.g., Sosis and Bressler 2003). It is unclear, for

example, how individuals determine how much costlier a ritual back scar is than a week of isolation or a day of fasting. Here we used judgments of graduate students who had not performed the rituals they were asked to rate, but ideally we need to evaluate how ritual performers and non-performers differ in their judgments about ritual costs, which will offer insights into the proximate psychology of ritual behavior (Sosis 2003).

Religious behavior has often been cited as a cause of warfare; here we have explored the converse, that warfare can be a determinant of extreme religious behavior. We caution readers about applying our results to understand current geopolitical trends and the complex relationship between religious fundamentalism and warfare. We do believe that costly signaling theory can provide insights into the rise of religious fundamentalism (Sosis 2003) and its association with warfare, terrorism, and militia movements, but we are not claiming that warfare is a determinant of contemporary fundamentalism. We would argue, however, that the cooperation and intra-group trust achieved through costly ritual behavior enhances the ability of religious groups to organize for acts of terror and war (see Berman n.d.). By understanding how religion interrelates with both cooperation and warfare, we hope we can learn how to promote the former, while discovering how to avoid the latter.

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Figure 1: Frequency distribution of cost ratings (N=60)

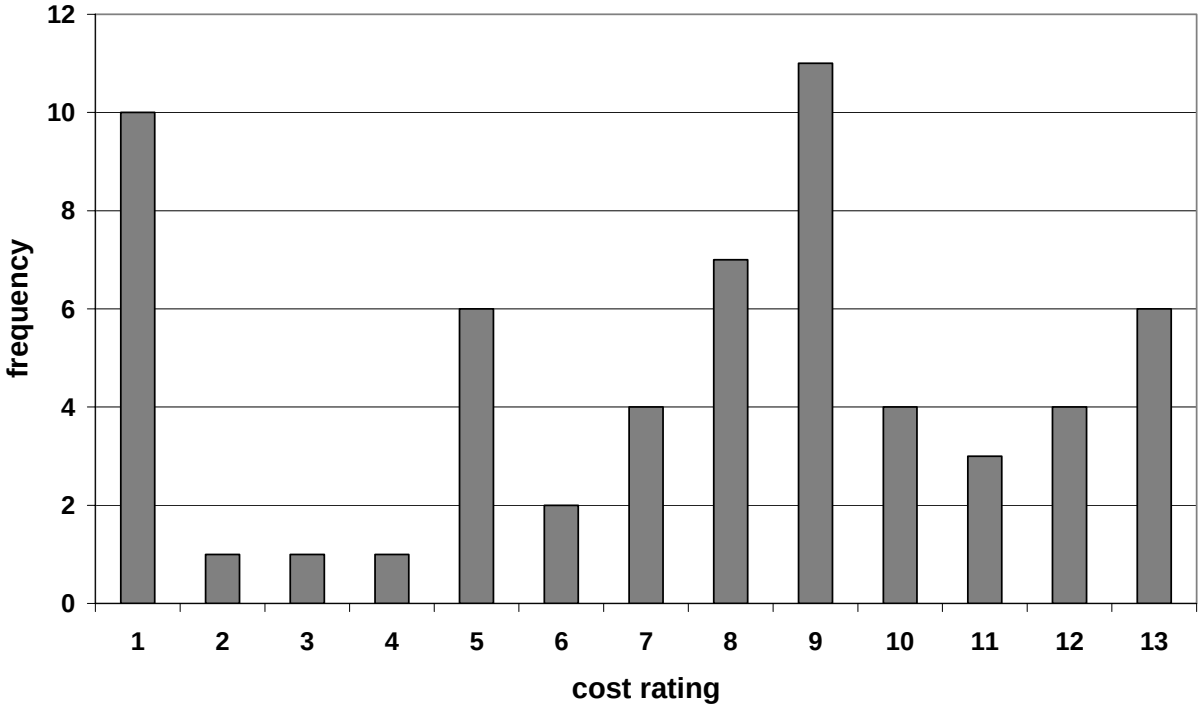

Figure 2: Cost ratings by natural log of community size
(F = 1.25, df = 3, p = .30)

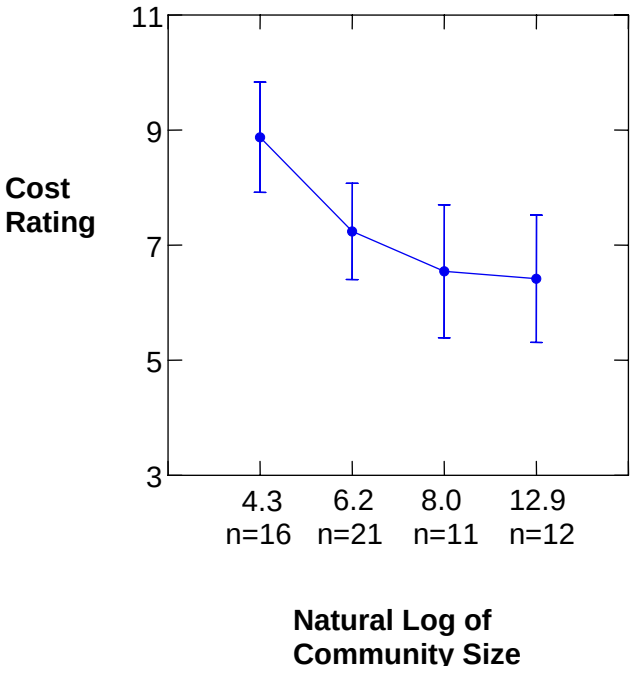

Figure 3: Cost ratings by subsistence type
(F = 6.63, df = 1, p = .013)

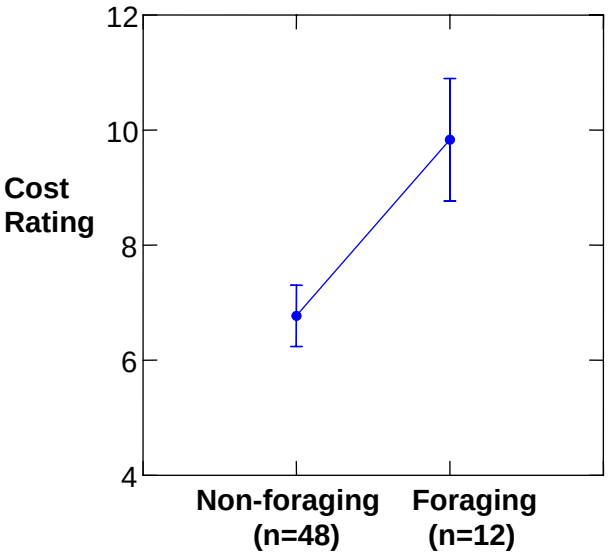

Figure 4: Cost ratings by overall warfare frequency
(F = 12.45, df =1, p<.001)

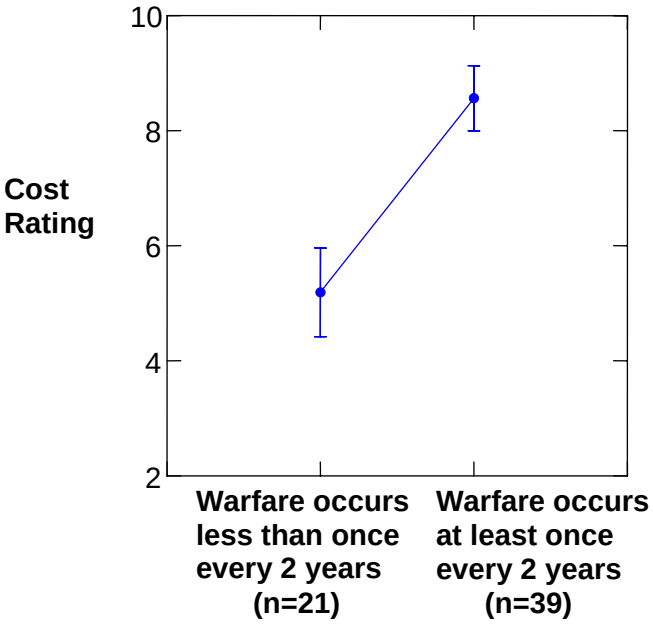

Figure 5: Cost ratings by type of warfare

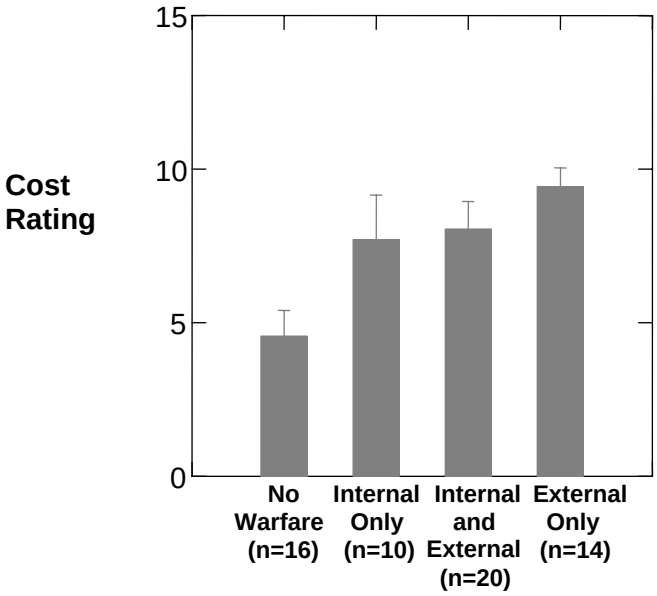

Figure 6: Frequencies of permanent markers by presence and absence of external warfare

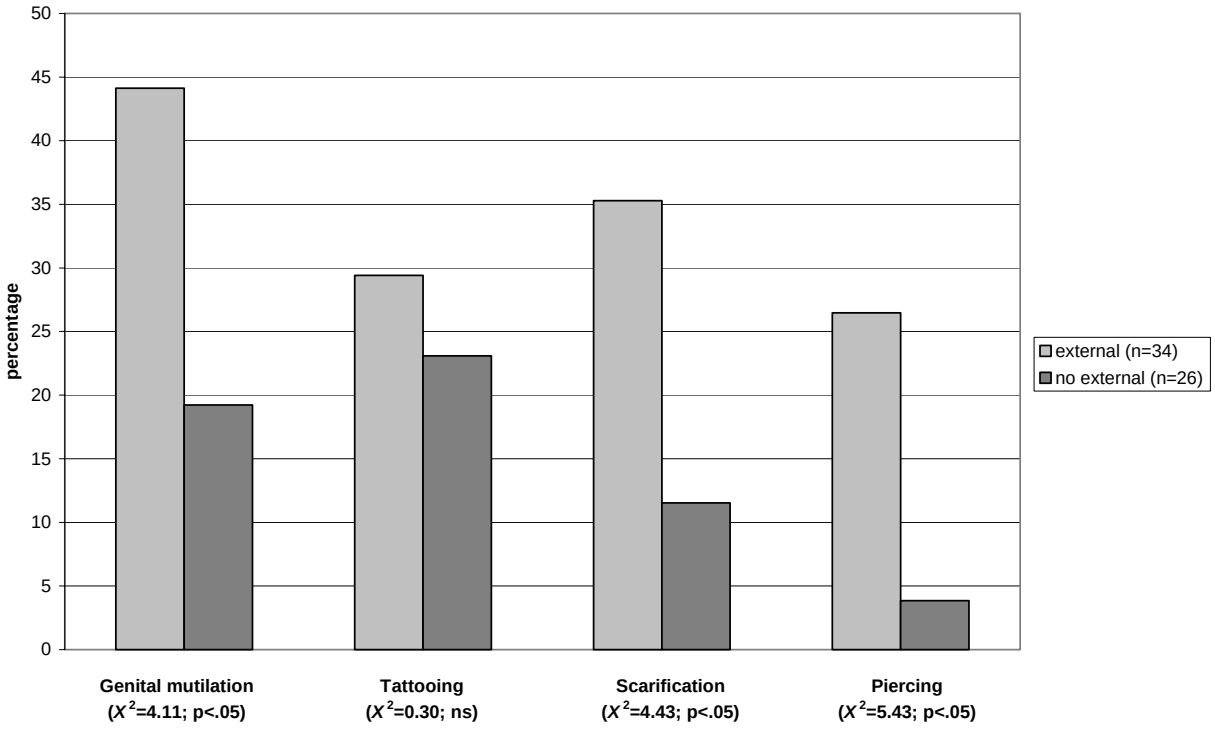

Figure 7: Frequencies of nonpermanent rites by presence and absence of internal warfare

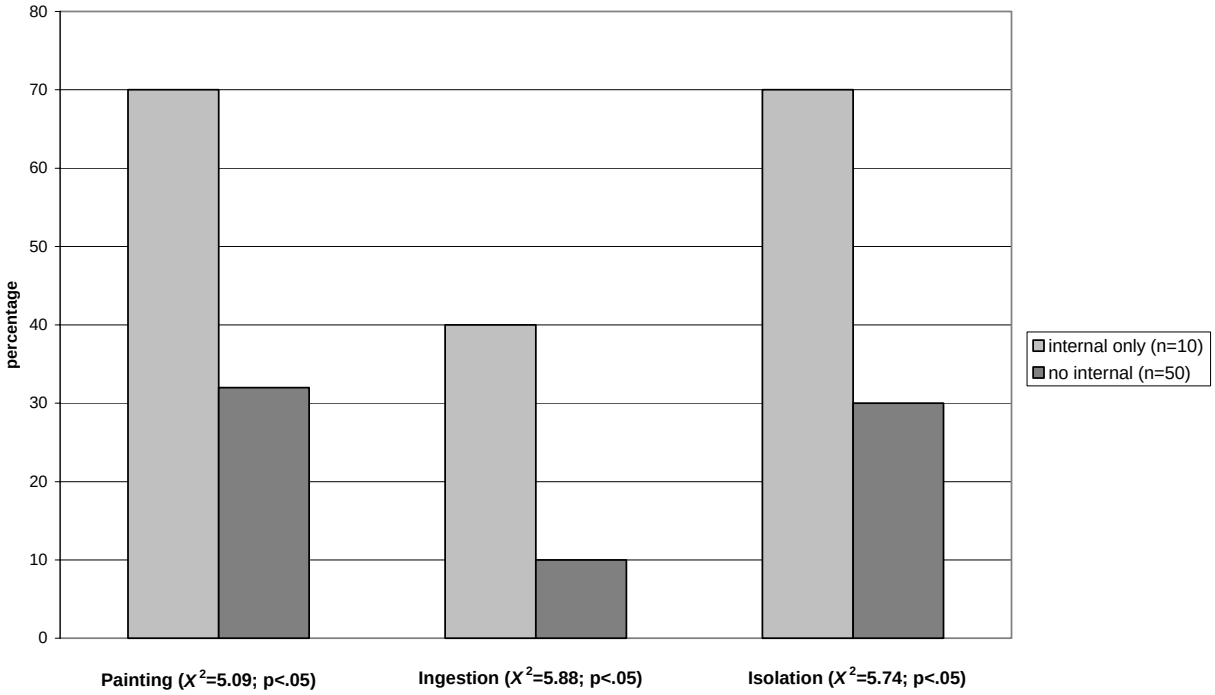

Table 1: Coding Schema for Independent Variables

Independent Variable	*Coding Schema*	*Analyses*
Overall frequency of warfare	1 = rare or absent 2 = warfare seems to occur once every 3 to 10 years 3 = warfare seems to occur once every 2 years 4 = occurs at least once a year 5 = constant warfare	0 = if categories 1 or 2 1 = if categories 3, 4, or 5
Frequency of external warfare	1 = rare or absent 2 = warfare seems to occur once every 3 to 10 years 3 = warfare seems to occur once every 2 years 4 = occurs at least once a year 5 = constant external warfare	0 = warfare absent 1 = warfare present
Frequency of internal warfare	1= rare or absent 2= warfare seems to occur once every 3 to 10 years 3= warfare seems to occur once every 2 years 4= occurs at least once a year 5= constant internal warfare	0 = warfare absent 1 = warfare present
Periodicity of resources	1 = low or none (supply equal throughout the year) 2 = intermediate (two or several periods of supply) 3 = high (esssential part of supply in one period year)	
Socialization for cooperation	1 = socialization mentioned but cooperation not mentioned 2 = cooperation mentioned as part of a suite of socialization values 3 = cooperation is discussed as the most important of values 4 = cooperation is clearly identified as the primary social value	0 = if categories 1 or 2 1 = if categories 3 or 4
Subsistence type	1 = foraging 2 = horticulture 3 = pastoral 4 = agriculture	0 = non-foraging 1 = foraging
Polygyny	0 = polygyny absent 1 = polygyny present	
Social stratification	0 = social stratification absent 1 = social stratification present	
Residence patttern	1 = patrilocal 2 = matrilocal 3 = ambilocal 4 = avunculocal 5 = neolocal 6 = matrilocal-neolocal 7 = ambilocal or neolocal 8 = patrilocal-neolocal	0 = if categories 2-7 1 = if categories 1 or 8
Descent pattern	1 = patrilineal 2 = matrilineal 3 = ambilineal 4 = bilateral	0 = if categories 2-4 1 = if category 1
Community size	1 = <50 2 = <100 3 = <200 4 = <400 5 = <1000 6 = <5000 7 = <50,000 8 = >50,000	1 = <200 2 = <1000 3 = <5000 4 = >5000

Table 2: Data for Primary Variables in Analyses*

Society	*Community Size*	*Residence Pattern*	*Resource Periodicity*	*Socialization for Cooperation*	*Susistence Type*	*Polygyny*	*Social Stratification*	*Overall Warfare Frequency*	*Cost Rating*
Akan	2	0	2	1	1	1	1	1	7
Amhara	2	1	2	1	0	0	1	1	7
Andamans	1	0	1	1	1	0	0	1	11
Aranda	1	0	1	1	1	1	0	1	12
Aymara	3	1	2	1	0	1	0	1	5
Azande	2	.	1	.	0	1	1	1	9
Bahia Brazil	4	1	1	1	0	0	1	0	1
Bemba	2	0	2	2	0	1	0	0	7
Blackfoot	1	0	3	3	1	1	0	1	13
Bororo	1	0	1	2	1	1	0	1	11
Central Thai	4	0	3	4	0	1	1	0	1
Chukchee	1	1	1	2	1	1	0	0	9
Chuuk	2	0	3	4	0	1	0	0	7
Copper Inuit	1	0	3	3	1	1	0	0	1
Dogon	2	1	2	2	0	1	1	1	8
Eastern Tora	2	1	3	3	0	1	1	1	13
Ganda	2	1	2	1	0	1	1	1	1
Garo	2	0	2	2	0	0	0	0	9
Guarani	1	0	1	1	0	1	0	1	9
Hausa	4	1	2	1	0	1	1	1	11
Highland Scotts	4	0	1	1	0	0	1	0	1
Hopi	3	0	3	4	0	1	0	1	8
Iban	4	0	1	1	0	1	0	1	9
Ifugao	3	0	3	4	0	1	0	1	9
Iroqouis	3	0	3	4	0	1	1	1	5
Kanuri	4	0	3	2	0	1	1	1	12
Kapauku	2	1	1	1	0	1	0	1	9
Khasi	4	0	3	4	0	0	1	0	9
Klamath	1	1	3	4	0	1	0	1	12
Kogi	1	1	3	4	0	1	0	0	5
Korea	2	1	3	4	0	1	1	1	2
Kuna	3	0	2	4	0	0	0	0	1
Kurds	4	1	1	1	0	1	1	0	6
Lau Fijians	4	1	1	1	0	1	0	1	10
Lozi	3	0	2	3	0	1	1	1	8
Lybian Bedouins	1	1	2	2	0	1	0	1	6
Maasai	2	1	1	3	0	1	0	1	13
Mataco	1	0	2	4	1	0	0	0	9
Mbuti	1	1	1	4	1	1	0	1	10
Ojibwa	2	0	1	1	0	1	0	1	5
Ona	1	0	1	2	1	1	0	1	13
Pawnee	2	0	2	1	0	1	1	1	1
Saami	1	0	2	3	0	0	0	0	1
Santal	2	1	2	1	0	1	0	0	10
Saramka	2	1	1	1	0	1	0	0	9
Serbs	4	1	2	2	0	0	1	0	5
Shluh	3	1	3	4	0	1	1	1	5
Singhalese	3	0	3	4	0	1	1	0	1
Somali	3	0	1	3	0	1	0	1	8
Taiwan Hokki	4	1	3	3	0	0	1	1	4
Tarahumarans	2	0	1	1	0	1	0	0	3
Tikopia	3	1	2	2	0	1	1	1	9
Tiv	3	1	2	3	0	1	0	1	13
Tlingit	1	0	2	4	1	1	1	1	12
Trobriands	2	0	2	2	0	0	1	0	1
Tukano	1	1	1	1	0	1	0	1	8
Tzeltal	4	0	2	3	0	0	1	1	8
Wolof	2	1	3	4	0	1	1	1	8
Yakut	2	0	1	1	0	1	0	0	13
Yanoama	2	0	1	1	1	1	0	1	10

* See Table 1 for variable definitions

Table 3: ANOVA for External and Internal Warfare (n=60)

Independent Variable	*F-ratio*	*p value*
External	7.864	0.007
Internal	0.894	0.348
External * Internal	5.895	0.018