Is religion adaptive? Yes, no, neutral, but mostly we don't know

Peter J. Richerson
Lesley Newson
Cultural Evolution Laboratory
Department of Environmental Science and Policy
University of California Davis

Prepared for ***The Believing Primate:***
Scientific, Philosophical and Theological Perspectives on the Evolution of Religion

Jeffrey Schloss and Michael Murray, editors

pjricherson@ucdavis.edu; L.Newson@ex.ac.uk

Abstract

The question of whether religion is adaptive or not is debated with much vigor and passion, but the question as usually posed is much too simplistic to be answerable. Religions are extremely diverse. What is true of one often will not apply to another. Given religions are complex systems of beliefs, emotions, rituals, moral injunctions, and social institutions and organizations. Some parts may be adaptive and others maladaptive. We know that cultural evolutionary processes can, in theory, lead to adaptations, maladaptations, and neutral variation. Religion is an appreciable fraction of the totality of culture, and any appreciable fraction of culture is virtually certain to exhibit all three. The list of proposed functions and dysfunctions of religions is long. The bulk of the empirical information that bears on the consequences of religions for individuals and groups is largely non-quantitative or evaluates only selected aspects of religious belief. To appreciate some of the complexity we must contend with, consider the role of natural selection on religious variation. Selection might act on religious ideas directly, favoring parasitic religious memes (which would be adaptive in their own terms of course). If a religion increases individual health and well-being or promotes fertility, religious variants that increase ordinary individual or inclusive fitness will be favored by selection, perhaps to the detriment of the collective welfare. If some religious variants promote intra-group cooperation, they may be favored by group selection. But cooperative groups may compete violently or prey upon other groups in ways that are maladaptive judged from either the individual or the meta-group level. The decision-making forces by which human individuals and collectivities influence the evolution of religion can likewise have adaptive and maladaptive outcomes at different levels of organization, all depending upon the details of the situation. Much of the variation between religious is likely to be neutral symbolic variation with no fitness consequences at all. As is generally the case, the evolution of religion will be the net result of many forces tugging in different directions. Quantitative microevolutionary studies will be necessary to estimate the various components of fitness affected by religious variation. Demographers interested in religion have produced some path-breaking studies along these lines.

Introduction

We view human culture to be an evolving part of human biology and this gives us a new approach to understanding aspects of culture like religion. But gene-culture evolutionary analysis doesn't simplify the matter of explaining them. Biological phenomena generally are complex and diverse (Richerson & Boyd, 1987). For example, each species is typically a complex meta-population of complex organisms with a complex evolutionary history. In addition, biologists have to worry about millions of species in total and dozens to hundreds of interacting species even in small biological communities. In the case of humans, culture complicates the evolutionary process, and humans are diversified into thousands of cultures and subcultures. In the complex societies of the past few millennia, internal differentiation has become quite extreme. Human communities are typically as complex as natural ones. Odd as it may seem, the complexity of biology very often restricts us to understanding particular cases in terms of quite simple models (Burnham & Anderson, 2002). In truth, we can often understand biological phenomena when Nature is kind and the phenomenon of interest is dominated by relatively few processes.

Using evolutionary theory as a way to gain an understanding of religion gives us access to concepts, and theoretical and empirical tools that have been very successful in explaining biological diversity. Of course the tools of evolutionary biology have been mostly developed through the study of non-human living organisms with the assumption that it is *genes* that are evolving. The evolutionary study of human behavior adds an important wrinkle. In all living things, information is transmitted down the generations coded in genes. Humans also pass on a vast amount of information culturally, by teaching and imitating one another. To get an idea of the scale, consider that the human genome has perhaps 20,000 structural genes while the vocabulary of high school graduates numbers about 60,000 words. Kids do not invent those words, at least not most of them; they pick them up, inherit them, from the people they associate with. And of course vocabulary is only a modest part of their cultural inheritance.

The cultural and genetic inheritance systems in humans each carry a large amount of information but one important difference is that human genes vary only slightly across our species. Our cultural characteristics, on the other hand are highly variable. Our understanding of how cultural characteristics evolve to create this huge diversity is quite modest in some respects. Historians, paleoanthropologists, archaeologists and other scholars have provided us with good descriptive picture of how various cultural characteristics have changed over time. Anthropologists and other scholars have given us a good qualitative picture of cultural diversity. But this is very different from the quantitative and mechanistic understanding of evolution that has been pursued by biologists looking at how genes change.

When Darwin began to develop his theories, naturalists and fossil-hunters had built up reasonable descriptive accounts of the diversity and change in living organisms. Darwin saw that this hotchpotch of data made sense if the diversification of living things had occurred through *descent with modification*. Darwin saw several ways that modification could occur. There were three types of selection (natural, sexual, artificial), random variation, and the inheritance of acquired changes. Darwin (1874) saw humans as a

special case and developed his ideas on human evolution at some length in the *Descent of Man*. In the 20th Century, biologists energetically pursued the Darwinian approach to the evolution of genes but social sciences developed in a quite un-Darwinian direction as they emerged in the early 20th Century. Only in the last quarter of the 20th Century did scholars begin to turn their minds to developing a quantitative, mechanistic theory of cultural evolution and most of the pioneers were biologists, not mainstream social scientists (Cavalli-Sforza & Feldman, 1981; Lumsden & Wilson, 1981). Most Twentieth Century social scientists saw little use in trying to derive a basic theory of human behavior from biology or evolution. An important exception was the psychologist Donald Campbell (1965; 1975). Today Darwinian social science is perhaps as mainstream as any other variety in this unfortunately fragmented field of inquiry (Gintis, 2004; Laland & Brown, 2002).

That religions are part of culture can be seen by the way they are inherited. If a baby, whose parents were Buddhist, is adopted by a Christian family in the United States, it will grow up to know about Christianity and will maybe consider itself to be a Christian. Just as a child of Chinese speaking parents adopted by English speakers an English-speaking community receives no knowledge of Chinese words from its genes, neither will it have Buddhist teaching coded in its genes. But on the other hand, the *capacity* to learn a language *is* inherited genetically, even if the vocabulary and rules of grammar are not. Being able to learn to communicate through language is adaptive. People lacking in this ability were less fit than those who were good at it. The genes of adept language learners were more likely to be passed on that people who could not use this mode of communication. If possessing religious beliefs also made people more fit, the *capacity* to acquire such beliefs is likely to be genetically coded.

So we can use an evolutionary approach to look at whether being religious enhances fitness or detracts from it. If it enhances fitness, it is likely the inclination to be religious is adaptive and therefore somehow coded in the genes. We can also use an evolutionary approach to look at specific kinds of religion or components of religion to see how they change. Which were passed on generation after generation in their culture and which rapidly become extinct? Obviously the two ideas are linked. The kinds of religion or components of religion which brought net benefits to its members and allowed them to "go forth and multiply" more effectively were the ones most likely to survive in the culture.

As with most biological phenomena, religion immediately bombards us with complexity. Any given religion is an amalgam of beliefs, practices, institutions, and organizations. To complicate matters even further, religions are webbed up with other domains of culture—art, social and political organization, family life, practical knowledge, and so on. Religions are diverse. We have polytheisms, monotheisms, and a-theistic spiritual, ethical, and mystical systems. Religions also differ in what they consider to be important. Some insist that adherents maintain a proper set of beliefs, some consider carrying out proper ritual to be all-important, and some emphasize common commitment to ethical ideals. Some are restrict entry to a select few. Others are evangelical and open to all who want to join. Some religions are bureaucratic and authoritarian and some are entirely the

product of egalitarian local groups. It is likely that almost any human behavior we can imagine has turned up as a component of religion, sometime, somewhere.

The basics of evolution I - adaptation

The idea that natural selection favors genetic variations that cause their bearers to survive better or reproduce more is familiar to everyone who has had a good high school biology course. But Richard Dawkins (1976) pointed out, genes are not the only entities that can respond to selection. Cultural elements, ideas or bits of information—Dawkins coined the term "memes"—can be selected just as genes can. Historical examples such as those given by Rodney Stark (1997) suggest that religion could be a cultural variant that persists because it brings advantages. Stark argues that early Christianity grew rapidly in the late Roman period in part because it generated congregations that engaged in mutual helping in a very uncertain world. This helping caused Christians to be more likely to survive and reproduce than pagans. In time, therefore, Christians began to outnumber pagans. Q.E.D. religion is adaptive?

The question is more complex. The notion of adaptation becomes quite complex once we venture very far onto the seas of biological complexity and diversity. Culture adds newer and greater depths to explore. Consider sexual selection. Darwin paired his discussion of humans with his discussion of sexual selection because he wanted to argue that the conspicuous differences between the races like skin color and nose form were due to sexual rather than natural selection. Mate choice sexual selection was a lot like fad and fashion. Arbitrary aesthetic displays like peacock tails evolve to attract the opposite sex, but are otherwise useless or even costly. So can a peacock's tail be considered an adaptation? Biologists differ in their answers to questions like this. Some see an adaptation as something which increases survival while others define an adaptation as being whatever selection has favored, in which case a peacock's spectacular tail is an adaptation on the part of males for mating success.

We will use a basic definition of adaptation that derives from what the great 20th Century evolutionary biologist Ronald Fisher called the "fundamental theorem of natural selection" (Grafen, 2003). According to this theorem, natural selection builds adaptations by favoring genetic variants that increase the mean fitness of individuals or of communities of cooperative individuals. By the way, this is *not* all that selection does and certainly not all that evolution does. For example, sexual selection may decrease the fitness of male peacocks because of the fitness costs of carrying a ridiculously large and cumbersome tail. It may decrease the fitness of peahens as well. Quite conceivably, hens often fail to mate because the local male population has been depleted by predation on encumbered males. Thus, sexual selection can favor variants that decrease rather than increase mean fitness. But whenever we refer to "adaptation" we will exclude such things and refer to *any genetic or cultural variant that increases the mean genetic fitness of a population*. Normally, complex adaptations are built up incrementally by selection or other processes but the "atom" of adaptation is some heritable variant that increases mean fitness compared to alternate variants. This definition will serve as a sort of lighthouse, a

point of reference for an adventure on the dark and stormy seas of evolutionary complexity that follow. So note it well!

The basics of evolution II - selection at multiple levels

Competition is the engine of natural selection and this has lead many people to suggest that taking an evolutionary approach demands that we see individuals as fundamentally competitive. This is not necessarily the case because selection can work at different levels of organization. Classically, biologists talk about survival of the fittest organism, in other words, selection at the level of the individual organism. Selection is seen to favor traits that increase the mean fitness of individuals, to favor variants that increase the survival and reproduction of individuals. But this introduces a problem because many organisms, ameba for example, consist of a single cell, while others, humans for example, consist of billions of cells organized in a way that allows them to cooperate to produce a single thriving organism. Because of this, Richard Dawkins (Richard Dawkins, 1976) proposed that it is more helpful to think of selection taking place at the level of genes. It is the genes that are selfish not the organisms that contain them. By this reckoning, selection at the level of the individual organism is really group selection, the selection of an organization of cooperating genes.

Eors Szathmary and John Maynard Smith (1995) argued that the history of life over that last three billion years could be read as a series of major transitions, which allowed the assembly of larger and larger groups – individual genes grouped to form cells made up of many cooperating genes, individual cells grouped to form larger organisms make up of many cooperating cells, and so on. Why is the assembly of groups so rare as to be considered a major life transition and why does it take millions of years to achieve? It's because such an assembly can only be stable once mechanisms emerge that ensure that the individuals within cooperative groups continue to work together to achieve a common goal.

We take it for granted that the genes that make up our genome are each contributing to the work of our cells. But as molecular biologists gained a more detailed understanding of life at the sub-cellular level, they discovered the kinds of nefarious behaviors genes are capable of. Some have been identified that act like selfish parasites at the expense of the cell as a whole, doing things like disrupting cell division by inserting multiple copies of themselves at the expense of other genes. You have a full compliment of necessary genes because the well-behaved genes of your four grandparents were divided up reasonably fairly to produce the egg and sperm that united to created your genome. This is because the cells of sexually reproducing organisms have mechanisms for making cell division an orderly process that usually doesn't usually allow rogue genes to get away with anything. There is also a problem of roguish behavior on the part of cells within the body of a multi-cellular organism. Mutations in certain genes can make our body cells cease to play their role. Again, we have mechanisms to deal with this. Much of the work of our immune system is dedicated to detecting and destroying body cells that fail to cooperate and begin to live like parasites. It is only when these mechanisms fail that we get cancer.

Transition to a higher level of organization are unusual events because the probability is low that a combination of random changes will occur that produces mechanisms that succeed in preventing non-cooperating individuals getting the upper hand. But once such a mechanism exists, a cooperative group of genes or cells can usually exploit the environment better than the many individual components competing on their own. After that, selection between groups will drive the evolution of organization and control systems that are increasingly effective. Members of better-organized groups will cooperate more fully so the likelihood of their survival and reproduction will be higher.

In theory, cooperation can also occur at the next level up, within communities of individual multi-cellular organisms. Group selection can operate to encourage cooperation whenever a reliable statistical association exists between being a cooperator and being in a group composed of other cooperators (Henrich, 2004). In other words, groups can only work together if a high enough proportion of its members are working hard enough for the group as a whole. Making sure that happens is not easy when the group members are free to move around. Up to now in the evolution of life on Earth, only limited degrees of cooperation are seen at the level of the organism. A mechanism for maintaining cooperation within a community of organisms would need to ensure that a sufficiently high proportion of the members are behaving cooperatively rather than competing. This means well-behaved members must be retained, encouraged to reproduce, and, if possible, new cooperators must be recruited from outside the community. Members who fail to cooperate must be recognized and either rehabilitated or expelled from the community. Uncooperative outsiders must be recognized and barred from entry.

Game theoretical simulations have shown that if cooperative behavior is genetically inherited (i.e. genes induce the cooperative behavior) then cooperative communities are only likely to emerge in two circumstances: 1) If the individuals in the community have the same or very similar genes; 2) in small groups between individuals who have established long-term reciprocal relationships. In the later cases, the genes encourage reciprocal behavior rather than cooperation.

Humans are rare if not unique in having cooperation within large communities of unrelated individuals. Our unusual form of cooperation is part of our genetic inheritance. We are endowed with the mental tools for operating a cultural inheritance system. We may not have genes that force us to cooperate but we can learn to cooperate. This does not mean learning to cooperate with anyone anyhow; we learn in what situations being cooperative would be appropriate. We also become very adept at recognizing the kinds of behavior our culture would consider in appropriate or unacceptable. Cultural institutions can emerge within human communities that reward high levels of cooperation and punish or expel non-cooperators. So, just as organisms have genetically evolved mechanisms that work to maintain communities of cooperating cells, groups of humans have culturally evolved behaviors and institutions that provide mechanisms that do the same thing.

Robert Boyd and Peter Richerson (1985; Peter J. Richerson & Boyd, ; 2005) have developed what they call the "tribal social instincts hypothesis" to explain human cooperation. It argues that cooperation evolved hand-in-hand with the human capacity for culture. At the core of the hypothesis is the idea that group selection is a more potent force on cultural variation than on genetic variation (Henrich, 2004). Populations in semi-isolation rapidly evolved cultural differences. Symbolic boundaries limited the flow of ideas between groups. Individual members were inclined to copy the behavior most common within their group and this decreased the differences within the groups and increased differences between the groups. Individuals who failed to conform were punished and fared badly within the group.

As these processes continued for generation after generation in the remote past, primitive cooperative institutions arose. These institutions formed an environment in which genes were selected that conveyed the capacity to thrive and to make the most of culture. This eventually led to an innate social psychology. The successfully social human was relatively docile, prepared to conform to social institutions, and prepared to cooperate, especially with members of a symbolically marked in-group. The phrase "tribal social instincts" was coined because the kinds of groups in which they evolved are commonly called tribes, although anthropologists often use other terms for them.

Modern complex societies betray the nature of the tribal instincts. Religion is often employed as a way of making the in-group. Even very large systems like nations are usually united by a common language, and nations in the modern sense only became possible after mass literacy and mass communication made it possible for the mass of people to sense a cultural kinship with each other (Anderson, 1991). Tribal scale social institutions are still the building blocks of complex societies. Armies, civilian bureaucracies, companies, voluntary organizations almost always have units much like the residential bands of hunter-gatherers (academics, think "department") and like the tribe (academics, think "universities"). Or disciplines and sub-disciplines. The religious will think congregation and sect. We shall use what we think of as the least value-laden term: "cooperative community."

Group selection between communities gradually improves the communities' cultural mechanisms that promote cooperation. Those with the more effective mechanisms will be more successful and this means that their institutions (as well as their members) will have a higher rate of reproduction. This can happen through a number of means. The more successful communities may conquer less successful ones and impose their institutions. The more successful communities may have greater growth of membership through reproduction and immigration. Over crowding might then cause members to migrate and set up new communities with similar institutions. Other communities with less effective institutions may well abandon them and adopt the more successful cultural mechanisms. The different cooperative groups will continue to compete and their cooperative institutions will change. In time, these processes should cause the evolution of increasingly effective institutions.

The honing of these mechanisms will not necessarily lead to the increased fitness of individual members of the cooperative community. On top of the cost invested in the cooperative effort, there are the costs of running the mechanisms and the more effective the mechanisms, the more costly they are likely to be. Cooperators within groups must signal that they are members in good standing to avoid being expelled from the community as uncooperative outsiders trying to freeload. Such signals must be difficult to give or imposters would find it easy to cheat the detection system. By the way, a system of signaling belonging is also needed for the body cells within an organism. Your cells manufacture and display a combination of complex protein markers that is characteristic of your genome and denotes your "tissue type". These proteins are difficult for infectious agents to make. And should tissue be implanted in your body made up of cells with the wrong combination of markers on their surface, it be attacked and "rejected" by your immune system. Hence the need for immuno-suppressant drugs for transplant patients. The patient's body is just trying to make sure that no non-self DNA is invading to take advantage of the products of the cooperation between its cells.

Religion as a promoter of cooperation

Human communities have evolved a number of ways of keeping the proportion of cooperators to non-cooperators as high as possible. Religions are clearly among these but what elements of religion operate to maintain cooperation and how effective are they? And do the institutions enhance the members' welfare and fitness? Many religions teach a moral code and prescribe cooperation. But the members the members of some faith groups display a diversity of behavior which can range from great heights of altruism to cavernous depths of selfishness. If this goes unnoticed by the members of the religious community or they tolerate it, the institutions of this religion are not effective promoters of cooperation. Members are not likely to experience tangible welfare benefits from belonging to such an organization.

Iannacone (1994) argues that strict faiths can generate higher levels of cooperation and mutual help that lax ones because the practices of strict churches are too costly for cheaters to fake. The beliefs of strict churches are complex and difficult to learn. The ongoing expenditures of time and resources to conform to the practices of strict faiths are high. Subscribing to outlandish beliefs handicaps members from reasonably considering the evidence and judging what might really be in their best interest. Belonging to a strict faith is a conspicuous commitment that makes it difficult for members to maintain strong ties with members of other belief systems. Few are willing to pay such high costs unless their commitment to the religious community is genuine. The group is therefore protected from imposters.

But on the other hand, the higher the costs that members of a community must pay, the less cooperative product the strict church provides. So belonging to a strict church may also provide no tangible benefits or even have net costs. The membership might be so engaged in maintaining rituals and ritual objects that they can devote no effort left to helping one another. Furthermore, the levels of practical commitment that might sometimes be required of devout faith group members may be detrimental to their

welfare. As we know very well from the Middle East today, the Balkans a few years ago, and in Western Europe in the Sixteenth and Seventeenth Centuries, unless over-arching institutions exist that promote tolerance between religious groups, members of groups might be expected to engage in violence to protect or avenge fellow group members.

Religions can therefore both enhance and detract from the welfare of its members. Examples of this are provided by Sonya Salamon (1992). She reports that German ancestry farming communities in the American state of Illinois have a single church in each community, either Catholic or Lutheran but never both in any one community. The churches here are institutions that foster local solidarity. However, British ancestry communities in the state have a number of small Protestant churched in each community. Congregations here typically compete for members so religion a divisive rather than unifying influence on the community.

Arguments made by historians and social scientists about the positive or negative influences of religion can be confusing. For example, Edward Gibbon (2006) argued that the Christian Church persuaded its members to transfer resources to the humble and unproductive members of society. This, he said, contributed to the decline and fall of the Roman Empire – a negative outcome. Rodney Stark (1997) argues that early Christian congregations grew rapidly because of the welfare services that were provided for members and hence Christianity gained acceptance in Roman society – a positive outcome. These may, in fact, amount to the same argument: What was good for the Christian Church was not necessarily good for the Roman Empire. And evolutionists' approach avoids such confusion by agreeing that the outcome being monitored is fitness – the size and welfare of subsequent generations. The Christian Church contributed to the health of subsequent generations by transferring resources to humble families. On the other hand, so did the Roman Empire by providing the infrastructure for trade and a larger economy. Since the fall of the Roman Empire resulted in widespread depopulation in the West, the net fitness effect of Christianity was arguable negative. (Arguable because the rise of Christianity is only one of a number of plausible hypotheses about the causes of Roman collapse (Diamond, 2005).)

Frequency dependent selection and the established church

When religion promotes welfare because it unifies a community under a common set of customs, institutions, and organizations, such as Sonya Salamon observed in the German communities of Illinois, it is only effective when the majority of people in the population are members of the religious community. And the larger the majority, the more effective it is. Throughout the history of civilization, many conquerors and leaders have attempted to unify a population by declaring one form of religion to be official, often with themselves as the official leader. The teachings in the Qur'an unified Arab clans and eventually many different national groups despite the schisms that soon developed. Many societies, be they historically, Buddhist, Christian, Jewish or Islamic were and still are hostile to unofficial ideologies. And in the case of Hinduism, the system of assigning families to castes has a religious basis, and to some extent it still does form the

fundamental organizing institutions of Indian society (Gadgil & Malhotra, 1983; Srinivas, 1962).

The fact that so many populations throughout history have had official religions suggests that it is often effective as a means of bringing net advantage to a population. Once a faith has exclusive access to a population, it can promote cooperation on a wider scale and coordinate larger groups. This can bring important benefits to the members of a wide religious community. To the extent of its ability to do this, we can say that religion might also be most adaptive when it is more common in the population. On the other hand, established churches often become hidebound, bureaucratic, and corrupt. Sometimes they are the handmaidens of predatory elites. Sociologists of religion Roger Finke and Rodney Stark (Finke & Stark, 1992) contrast America's vibrant religious economy based upon a plethora of entrepreneurial churches and sects with the feeble established churches of Western Europe.

Evolutionary analysis can reveal some counter intuitive effects. If possessing a characteristic is very beneficial to an individual's welfare, one might expect this characteristic to be very common in a population. If belonging to a religion brings great benefits, it seems as if everyone will eventually become a member. This is not always the case, however. The outcome of selection can sometimes be very far from the outcome that would maximize fitness. In biology, this can be seen by considering the sex ratio of babies born in a species like cattle. A bull is able to produce far more offspring than a cow. A cow can only become pregnant about once a year while a bull can impregnate many cows during that time. In theory then, having the "male" characteristic brings far more fitness than having a "female" characteristic and this advantage to males should mean that more males should be born than females. But of course, males can only enjoy this kind of advantage when there are far more females than males. As the proportion of males increases, their average fitness decreases. A 50:50 sex ratio turns out to be roughly where selection comes to rest in most species. Ranchers, who want to maximize their offtake of animals from their pastures, maintain only enough bulls to do their proper work, about one to twenty cows. Female fig wasps do roughly the same thing when laying eggs in a fig, but only when no males from competing females are likely to introduce competing males into the fig.

That 50:50 distribution of sexual characteristics is a special case of what evolutionists call frequency dependent selection. Commonly, a characteristic is most beneficial to its bearers when its frequency in a population is low. Possessing the cultural characteristic of being "a doctor" means a person can command a high income but only because there numbers are few. Doctors know this and take various measures to ensure that the characteristic remains rare.

This is also the case for religions. Amish communities are currently growing rapidly in the United States and Canada, mostly because of their very high birth rates. In this case of this religion, the biological fitness benefits to being a member are really substantial. The fitness of the Amish and other religious sects in first-world countries that are resisting the demographic transition is probably the highest in the world. Families of nine or more are

not uncommon. However, most Amish, do not pursue education past age 13 and this sharply limits the number of occupations that Amish can pursue. The proportion of Amish in the population is increasing and as they become more common three things might happen and all three will lead to a decline in the mean fitness of the Amish. First, Amish economic success might drop as they need to compete more fiercely for the limited number of occupations that can be performed by people with little education. The Amish have moved into various craft and factory occupations in recent years as land has become too expensive for all of them to remain in farming. Eventually Amish family sizes might be limited by falling wages in the occupations they are able to serve. Second, the Amish population might continue to rise, eventually reducing the skilled labor force enough to handicap the economies of the United States and Canada. Third, the Amish might decide to become less strict and allow members to pursue higher education. This might introduce influences in the members' lives that are likely to compete with producing large families. The Amish remain distinctive and resist modernization in part by avoiding education professionals who are the epitome of modernity. Whatever the outcome, the adaptedness of the Amish and other high fertility religious groups is certain to change as they rise from an insignificant part of the population to a major component.

Another advantage of belonging to a rare religion is that small sects may be less at risk from penetration by selfish imposters. When a sect is small, few non-cooperators will know enough about it fake membership. Quite cheap occult signals may be sufficient to differentiate members from non-members. The doctrines and practices of large churches tend to be common knowledge. Hence they are easy to penetrate. Also, large churches are inevitably bureaucratic and may tend to become excessively top down organizations. Small sects may much more effectively tap the local enthusiasm and esprit. More on this hypothesis under the heading of cultural evolution below.

Cultural evolution

We have discussed a number of ways in which it is useful to think of the culture of a population as being similar to the gene pool of the population. By this analogy, the various cultural elements (ideas, skills, languages, social institutions, and so on) that are available to the population can be seen as genes. We inherit these cultural elements by learning them, through imitating others and by being taught by others, just as we inherit genes from our parents. Thus all the complexities of adaptation discussed above apply to genes a well as culture albeit with many differences of detail.

The analogy becomes more useful if we also keep in mind the many ways that the inheritance of cultural elements differs from the inheritance of genes. For our purposes here, it is sufficient to concentrate on just a few of these – the ones that give rise to the most interesting differences regarding adaptation.

The most fundamental difference perhaps is that cultural evolution is "Lamarckian." It includes the inheritance of acquired variation. Humans are not necessarily passive participants in transmission of culture. From the many cultural elements available to our population, we can to some extent make decision about which to adopt and which to

ignore or forget. We can also decide which to keep to ourselves and which to teach (or how actively to teach) and to whom they should be taught. We may decide to reject all the cultural variants on offer and make up our own. These sorts of behaviors enable individual members of a culture to make the most of being a member. The behaviors create what we see as "forces" – "decision-making forces" – that operate to push culture to evolve in a direction. Donald Campbell (1965) argued that the decision-making forces constituted "vicarious selectors." Presumably human psychology was under selection in the past to have rules for acquiring culture that enhanced genetic fitness, at least under conditions that approximate those that we evolved under. Much of the work on the evolution of human behavior takes it for granted that human decisions of all sorts will be fitness optimizing (Laland & Brown, 2002). In accord with this argument, humans are a spectacularly successful species based on our culturally transmitted technology and social institutions (Peter J. Richerson & Boyd, 2005).

In religion as in any other realm of culture, individuals use their decision-making abilities to try to invent and adopt variants that are favorable to themselves. Thus, if individuals have any choice at all of church, pastor, or doctrines they are liable to adopt those that benefit them. It is not difficult to see why natural selection favored those who were better at choosing between the cultural variants available to them.

Cultural evolution, however, also allows plenty of scope for to emergence of variants that are "maladaptive", that are detrimental to the welfare and fitness of the members of the culture (Richerson & Boyd, 2005). As with adaptations, all of the potential maladaptive processes that exist for genes also have cultural analogs. Some of these probably have greater force in the case of culture, most notably the potential for virus-like selfish memes to arise and spread among the members of a population. One example that occurred recently was the idea that the new "MMR triple" vaccine for mumps, measles and rubella causes autism. Adopting this piece of scientifically unfounded piece of information caused many parents not to have their children vaccinated. As a result the many of them succumbed to the biological viruses with a few suffering permanent damage.

The evolution of cultural maladaptations is a particular risk because of another important difference between cultural evolution and the evolution of genes: the pattern of the transmission of information. Genetic transmission is constrained to be vertical—from parents to offspring. This, thanks to the cellular mechanisms that keeping rogue genes at bay, makes biological evolution relatively orderly. Cultural variants can be transmitted vertically (from parent to offspring) but also oblique transmission (unrelated adults to children) and horizontal transmission (among peers) are also important. Individuals equipped with some reasonable decision-making rules can hope to harvest some good ideas by imitating people other than your parents. But there is always a risk. The scope for the evolution of attractive-seeming but ultimately harmful information in obliquely transmitted cultural elements is great and it is even greater when the information is horizontally transmitted, that is from individuals who are as inexperienced and untested as ones self.

Some students of cultural evolution imagine that culture is largely made up of what they consider to be "parasitic memes" (Blackmore, 1999). Richard Dawkins (2006) argues that religion is such a maladaptive cultural element, typically transmitted to children at young ages when their minds are impressionable, and their decision-making powers not yet fully functional. He subscribes to a byproduct hypothesis to explain most if not all of religion. Young minds have to be impressionable so as to rapidly and accurately acquire essential information from parents. Parasitic religious memes take advantage of this impressionability. Evolutionary psychologists have advanced similar ideas (Atran & Norenzayan, 2004).

One doesn't have to follow these authors in suggesting that *all* religious ideas, institutions and organizations are maladaptive to realize that some may be. Extreme examples of religious sects espousing maladaptive ideas do certainly exist, for example the cult led by Jim Jones that committed mass suicide in 1978. Modern societies have much greater rates of horizontal and oblique cultural transmission compared to traditional ones. The scope for the evolution of pathological memes is consequently greater than in the past. The rapid decline in fertility in modern and modernizing societies is explicable on this basis (Newson, Postmes, Lea, & Webley, 2005). Religious groups like the Anabaptists that still have high fertility comprehensively reduce their exposure to modern memes and maintain tight kin networks. Even quite pronatalist religions like Catholicism have not been very effective in the face of the demographic transition.

Other cultural-evolutionary mechanisms may generate specific sorts of maladaptations. For example, symbolic culture can evolve exaggerated traits by a mechanism much like sexual selection (Richerson & Boyd, 1989). Exaggerated, costly, religious rituals could be examples. The Protestant Reformation's charge that the Roman Catholic Church's lavish expenditures for buildings and ornaments were dysfunctional is a potential example. Perhaps costly religious behavior often has little or nothing to do with guaranteeing honest signals and is mostly or entirely costly competitive exaggeration. On the other hand, such initially symbolic variation perhaps generates the raw material for cultural group selection. Roy Rappaport (1979) advanced an interesting hypothesis along these lines. He thought that "supernatural veils" were necessary to protect group-functional adaptations from the corrosive attack of individually selfish rationality. Random exaggeration may be the group level analog of mutation, ultimately a raw material for adaptation. For every Jacob Amman or Joseph Smith there must be hundreds of religious innovators like Ann Lee, the founder of the celibate Shakers, whose sects at best prosper briefly and then disappear.

Having culture brings net benefits or humans would not have it and nor would we would not be such a successful species. Unalloyed maladaptive cultural variants are the exception rather than the rule. We attribute this to the ability of humans to decide between cultural elements and create new ones. Religious conversion and religious innovation are important examples. An innovator like Mormon founder Joseph Smith was able to invent a quite novel new religion, though in truth he mainly selected a novel combination of ideas that were current in his community in the early 19th Century (Brooke, 1994). Clearly many people decided that adopting those ideas will benefit them

and clearly many feel they have benefited. Currently, the Latter Day Saints are one of the most actively proselytizing religions in the world and enjoy rapid growth as a result (Iannaccone, Olson, & Stark, 1995).

David Wilson (2002) provides a number of examples of religious ideas being adopted because they provided fitness benefits. The formation and spread of Calvinism is his central example. He describes in some detail how the problem of corruption in the Catholic Church led Calvin to propose, and the people of Geneva eventually to adopt, a religiously inspired code of conduct that effectively ended the disruptive factionalism in the city. Calvin's model inspired much imitation based on its success in Geneva. Karen Armstrong (1991) gives a similar account of Muhammad's religiously inspired code aimed at regulating the intertribal anarchy of the Arabs. Stephen Lansing (1993) shows how Balinese Water Temples function to organize scarce water and coordinate rice planting on Bali so as to optimize rice yields. Religions also seem to have many individually adaptive benefits. For example, Hill and Pargament (2003) review the literature on the connection between religion and spirituality and physical and mental health.

Conclusion

In the face of biological and cultural complexity and diversity, phenomena like religion are unlikely to support sweeping generalizations about adaptation versus maladaptation. Theory tells us that many things are possible. Any generalizations will have to be based upon careful empirical work. The basic task is to tot up the various kinds of costs and benefits that accrue to religious variants. This project has barely begun in any domain of culture. Students of religion have done some exemplary studies in this regard. Roof and McKinney (1987) showed how demographic data could be mobilized to show the relative importance of differential birth rates and differential conversion and apostasy in the growth and decline of religions. Differential birth rate (natural selection) tends to be more important than differential conversion and apostasy. Hout et al.'s (2001) careful work along these lines shows how progress can be made despite the problems of complexity and diversity. Our own unpublished work with Brian Paciotti using experimental games suggests that different forms of religiosity make small positive and negative contributions to prosocial behavior.

References

Anderson, B. R. O. G. (1991). *Imagined Communities: Reflections on the Origin and Spread of Nationalism* (Rev. and extended ed.). London: Verso.

Armstrong, K. (1991). *Muhammad: A Western Attempt to Understand Islam*. London: Victor Gollancz.

Atran, S., & Norenzayan, A. (2004). Religion's evolutionary landscape: Counterintuition, commitment, compassion, communion. *Behavior and Brain Sciences, 27*, 713-770.

Blackmore, S. (1999). *The Meme Machine*. Oxford: Oxford University Press.

Boyd, R., & Richerson, P. J. (1985). *Culture and the Evolutionary Process*. Chicago: University of Chicago Press.
Brooke, J. L. (1994). *The Refiner's Fire: The Making of Mormon Cosmology, 1644-1844*. Cambridge: Cambridge University Press.
Burnham, K. P., & Anderson, D. (2002). *Model Selection and Multi-model Inference.* Berlin: Springer Verlag.
Campbell, D. T. (1965). Variation and selective retention in socio-cultural evolution. In H. R. Barringer, G. I. Blanksten & R. W. Mack (Eds.), *Social Change in Developing Areas: A Reinterpretation of Evolutionary Theory* (1965 ed., pp. 19-49). Cambridge, MA: Schenkman Publishing Company.
Campbell, D. T. (1975). On the conflicts between biological and social evolution and between psychology and moral tradition. *American Psychologist, 30*(12), 1103-1126.
Cavalli-Sforza, L. L., & Feldman, M. W. (1981). *Cultural Transmission and Evolution: A Quantitative Approach*. Princeton, NJ: Princeton University Press.
Darwin, C. (1874). *The Descent of Man and Selection in Relation to Sex* (2nd ed.). New York: American Home Library.
Dawkins, R. (1976). *The Selfish Gene*. Oxford: Oxford University Press.
Dawkins, R. (2006). *The God Delusion*. London: Bantam.
Diamond, J. (2005). *Collapse: How Societies Choose to Fail or Succeed*. New York: Viking.
Finke, R., & Stark, R. (1992). *The Churching of America, 1776-1990: Winners and Losers in Our Religious Economy*. New Jersey: Rutgers University Press.
Gadgil, M., & Malhotra, K. C. (1983). Adaptive significance of the Indian caste system: an ecological perspective. *Annals of Human Biology, 10*, 465-478.
Gibbon, E. (2006). *The Decline and Fall of the Roman Empire*. Retrieved December 2, 2006, from http://www.ccel.org/ccel/gibbon/decline.html
Gintis, H. (2004). Towards the unity of the behavioral sciences. *Politics, Philosophy & Economics, 3*(1), 37-57.
Grafen, A. (2003). Fisher he evolutionary biologist. *The Statistician, 52 (Part 3)*, 319-329.
Henrich, J. (2004). Cultural group selection, coevolutionary processes and large-scale cooperation. A target article with commentary. *Journal of Economic Behavior and Organization, 53*, 3-143.
Hill, P. C., & Pargament, K. I. (2003). Advances in the conceptualization and measurement of religion and spirituality: Implications for physical and mental health. *American Psychologist, 58*(1), 64-74.
Hout, M., Greeley, A. M., & Wilde, M. J. (2001). The demographic imperative in religious change in the United States. *American Journal of Sociology, 107*(2), 468-486.
Iannaccone, L. R. (1994). Why strict churches are strong. *American Journal of Sociology, 99*(5), 1180-1211.
Iannaccone, L. R., Olson, D. V. A., & Stark, R. (1995). Religious resources and church growth. *Social Forces, 74*(2), 705-731.
Laland, K. N., & Brown, G. R. (2002). *Sense and Nonsense: Evolutionary Perspectives on Human Behaviour*. Oxford: Oxford University Press.

Lansing, J. S. (1993). Emergent properties of Balinese Water Temple networks: Coadaptation on a rugged fitness landscape. *American Anthropologist, 95*(1), 97-114.

Lumsden, C. J., & Wilson, E. O. (1981). *Genes, Mind, and Culture: The Coevolutionary Process*. Cambridge, MA: Harvard University Press.

Maynard Smith, J., & Szathmary, E. (1995). *The Major Transitions in Evolution*. Oxford: W.H. Freeman/Spectrum.

Newson, L., Postmes, T., Lea, S. E. G., & Webley, P. (2005). Why are modern families small? Toward an evolutionary and cultural explanation for the demographic transition. *Personality and Social Psychology Review, 9*, 360-375.

Rappaport, R. A. (1979). Ecology, Meaning, and Religion (pp. xi, 259). Richmond CA: North Atlantic Books.

Richerson, P. J., & Boyd, R. (1987). Simple models of complex phenomena: The case of cultural evolution. In J. Dupré (Ed.), *The Latest on the Best: Essays on Evolution and Optimality* (pp. 27-52). Cambridge: MIT Press.

Richerson, P. J., & Boyd, R. (1989). A Darwinian theory for the evolution of symbolic cultural traits. In M. Freilich (Ed.), *The Relevance of Culture* (pp. 120-142). Boston: Bergin and Garvey.

Richerson, P. J., & Boyd, R. (1999). Complex societies - The evolutionary origins of a crude superorganism. *Human Nature-an Interdisciplinary Biosocial Perspective, 10*(3), 253-289.

Richerson, P. J., & Boyd, R. (2005). *Not By Genes Alone: How Cultural Transformed Human Evolution*. Chicago: University of Chicago Press.

Roof, W. C., & McKinney, W. (1987). *American Mainline Religion: Its Changing Shape and Future*. New Brunswick NJ: Rutgers University Press.

Salamon, S. (1992). *Prairie Patrimony: Family, Farming, and Community in the Midwest*. Chapel Hill: University of North Carolina Press.

Srinivas, M. N. (1962). *Caste in Modern India, and Other Essays*. Bombay: Asia Pubublishing House.

Stark, R. (1997). *The Rise of Christianity: How the Obscure, Marginal Jesus Movement Became the Dominant Religious Force in the Western World in a Few Centuries*. San Francisco: HarperCollins.

Wilson, D. S. (2002). *Darwin's Cathedral: Evolution, Religion, and the Nature of Society*. Chicago: University of Chicago Press.