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The Origin of Religion as a Small-Scale Phenomenon

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INTRODUCTION

Religion has continued to remain one of the more difficult phenomena to explain in evolutionary terms, mainly because its ubiquitous association with conformism, altruism and self-sacrifice make it look suspiciously like a candidate for group selection. Since group selection (in the formal sense) is generally considered anathema within evolutionary biology (for generally correct reasons[1]), most evolutionary scientists have preferred to leave the topic to social scientists and instead assumed that its apparently maladapted features are by-products of the proximate mechanisms that underpin other evolutionary processes.

However, the recent revival of interest in multilevel selection opens up novel opportunities for understanding the evolutionary origins of religion within the standard Darwinian framework. Multilevel selection (or group-level selection, as opposed to group selection) recognizes that fitness benefits can sometimes accrue to individuals through group-level effects, rather than always being the direct product of the individual's own actions. Most of these cases involve cooperation in some form, with cooperative hunting perhaps representing the best-studied case. In cooperative hunting, individuals can bring down very much larger prey (e.g. buffalo) by acting together than any one individual can manage when acting alone (where an animal the size of a gazelle may be the effective limit) (Schaller 1968). As a result, each individual benefits by a much larger per capita share of meat from the kill.

Evolutionary analyses of cooperation have invariably focussed on dyadic relationships, and used a strictly economic perspective: individuals decide to cooperate with those who consistently reciprocate and do not defect. Such analyses presume that the benefits of cooperation derive directly from the two individuals interacting with each other (e.g. by trading resources). In some

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cases, however, the benefit of cooperation may derive from the existence of the group itself rather than the actions of any particular dyad within the group. An obvious example is the use of group size as a defence against predators, as is the case among primates (Dunbar 1988; Shultz et al. 2004; Dunbar and Shultz, 2007). This introduces a group-level process that requires the individual to be sensitive to the needs of the other members of the group. In effect, the relationships among the individuals involved amount to an implicit social contract, and social contracts of this kind require individuals to bear costs in terms of their immediate self-interest in order to gain disproportionately in the long term through cooperation: I have to allow my collaborators a fair share of the profits, otherwise they won't cooperate with me. Social contracts of this kind are particularly susceptible to freeriders who take the benefits of the contract but avoid paying all the costs. Freeriders destabilize social contracts and cause their breakdown (Enquist and Leimar 1993; Nettle and Dunbar 1997; Dunbar 1999).

Primates represent a specific case of these group-level effects because they form social groups that are essentially cooperative solutions to the problem of predation. To maintain cohesion in such groups, primates seem to have evolved an all but unique form of bonded sociality that allows groups to maintain cohesion and co-action through time (Shultz and Dunbar, 2007, 2010; Dunbar and Shultz, 2010). It seems that, during the course of primate evolution, there has been increasing pressure favoring the evolution of progressively larger groups within certain lineages. This has inevitably introduced strains that threaten to undermine social cohesion, and these thus require neutralizing if each individual is to benefit from the advantages of group-level cooperation (Dunbar 2010a). The evolution of unusually large communities (by primate standards) during the course of later human evolution exacerbated these effects. Exactly what the benefits of such large communities might have been for our lineage remains unclear. However, competition between (and raiding by) rival human groups and/or the opportunity to trade with other communities are obvious possibilities (Alexander 1989; Dunbar 1996).

The substantive issue facing species in this respect is how to manage freeriders who take the benefits of sociality but do not pay all the costs. Living in groups incurs ecological costs that increase with the size of the group: these include competition for food sources, harassment, increased day journey lengths, and additional time budgeting costs (Dunbar et al. 2009). Freeriding is disruptive because it loads the costs of the social contract onto some individuals while others get away with paying significantly less. As a result, those who have been exploited become less willing to support the social contract. In the absence of sufficient benefit to outweigh these costs, individuals will leave in order to be in smaller groups that incur fewer costs.

One way of ameliorating these costs is to detect and punish freeriders. There has been considerable interest in cognitive mechanisms both for monitoring

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social contract infringements (e.g. Cosmides 1989; Cosmides and Tooby 1992; Bateson et al. 2006) and for punishing offenders (Fehr and Gächter 2002; Fehr and Rockenbach 2003), especially in humans. At one level, these provide important mechanisms for discouraging freeriding. However, they inevitably work most effectively when community size is small: the time and cognitive costs of monitoring the behavior of very large numbers of individuals inevitably becomes prohibitive, and the advantages of doing so rapidly cease to be worthwhile (Sutcliffe et al. 2011). Enquist and Leimar (1993) used a modeling approach to show that freeriders are more successful (and easily eliminate co-operators) in large, dispersed populations where it is difficult to monitor the behavior of freeriders.

A second problem is that everyday experience suggests that the threat of punishment is most effective when the offender is a member of the punisher's immediate community: only if the punisher's action is backed up by the implicit threat of communal action does it pay the offender to accept being sanctioned. Communities will typically only back up the punisher when they know them personally (as has become painfully apparent in contemporary urbanized society). When this is not the case, it always pays the offender to challenge or ignore the punisher.[2] This is one reason why legal restrictions on behavior (e.g. prohibitions against poaching or breaking the speed limit) are so often flouted. Even when the sanction for breaking the law is draconian, the incentive to break the law will be high if the risk of being caught is low and the benefit sufficiently worthwhile (the problem known in conservation biology as the "Poacher's Dilemma" (Milner-Gulland and Leader-Williams 1992; Milner-Gulland 1993).

In fact, punishment is an inefficient mechanism for bonding large social groups, because there will always be an incentive to circumvent the costs imposed by the social contract. Psychologically, a more efficient mechanism would be to persuade everyone to sign up voluntarily to the communal project: individuals who are personally committed to the grand project will be more likely to adhere to the rules that underpin it, and the need for punishment will thus be redundant. This much is evidenced by the fact that, in an analysis of nineteenth-century American utopian religious (but not secular) communes, commune survival correlated with the number of things that individuals had to give up in order to be part of the commune: the more costly the commitment, the more willing aspirants were to stick with it (Sosis and Bressler 2003; Sosis and Alcorta 2003).

In this chapter, I shall suggest that religion arose as a mechanism to facilitate social cohesion in large communities in order to ensure that these communities provided the ecological benefits they were intended to provide. I shall argue that, precisely because religion evolved to bond very small scale communities, therein lie some of the tensions that we find in contemporary world religions.

THE SCALE OF THE PROBLEM

Primates bond their social groups through social grooming. Social grooming triggers the release of endorphins (Keverne et al. 1989), one of whose consequences is to create a psychopharmacological environment of trust that allows individuals to form alliances (Dunbar 2010a). Neuroscientists often interpret the function of endorphins as being reward (we keep grooming because we enjoy it), and it is undoubtedly true that endorphin activation is rewarding (they activate known reward centres in the brain such as the orbitofrontal cortex). However, this is to miss the real function of endorphins as part of the pain control system. It also fails to explain how we get from endorphins to reliable alliances: pleasurable reward per se is not sufficient to make us behave cooperatively—it is simply a recipe for encouraging us to seek out more grooming. Instead, the role of endorphins in social bonding seems to derive from the sense of relaxation and contentedness that their analgesic effects produce, and this in turn seems to facilitate the development of a relationship of trust between the groomer and the groomee (Dunbar 2010b; Machin and Dunbar 2011). Because grooming is reciprocated on a relatively rapid cycle (the typical duration of grooming bouts in monkeys is around five to six minutes, after which groomer and groomee switch roles, sometimes repeatedly), both parties experience a mutually reinforcing opiate effect.

The coalitions created by grooming buffer the individuals who engage in these exchanges against the principal costs of group-living (notably the harassment and small-scale disruptions to one's routine that arise in crowded situations) (Dunbar 2010a). By reducing the costs of group-living in this way, it is possible for primates to maintain the cohesion of large social groups and defuse forces that would otherwise inevitably result in the break-up and dispersal of social groups. However, the effectiveness with which grooming works to bond coalitions of this kind is ultimately limited both by the time available to invest in such relationships and by the fact that grooming is a one-on-one activity. For a relationship to work effectively, a minimum amount of time has to be devoted to it (Seyfarth 1978; Sutcliffe et al. 2011). Since, in primates, the amount of time spent grooming is a linear function of group size (Dunbar 1991; Lehmann et al. 2007), this ultimately imposes a limit on the size of groups that can be bonded in this way. Data from wild primates suggest that there is an upper limit of around 20 percent of total day time that can be devoted to social grooming in the face of other pressing ecological demands on animals' time (Dunbar 1991), and this places an upper limit on group size at about fifty to seventy animals.

Given that modern humans have a natural social group size of ∼150 (Dunbar 1992; Hill and Dunbar 2003; Zhou et al. 2005), the problem for hominins was the need to break through the grooming glass ceiling so as to be able to increase community size beyond the limit that it set. Part of the

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reason for social grooming's limitations in this respect is the fact that it is (and still remains even for us) a one-on-one activity. Data on activity budgets from a cross-cultural sample of contemporary human populations reveals that the average amount of time devoted to social activity each day is almost exactly 20 per cent (Dunbar 1998), the upper limit observed in other primates. It seems that we have not created additional social time, but instead have somehow managed to use the available time more efficiently.

There are a number of behavioral mechanisms that seem to have allowed us to break through this constraint on grooming time so as to allow social community size to increase beyond the limit imposed by grooming. Among the most important are laughter and music (Dunbar 2008). It turns out that these have the same endorphin-producing effects as social grooming (Dunbar et al. 2011, submitted). The key difference is that they can achieve this on a scale larger than the dyad. Laughter is, in effect, a form of social chorusing which has a very deep origin, reflecting the fact that it is a behavior we share with great apes, especially chimpanzees (Provine 1996; Davilla Ross et al. 2009). In pre-language hominins, laughter probably had more the form of social chorusing, perhaps similar to the kinds of chorusing seen in gelada baboons, a species of monkey that lives in unusually large social groups (Dunbar in press).

Nonetheless, laughter is probably a relatively small-scale phenomenon—much as chorusing is among the gelada. The contagiousness of relaxed social laughter is dependent on close physical proximity between the stimulus (i.e. the initiator of a bout of laughing) and the audience. Music allows a more extended audience effect, enabling a one/many contagion through timed synchrony among dancers (or singers) following a leader who sets the timing of moves (either in dance itself or through instrumental music). This seems to allow a radical widening of the social circle, enabling community cohesion to be effected on a wider scale. However, even in this case the scale remains modest, in that the dancers, singers, or musicians have to be able to see or hear the leader who is setting the pace. Notoriously, very large orchestras are difficult to coordinate, suggesting that there may be limits on the size of group that even this form of bonding mechanism can be used for.

Both of these mechanisms exploit the fact that physical activity imposes stress on the muscles, and this in turn triggers an endorphin response. In effect, we have learned how to trigger endorphin activation by exploiting behaviors that do not require direct physical contact. Removing the constraint of physical proximity means that we can increase the size of the effective broadcast group from the one–one of social grooming to a one–many scale. In effect, by "grooming" with several individuals simultaneously, we increase the amount of time spent grooming in a way that is directly proportional to the number of individuals involved in the broadcast group. While it seems intuitively obvious that both mechanisms have an upper limit on the size of group they can bond, we have little idea where these limits actually lie.

However, it seems plausible that this limit lies at groups in the tens rather than hundreds (Dunbar in press). My claim here that religion—and, especially, the rituals of religion—evolved because they allowed more individuals to take part in activities that were effective at triggering endorphin activation. Many of the rituals of religion (dancing, singing, adopting awkward postures for long periods during prayer, the explicit infliction of pain through flagellation and other practices) are extremely good activators of the endorphin system precisely because they impose stress or pain on the body (Dunbar 2004).

ORIGINS OF RELIGION

The earliest forms of religion were shamanistic (Kellett 1962; Eliade 1964, 1978). These are small-scale, personalized forms of religion that are directly experiential in nature (i.e. they typically involve "doing" something that is experienced, usually associated with trance states triggered by dancing and journeys in a spirit world), lack any formal theology (especially beliefs in gods that have absolute power over the fate of men), and are mainly associated with hunter-gatherer societies. Doctrinal, or world, religions are believed to have emerged later. These typically involve the existence of one or more gods, something more like a theology, formal ritual spaces (e.g. temples), ritual specialists (e.g. priests), and an emphasis on ritual practices (Eliade 1978).

The role of shamanistic religions is well illustrated by the function of trance-dance in !Kung San hunter-gatherer society. Here, intensely rhythmic music (chanting, clapping, drumming) is used to drive the dance, which normally has its culmination in the dancers entering trance states. Trance states of this kind form a regular part of religious practice in almost all small-scale societies (Bourguignon 2004). In the trance state, the adept enters the spirit world (typically through a narrow aperture or gateway, sometimes guarded by a dangerous gatekeeper whose clutches have to be avoided) and undertakes a journey through the spirit world, often accompanied by a guide (typically an ancestor or a therianthropic animal guardian), one of whose responsibilities is to ensure that the traveller can find the opening back to the physical world again (Eliade 1964; Vitebsky 1995). Entry into the spirit world through trance is generally considered risky, and is often associated with anxieties about not being able to find the way back. Concerns about returning are probably justified, since trance states can be so physiologically intense that there is a real risk of collapse and death. These dangers, and the fact that one's experiences in the trance state can be very frightening, invariably require that novices are trained and guided by an expert practitioner (a shaman).

However, the real issue is the functional consequences that trance dances have for community cohesion. In San communities, trance dances are typically

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held at times when it is felt that community cohesion is deteriorating (Marshall 1999; Alan Barnard, personal communication). Similar observations have been reported for the Aranta in Australia (Spencer and Gillen 1904). The effect of holding a trance dance seems to be to restore social equilibrium. With time, of course, the stresses and strains of social living inexorably lead once more to a decline in cohesion, triggering the need for another trance dance. The cycle length is commonly in the order of a month or more.

We know little about the physiological processes involved, although Lewis-Williams (2002) has discussed at some length the hallucinogenic-like aspects of trance states. While these effects are undoubtedly real and important, the substantive effect probably arises from the endorphin activation triggered by the physical exertion of the dancing. In effect, it produces the same kind of psychopharmacological state that grooming produces at the dyadic level, but it does this on a larger scale that can involve many individuals. As a result, it has the effect of generating in many individuals at the same time an enhanced sense of bondedness and commitment to the larger community. In some sense, this is a crude psychopharmacological fix and it seems to rely heavily on the physicality of dancing and musical performance to produce the trance effect (Rouget 1985). While the trance effect may simply be a secondary consequence of the physical exertion of the dancing, it is possible that, like epileptic fits, trance has the effect of "cleansing" the mind (by wiping the memory banks) of the toxic memories of those social events (insults, petty thefts, failures to adhere to social mores) that were originally responsible for the deterioration in relationships within the community.

What seems to be crucial here is the ritualized activity involved in the dance. The issue is not so much that you perform the actions, but that you perform them together in time and in step. Using sweep-oar rowing crews, we have been able to show that rowing on erg rowing machines in close coordination in a virtual boat doubles the endorphin surge compared to performing the same action alone, even when the power output was held constant (Cohen et al. 2010). Furthermore, there is evidence that even simple synchronized action (e.g. singing together or waving an arm in time) significantly enhances prosocial behavior in groups (Wiltermuth and Heath 2009). It seems that there is something about synchrony that ramps up endorphin activation, producing the sense of uplift and social engagement that Durkheim (1915) referred to as *effervescence* and Turner (1966) as *communitas* (see also Ehrenreich, 2006)—though we have no idea why this should be the case.

THE NEOLITHIC AND THE INVENTION OF RITUAL

The transition marked by the Neolithic is important in two key respects besides the rise of agriculture. One is that it involves the first appearance of

permanent settlements, and the second is the appearance of what seem to be ritual spaces. This is not to say that hunter-gatherer societies do not have ritual sites (obvious examples include Australian Aboriginal sacred sites), but these sites tend to be natural places and do not normally involve built structures. The Neolithic settlement, which begins from around 12,000 BP, is marked by a rapid shift into permanent settlements. The earliest settlements, associated with the short-lived Natufian culture in the Levant, were quite modest in size (anything from half a dozen huts to villages of around 100–150 individuals). That these settlements were permanent (or, at least, long lasting) is attested to by the remains of stone mortars for grinding that are far too heavy to move.

While there is no evidence of formal ritual sites (*sensu* temples) at any of these early sites, at later Anatolian sites such as Göbekli, Çayönü and Aşikh Höyük (dating from around 9500–7700 BP) there are spaces that are thought to have had ritual functions (Schmidt 2001; Hodder 2006). The presence of pit burials (often under the living floors of dwellings) in many of these sites clearly attests to a belief in an afterlife. Particularly poignant evidence of this is provided by cases where human adults were buried with dogs (at Ain Mallaha and Hayonim Terrace). These later sites are often significantly larger in size: Çatalhöyük, for example, has been estimated to have had a population in the order of 3000–8000 individuals over most of its 1,400-year history (Hodder 2006). Explicit evidence for just such a sequence has been documented in the correlated rise of ritual, religion, and statehood in the Zapotec empire of the Oaxaca Valley in southern Mexico: this impressive 7,000-year archaeological sequence begins with what appear to be dance floors at the campsites of hunter-gatherers and ends with major temple structures designed on calendrical lines that form the centerpiece for a substantial state (Marcus and Flannery 2004).

If this correlation between settlement, more doctrinal-like religions, religious spaces and religious specialists (priests) holds, then it raises the question as to why this apparent phase shift in mind-set and behavior came about. One explanation identifies the associated agricultural revolution as the driver: organized religion provided the calendrical coordination needed to manage the annual planting and harvesting cycle (Akkermans and Schwartz 2003; Garfinkel 2003). However, there is no plausible biological reason why people *have* to coordinate their agricultural practices. Agriculture undoubtedly made the growth of settlements possible, but it is a constraint rather than a cause of settlement. More importantly, this view overlooks the substantial social stresses that living in close proximity to others in large communities entails. A more plausible view is thus that doctrinal religions (in effect, the world religions as we currently have them) arose through the use of religion as a mechanism for enforcing the social contract when population units greatly exceeded those typical of hunter-gatherer societies (where more than fifty people rarely live together for more than a few weeks)—in a context where mutual defence/protection was the functional concern.

Irrespective of why settlement first occurred, the fact of settlement would have significantly increased the levels of social stress that Neolithic populations experienced. In their prior state as hunter-gatherers living in classic fission-fusion societies, they could alleviate the worst stresses of living together by dispersing into smaller groupings. These stresses are already present (and their fitness consequences well understood) in primate societies, and are largely a function of group size (Bowman et al. 1978; Dunbar 1980). Hunter-gatherer communities (which typically number around 150 in size) are commonly divided into 3–4 overnight camp groups, each of around 30–50 individuals and between which individuals and families move when minded to do so (e.g. to avoid squabbles or difficult social situations). Once a community has moved into a settlement and established permanent dwellings, this strategy is no longer available. Instead, the stresses of group-living will inexorably build up. Something is needed to make the population as a whole behave sufficiently prosocially towards each other so as to avoid social breakdown, and religion is probably by far the best candidate.

Since Neolithic farming communities invariably incurred significant costs (their bones bear evidence of more nutritional stress than those of hunter-gatherers in the same area in the period immediately preceding settlement: Ulijaszek 1991), the most likely explanation for settlement was threat of violence and raiding from neighbours (Keeley 1996; see also Johnson and Earle 2001; Bowles 2009). Humans are relatively immune from the threat of conventional predation by virtue of their body size (Dunbar et al. 2009), making protection against rival communities one of the few benefits to be gained by large community size. This would explain the rather striking fact that many of the later Neolithic settlements in the Levant, including Çatalhöyük, are often formed into self-contained compounds that do not have windows (or even, in many cases, doors) on their exterior walls (Hodder 2006), a feature that might be considered odd if its purpose is not defensive. Indeed, religious ritual plays an important role in coordinating warfare in small-scale societies (Sosis et al. 2007; Johnson 2008).

More importantly, perhaps, it seems likely that the period preceding the Neolithic was associated with a significant rise in population densities, at least in the north-east corner of Africa. There is evidence from genetics that population size for the mitochondrial DNA lineage that gave rise to the modern Eurasian populations (the L3 haplogroup) underwent rapid and steady population expansion from about 70,000 BP (Atkinson et al. 2009). The L3 haplotype is thought to have arisen in Eastern Africa (where it is still particularly common today), and led to widespread migrations into other parts of sub-Saharan Africa, as well as to Eurasia. Haplogroup L2 (the most common sub-Saharan haplotype) is the only other African mtDNA haplotype group to exhibit any evidence of population explosion, but it did not do so until around 12–20,000 years ago, immediately prior to the first settlements. These data suggest that there may have been population pressures during this

period of just the kind required to trigger the need for defensive strategies. Since the Levant is a bottleneck for any expansion out of Africa, this might explain why settlements first appeared in this area.

If this scenario is correct, there would have been significant selection pressure to maintain community size and coherence at its maximum, despite the ecological and social costs incurred from living in close proximity. My suggestion is that organized, doctrinal forms of religion arose as a mechanism to reduce the social costs of freeriding by reducing individuals' willingness to behave selfishly, and that they did this by exploiting the endorphin-based mechanism that, in conventional primate social grooming, creates a sense of bondedness (and hence commitment) between grooming partners. While grooming is an essentially dyadic activity, the rituals of religion allow many individuals to take part at the same time. Indeed, potentially, the numbers of individuals that can take part may be very large indeed (witness the Kaaba ceremonies in Islam or papal masses in St Peter's Square, Rome), providing the activity is highly ritualized (and hence involves a great deal of synchronized behavior). I return to this point below. First, let me comment on two peculiarities of the doctrinal religions, both of which can be understood as a consequence of settlement size. These are the appearance of a theology and the relatively short ritual cycle that characterizes them.

The archaeological evidence suggests that Neolithic settlements very quickly expanded to include several thousand individuals. Hunter-gatherer trance dances tend to be somewhat infrequent (once a month would probably be the typical frequency) and rather irregular in temporal patterning, in part because they are a response to the momentary level of social friction within the community. If things are working well and everyone is getting along fine, then dances are less necessary and less likely to be held; but if there is a lot of bickering and relationships are repeatedly fractious, then dances may be held more often. In contrast, doctrinal religions tend to have rituals that occur on a more regimented and regular cycle, with something closer to a weekly cycle probably being typical (e.g. the special weekly day of worship that characterizes the Abrahamic religions). Increasing the frequency of rituals would be a natural response to the greater stresses that large communities inevitably generate. In effect, the inoculation against moral backsliding needs to be done more regularly because the stresses build up faster and cannot be so easily dissipated by community fission. There is some evidence suggesting a negative relationship between the frequency and psychological intensity (especially dysphoric emotional arousal) of religious rituals in traditional societies, and a negative relationship between dysphoria and community size, agricultural intensity (itself probably correlated with community size), and the presence of "high gods" (Atkinson and Whitehouse 2011). More importantly, the association between ritual frequency and dysphoric arousal is strongly dichotomized, suggesting a phase shift between two opposing states (high arousal with low frequency vs low arousal with high frequency).

The second issue arises from the fact that more regular ritual practice demands discipline from the individuals involved. In other words, some mechanism is needed to persuade people to turn up on a regular basis. This is precisely the function of a formal theology: it provides a reason why individuals should believe what they do and why they should take part in the regular cycle of worship and ritual as laid down by these beliefs. The theology itself is likely to reflect a combination of local cultural practices and those aspects of the mind's design that naturally predispose us to see the world in a particular way. The most important of these last will be those predispositions we have to believe in a spirit world (Boyer 2001; Atran 2002). These predispositions are derivative of our mentalizing capacities and, in particular, the higher order theory of mind competences (Kinderman et al. 1998; Stiller and Dunbar 2007) that allow us to step back from the world as we experience it and ask about the unseen world that might or might not lie behind it (Dunbar 2004, 2008). We can imagine that there is a spirit world that can influence our physical world because our mentalizing competences allow us to step outside ourselves to wonder whether and how the world could be different from the way we directly experience it (Dunbar 2004). Our natural instinct to interpret behavior intentionally sets us up to suppose that every physical event in the world (the wind blowing, volcanoes erupting) reflects volitional behavior (Dunbar 1996). In effect, these aspects of religion merely capitalize on natural psychological predispositions: they do not in any sense require that the world has to be this way, or tell us anything about the function(s) of religion as such.

This phase shift into doctrinal religions is associated with the appearance of "high gods". Roes and Raymond (2003) explicitly linked the appearance of high gods (or as they termed them, "moralizing gods") to society complexity, in particular with the historical appearance of larger chiefdoms. In addition, they were able to demonstrate a correlation between the frequency of internal conflict and society complexity. In other words, high gods play an especially important role in controlling freeriding through the threat of future punishment, either in this life or the next. Known as the "fear of supernatural punishment hypothesis" (or FSPH) (Johnson 2005), this suggestion has received considerable support from a number of cross-cultural studies (Johnson 2005; Atkinson and Bourrat 2011; Bourrat et al. in press). Although such a ploy ought to fall foul of the Poacher's Dilemma (how seriously *should* you take the uncertain threat of future punishment?), there is clearly something about the spirit world that adds an extra layer of threat that we seem predisposed to accept—either because this particular future is difficult to check empirically or because omniscience is commonly assumed to be a trait of members of the spirit world (Boyer 2001). However, we can only contemplate this as a possibility because we can work with high orders of intentionality. Without being able to aspire to fifth order intentionality (the typical limit for most adult humans: Kinderman et al., 1998; Stiller and Dunbar 2007), we

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would not be able to conceive of a high god capable of making such demands on us (Dunbar 2008).

WHY DO RELIGIONS FRAGMENT SO EASILY?

I have argued that the original function of religion is to bond large social communities, and in some respects religions still retain that function. Yet, religions seem to have an extraordinary capacity to fractionate into cults and sects, which seems odd if their purpose is to bond large communities. There is no world religion that has not undergone a continuous process of fragmentation into cults since its founding. Indeed, in many cases the first split typically occurs quite soon after the founder's death (famously so, of course, in the case of both the Shia/Sunni split in Islam and the Theraveda/Mahayana split in Buddhism). Even though the Coptic and Nestorian schisms in Christianity took four centuries to come about and the Catholic/Orthodox schism took something closer to 1,000 years, these major divisions in fact merely represent particularly dramatic instances of sectarianism within mainstream Christianity. Indeed, most major world religions began life as sects of another religion—Christianity famously as a sect of Judaism and, according to some recent suggestions (Wade 2009), Islam as a sect of Nestorian (i.e. monophysite) Christianity. Even within these grand divisions, there has been a constant succession of cults and sects with every passing decade, almost all of them centred around charismatic leaders (e.g. the many cults that emerged within Christianity during the early Middle Ages: Cohn 1970). In this respect, religions parallel language, which similarly fractionate into dialects (some of which eventually become separate languages) on a scale of centuries rather than millennia.

In both cases, this seems rather odd. Language and religion share with each other the fact that they are meant to coordinate behavior within a community. Yet both exhibit the same tendency to fragment into mutually antagonistic communities (or dialects). In effect, they exacerbate in-group/out-group effects, reinforcing community boundaries and exaggerating xenophobia. I suggest that both language (in the form of dialect) and religion (in the form of sects subscribing to different worldviews and different ritual practices) are mechanisms explicitly designed to reinforce in-group cohesion in the face of external threats. As such, they evolved specifically to weld groups of 100–200 individuals into tightly bonded, mutually supportive communities in the face of the threat of attack by neighbors.

Interestingly, the threat need not be physical: there is now good evidence that the problem may, in some cases at least, be the risk of acquiring dangerous pathogens for which the community lacks natural immunity. Fincher and Thornhill (2008a, b; Fincher et al. 2008; Thornhill et al. 2009) have shown,

on a country by country basis, that the number of religions, the degree of communalism versus individualism, the level of democritization, and the size of language communities all correlate with the pathogen load experienced (where parasite load was typically indexed by the summed prevalence levels for seven major infectious diseases). They interpret this as reflecting the need to create semi-isolated, self-contained communities that minimize inter-breeding when parasite loads are high (as they are in the tropics compared to high latitudes). These analyses suggest that communities are more inward-looking and more xenophobic when the threat is highest. When the pressure is taken off, as it is in the healthier climates at high latitudes, communities become less self-protective, and so they begin to open up and become more liberal.

The issue here is the role of religion in creating a sense of belonging on a very small scale, of membership of a mutual alliance against the world "out there". My contention is that, precisely because religion (or more correctly, perhaps, religiosity) evolved to bond very small communities *and* to do this through a more mystical, experiential form of religion (i.e. shamanic religions that involve collective practice rather than theological reasoning), there is a natural tendency for religions to fragment and recreate these small communities. This much is evident even in the language of the Abrahamic religions in particular, which tend to emphasize the close kinship of their members through the use of terms like *brother* and *sister*, *father* and *mother*. This may be why the major religions are so antagonistic towards mystical sects (Christians against the Gnostics, Islam against the Sufis, mainstream Judaism against the Kabbalah): mysticism threatens to undermine the authority of the hierarchy and destabilize the rather fragile coherence of super-large communities by encouraging a focus on individual charismatic leaders in small, mutually antagonistic communities (Lewis 2003).

This perpetual tension between the need to ensure large-scale social cohesion and our natural psychological predisposition to prefer small, intimate religious settings creates a problem that, in many ways, has dogged the history of most world religions. Most religious traditions seek to suppress this fragmentation. Others, however, deliberately exploit it: the Hutterites and Amish, for example, deliberately manage community (or parish) size to ensure that it remains within the upper limit of 150 (Dunbar 2008). Hutterites are quite explicit in this: they traditionally split their communities when they exceed 150 in size in order to obviate any need for hierarchies and laws, since these are anathema to their more communalistic Anabaptist form of Christianity (Mange and Mange 1980). Indeed, even within some mainstream branches of Christianity, efforts have been made to tailor parishes to this same size in order to facilitate a better sense of community: the Urban Church Project (1974), for example, recommended a maximum size of around 200 for Anglican parishes. Some additional evidence is offered by the fact that the nineteenth-century American utopian communes discussed above typically have

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very small sizes at foundation, with a very obvious bimodal distribution that has maxima at ∼50 and ∼150 individuals for secular vs religious communes, respectively (Dunbar 2011).

CONCLUSIONS

I have argued that religion has its origins in a small-scale phenomenon, the bonding of the very small communities typical of hunter-gatherer societies. Although the psychological features that underpin religion in this form have the capacity to be exploited so as to create much larger social groupings (i.e. well beyond the 150), nonetheless these are by no means perfect exaptations and there remains a tension between the natural small-scale processes and the large-scale contexts to which they have historically been adapted. This endogenous tendency to fractionate means that the larger (usually "doctrinal") religions are always fighting against themselves, creating a perpetual tussle between theological discipline imposed from above and more mystical, charismatic grass-roots movements that perpetually seek a more idiosyncratic independence.

The origin of religion as a small-scale phenomenon may explain why religions often become pathologically aggressive towards each other. Religiosity involves a psychology that was designed to maximize in-group cohesion at the expense of out-group relationships. In doing so, it created a powerful xenophobic psychology that was well adapted for exploitation in large-scale contexts. Religion in small-scale communities is based on face-to-face interaction and personal knowledge, and these no doubt act as a natural break on any tendencies to over-react towards others. In very large communities, however, this break does not exist: we find ourselves among strangers. Religion becomes one of the ethnic markers of community-membership, and especially when local community size exceeds the 150 or so with which we have been designed by evolution to cope.

NOTES

1. Although there continues to be considerable interest in the possibility of group selection (e.g. Okasha 2003; Wilson and Wilson 2007), Maynard Smith's (1964) plea that we should not confuse matters by using the term "group selection" to refer to something that can already be explained by standard Darwinian individual-level selection remains vital, but is, regrettably, just as invariably ignored. Group selection should properly be used to refer to an evolutionary process in which the unit of

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inheritance (and hence the level at which fitness is costed out) is the group, and not the individual. Most discussions of "group selection" invariably either muddy the waters on this or in reality refer to "group-level [i.e. multilevel] selection" (where selective advantage arises at the level of the group, but the unit of inheritance at which fitness is costed out remains the individual or gene as in the standard Darwinian model) but fail to make this clear.

2. This is not necessarily the case in conventional economic experiments, where strangers typically play against each other. However, these usually take place in the somewhat artificial context of a laboratory where players are protected against outright aggression by those they seek to punish.

REFERENCES

Akkermans, P. M. M. G. and G. M. Schwartz (2003). *The Archaeology of Syria*. Cambridge: Cambridge University Press.

Alexander, R. D. (1989). "Evolution of the human psyche". In P. Mellars and C. Stringer (eds.) *The Human Revolution*, pp. 455–513. Edinburgh: Edinburgh University Press.

Atkinson, Q. D. and P. Bourrat (2011). "Beliefs about God, the afterlife and morality support the role of supernatural policing in human cooperation." *Evolution and Human Behavior* 32(1): 41–9.

Atkinson, Q. D., R. D. Gray, and A. J. Drummond (2009). "Bayesian coalescent inference of major human mitochondrial DNA haplogroup expansions in Africa". *Proceedings of the Royal Society of London*, 276B: 367–73.

Atkinson, Q. D. and H. Whitehouse (2011). "The cultural morphospace of ritual form: Examining modes of religiosity cross-culturally". *Evolution and Human Behavior*, 32(1): 50–62.

Atran, S. (2002). *In Gods We Trust: The Evolutionary Landscape of Religion.* Oxford: Oxford University Press.

Bateson, M., D. Nettle, and G. Roberts (2006). "Cues of being watched enhance cooperation in a real-world setting." *Biology Letters*, 2(3): 412–14.

Bourguignon, E. (2004). "Possession and trance." In: C. Ember and M. Ember (eds), *Encyclopedia of Medical Anthropology*, pp. 137–45. Philadelphia: Springer.

Bourrat, P., Q. D. Atkinson, and R. I. M. Dunbar (in press). "Supernatural punishment and individual social compliance across cultures." *Biology & Religion*.

Bowles, S. (2009). "Did warfare among ancestral hunter-gatherers affect the evolution of human social behaviors?" *Science*, 324: 1293–8.

Bowman, L. A., S. Dilley, and E. B. Keverne (1978). "Suppression of oestrogen-induced LH surges by social subordination in talapoin monkeys." *Nature*, 275: 56–8.

Boyer, P. (2001). *Religion Explained: The Human Instincts That Fashion Gods, Spirits and Ancestors.* London: Heinneman.

Cohen, E., R. Ejsmond-Frey, N. Knight, and R. I. M. Dunbar (2010). "Rowers' high: behavioural synchrony is correlated with elevated pain thresholds." *Biology Letters,* 6: 106–8.

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Comp. by: PG4500   Stage : Proof   ChapterID: 0001787547   Date:24/11/12   Time:17:55:41
Filepath:d:/womat-filecopy/0001787547.3D63

OUP UNCORRECTED PROOF – FIRST PROOF, 24/11/2012, SPi

Cohn, N. (1970). *The Pursuit of the Millennium: Revolutionary Millinarians and Mystical Anarchists of the Middle Ages.* Oxford: Oxford University Press.

Cosmides, L. (1989). "The logic of social exchange: Has natural selection shaped how humans reason? Studies with the Wason selection task." *Cognition*, 31: 187–276.

Cosmides, L. and J. H. Tooby (1992). "Cognitive adaptations for social exchange." In J. H. Barkow, L. Cosmides, and J. H. Tooby (eds) *The Adapted Mind*, pp. 163–228. Oxford: Oxford University Press.

Davilla Ross, M., M. J. Owren, and E. Zimmermann (2009). "Reconstructing the evolution of laughter in great apes and humans." *Current Biology*, 19(13): 1–6.

Dunbar, R. I. M. (1980). "Determinants and evolutionary consequences of dominance among female gelada baboons." *Behavioral Ecology and Sociobiology*, 7: 253–65.

——(1988). *Primate Social Systems*. Chapman & Hall, London.

——(1991). "Functional significance of social grooming in primates." *Folia Primatologica* 57: 121–31.

——(1992). "Coevolution of neocortex size, group size and language in humans." *Behavioral and Brain Sciences* 16(4): 681–735.

——(1996). *Grooming, Gossip and the Evolution of Language*. London: Faber & Faber.

——(1998). "Theory of mind and the evolution of language." In: J. Hurford, M. Studdart-Kennedy, and C. Knight (eds), *Approaches to the Evolution of Language*, pp. 92–110. Cambridge: Cambridge University Press.

——(1999). "Culture, honesty and the freerider problem." In: R. I. M. Dunbar, C. Knight and C. Power (eds), *The Evolution of Culture*, pp. 194–213. Edinburgh: Edinburgh University Press.

——(2004). *The Human Story*. London: Faber & Faber.

——(2008). "Mind the gap: Or why humans aren't just great apes." *Proceedings of the British Academy* 154: 403–23.

——(2010a). "Brain and behaviour in primate evolution." In P.H. Kappeler and J. Silk (eds), *Mind the Gap: Tracing the Origins of Human Universals*, pp. 315–30. Springer: Berlin.

——(2010b). "The social role of touch in humans and primates: Behavioural function and neurobiological mechanisms." *Neuroscienc and Biobehavioral Reviews*, 34(2): 260–8.

——(2011). "Constraints on the evolution of social institutions and their implications for information flow." *Journal of Institutional Economics* 7: 345–71.

——(in press). "Bridging the bonding gap: The transition from primates to humans. *Philosophical Transactions of the Royal Society of London.*

——R. Baron, A. Frangou, E. Pearce, E. J. C. van Leeuwen, J. Stow, G. Partridge, I. MacDonald, V. Barra, and M. van Vugt (2012). "Social laughter is correlated with an elevated pain threshold." *Proceedings of the Royal Society of London*, B, 22 March, 279(1731), 1161–1167.

Dunbar, R. I. M., K. Kaskatis, I. MacDonald, and V. Barra (submitted). "The evolutionary significance of music: Performance of music elevates pain threshold and positive affect."

Dunbar, R. I. M., A. H. Korstjens, and J. Lehmann (2009). "Time as an ecological constraint." *Biological Reviews*, 84: 413–29.

Dunbar, R. I. M., and S. Shultz (2007). "Understanding primate brain evolution." *Philosophical Transactions of the Royal Society of London,* 362 B: 649–58.

Comp. by: PG4500   Stage : Proof   ChapterID: 0001787547   Date:24/11/12   Time:17:55:41
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OUP UNCORRECTED PROOF – FIRST PROOF, 24/11/2012, SPi

64   *R. I. M. Dunbar*

Dunbar, R. I. M., and S. Shultz (2010). "Bondedness and sociality." *Behaviour* 147(7): 775–803.

Durkheim, E. (1915 [1965]). *The Elementary Forms of Religious Life.* New York: Free Press,.

Ehrenreich, B. (2006). *Dancing in the Streets.* New York: Metropolitan.

Eliade, M. (1964). *Shamanism: Archaic Techniques of Ecstasy.* Princeton, NJ: Princeton University Press.

——(1978). *A History of Religious Ideas.* I. *From the Stone Age to the Eleusinian Mysteries.* Chicago: Chicago University Press.

Enquist, M. and O. Leimar (1993). "The evolution of cooperation in mobile organisms." *Animal Behaviour* 45(4):747–57.

Fehr, E. and S. Gächter (2002). "Altruistic punishment in humans." *Nature* 415: 137–40.

Fehr, E. and B. Rockenbach (2003). "Detrimental effects of sanctions on human altruism." *Nature* 422: 137–40.

Fincher, C. L. and R. Thornhill (2008a). "A parasite-driven wedge: Infectious diseases may explain language and other biodiversity." *Oikos* 117: 1289–97.

————(2008b). "Assortative sociality, limited dispersal, infectious disease and the genesis of the global pattern of religion diversity." *Proceedings of the Royal Society of London*, 275B: 2587–94.

————D. R. Murrray, and M. Schaller (2008). "Pathogen prevalence predicts human cross-cultural variability in individualism/collectivism." *Proceedings of the Royal Society of London*, 275 B: 1279–85.

Garfinkel, Y. (2003). *Dancing at the Dawn of Agriculture.* Austin: University of Texas Press.

Hill, R. A. and R. I. M. Dunbar (2003). "Social network size in humans." *Human Nature* 14(1): 53–72.

Hodder, I. (2006). *Çatalhöyük: The Leopard's Tale: Revealing the Mysteries of Turkey's Ancient "Town".* London: Thames & Hudson.

Johnson, A. W. and T. K. Earle (2001). *The Evolution of Human Societies: From Foraging Group. to Agrarian State.* 2nd edition. Stanford: Stanford University Press.

Johnson, D. (2005). "God's punishment and public goods: A test of the supernatural punishment hypothesis in 186 world cultures." *Human Nature* 16(4): 410–46.

——(2008). "Gods of war: The adaptive logic of religious conflict." In J. Bulbulia, R. Sosis, E. Harris, R. Genet, C. Genet, and K. Wyman (ed.), *The Evolution of Religion*, pp. 111–17. Collins Foundation Press: Santa Margarita (CA).

Keeley, L. H. (1996). *War Before Civilization*. Oxford: Oxford University Press.

Kellett, E. E. (1962). *A Short History of Religion.* Harmondsworth: Pelican Books.

Keverne, E. B., N. Martensz, and B. Tuite (1989). "Beta-endorphin concentrations in cerebrospinal fluid of monkeys are influenced by grooming relationships." *Psychoneuroendocrinology* 14: 155–61.

Kinderman, P., R. I. M. Dunbar, and R. P. Bentall (1998). "Theory-of-mind deficits and causal attributions." *British Journal of Psychiatry*, 89: 191–204.

Lehmann, J., A. H. Korstjens, and R. I. M. Dunbar (2007). "Group size, grooming and social cohesion in primates." *Animal Behaviour* 74(6): 1617–29.

Lewis, I. M. (2003). *Ecstatic Religion*, 3rd edition. London: Routledge.

Lewis-Williams, D. (2002). *A Cosmos in Stone: Interpreting Religion and Society Through Art*. Walnut Creek: AltaMira Press.

AQ3

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OUP UNCORRECTED PROOF – FIRST PROOF, 24/11/2012, SPi

Machin, A. and R. I. M. Dunbar (2011). "The brain opioid theory of social attachment: A review of the evidence." *Behaviour* 148: 985–1025.

Mange, A. and E. Mange (1980). *Genetics: Human Aspects*. New York: Holt Rinehart & Winston.

Marcus, J. and K. V. Flannery (2004). "The coevolution of ritual and society: New C-14 dates from ancient Mexico." *Science* 101: 18257–61.

Marshall, L. J. (1999). *Nyae Nyae !Kung Beliefs and Rites*. Cambridge (MA): Harvard University Press.

Maynard Smith, J. (1964). "Group selection and kin selection." *Nature* 201:1145–6.

Millner-Gulland, E. J. (1993). "An econometric analysis of consumer demand for ivory and rhino horn." *Environmental and Resource Economics*, 3: 73–95.

——and Leader-Williams, N. (1992). "A model of incentives for the illegal exploitation of black rhinos and elephants: Poaching pays in Luangwa Valley, Zambia." *Journal of Applied Ecology*, 29: 388–401.

Nettle, D. and R. I. M. Dunbar (1997). "Social markers and the evolution of reciprocal exchange." *Current Anthropology* 38: 93–8.

Okasha, S. (2003). "The concept of group heritability." *Biology and Philosophy* 18(3): 445–61.

Provine, R. (1996). *Laughter: A Scientific Investigation.* London: Faber & Faber.

Roes, F. L. and Raymond, M. (2003). "Belief in moralizing gods." *Evolution and Human Behavior* 24: 126–35.

Rouget, G. (1985). *Music and Trance: A Theory of the Relations Between Music and Possession*. Chicago: University of Chicago Press.

Schaller, G. (1968). *The Serengeti Lion.* Chicago: Chicago University Press.

Schmidt, K.(2001). "Göbekli Tepe, southeastern Turkey: A preliminary report on the 995–1999 excavations." *Paléorient* 26: 45–54.

Seyfarth, R. M. (1978). "A model of social grooming among adult female monkeys." *Journal of Theoretical Biology*, 65: 671–98.

Shultz,S. and R, I. M. Dunbar (2007). "The evolution of the social brain: Anthropoid primates contrast with other vertebrates." *Proceedings of the Royal Society of London,* 274B: 2429–36.

—————(2010). "Encephalisation is not a universal macroevolutionary phenomenon in mammals but is associated with sociality." *PNAS* 107: 21582–6.

Shultz, S., R. Noe, S. McGraw, and R. I. M. Dunbar (2004). "A community-level evaluation of the impact of prey behavioural and ecological characteristics on predator diet composition." *Proceedings of the Royal Society of London,* 271B: 725–32.

Sosis, R. and C. Alcorta (2003). "Signaling, solidarity, and the sacred: The evolution of religious behaviour." *Evolutionary Anthropology* 12(6): 264–74.

Sosis, R. and E. R. Bressler (2003). "Cooperation and commune longevity: A test of the costly signaling theory of religion." *Cross-Cultural Research* 37(2): 211–39.

Sosis, R., H. C. Kress, and J. Boster (2007). "Scars for war: Evaluating alternative signalling explanations for cross-cultural variance in ritual costs." *Evolution and Human Behaviour* 28(4): 234–47.

Spencer, B. and F. J. Gillen (1904). *The Northern Tribes of Central Australia*. London: Macmillan & Co.

Stiller, J. and R. I. M. Dunbar (2007). "Perspective-taking and memory capacity predict social network size." *Social Networks* 29(1): 93–104.

Comp. by: PG4500   Stage : Proof   ChapterID: 0001787547   Date:24/11/12   Time:17:55:42
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66   *R. I. M. Dunbar*

Sutcliffe, A. G., R. I. M. Dunbar, J. Binder, and H. Arrow (2011). "Relationships and the social brain: Integrating psychological and evolutionary perspectives." *British Journal of Psychology* 103: 145–168.

Thornhill, R., C. L. Fincher, and D. Aran (2009). "Parasites, democratization, and the liberalization of values across contemporary countries." *Biological Reviews*, 84: 113–31.

Turner, V. (1966). *The Ritual Process: Structure and Anti-Structure.* Cornell University Press: Ithaca, NY.

Ulijaszek, S. J. (1991). "Human dietary change." *Philosophical Transactions of the Royal Society of London,* 334B: 271–9.

Urban Church Project (1974). "Let My People Grow!" Workpaper No.1. Unpublished report to the General Synod of the Church of England, London.

Vitebsky, P. (1995). *The Shaman: Voyages of the Soul, Trance, Ecstasy and Healing from Siberia to the Amazon.* London: Duncan Baird.

Wade, N. (2009). *The Faith Instinct: How Religion Evolved and Why it Endures.* New York: Penguin Press,.

Wilson, E. O. and D. S. Wilson (2007). "Rethinking the theoretical foundation of sociobiology." *Quarterly Review of Biology* 82: 327–48.

Wiltermuth S. S. and C. Heath (2009). "Synchrony and cooperation." *Psychological Science*, 20: 1–5.

Zhou, W-X., D. Sornette, R. A. Hill, and R. I. M. Dunbar (2005). "Discrete hierarchical organization of social group sizes." *Proceedings of the Royal Society of London,* 272B: 439–44.

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