

A friend, appalled by the killings perpetrated in so many parts of the world in the name of religion, questioned how such behavior could have become a part of our makeup as a species. What was the route by which natural selection made this behavior a part of us? What were the conditions in our evolution that could account for the evolution of such behavior?

It seems to me that there are really two questions being asked here. First, what evolutionary forces would prompt a religious leader to instigate such behavior in his/her followers? And, second, what evolutionary forces would lead the followers of a religion to carry out such acts, even though it might mean the loss of their own lives?

The first question: Why would a religious leader instigate such behavior in his/her followers? I think the answer ultimately comes down to the evolution of behaviors favoring competitive ability for critical resources:

I think you have to set aside the philosophical underpinnings of religion. In the real world religions always seem to be run by bureaucrats, they just happen to be bureaucrats who assume they have all the right answers directly from a supreme being (mystics have never made out very well in established religions). And like bureaucrats everywhere they are seemingly obsessed with maintaining or increasing their power base. (Not that there aren't leaders who are exceptions to this generalization, but perhaps many who have marketed themselves as exceptions are far from it.)

This desire to increase their power base is just an expression of competition among the leaders of religions for the resource we call followers. Success in this competition is measured by the ability to maintain or increase the number of one's adherents, or perhaps the proportion of the population that are adherents. There is direct competition for followers and perhaps, more indirectly, competition to make other types of critical resources, such as land or

food, more available to their followers and thus indirectly increase the relative number of their followers in years to come. Because of this competition it is logical for religious leaders to exhort their followers to convert others, to disenfranchise, to push aside or even to kill individuals who are not followers. This would enhance the leader's "market share" and simultaneously leave his followers with a greater share of the resources, further increasing his power. This is straightforward completion by the leaders for critical resources and so seems pretty straightforward and understandable.

The same argument can be extended to leaders of nations, or corporations, or any other group that has a leader. It is the same competitive behavior and has the same evolutionary origin as any competition between individuals.

So, the next step is to follow the chain of logic backwards and ask "Why are we competitive?" Or rather, "How did competitive behavior evolve?"

To an ecologist the central underlying organizing principle is competition for critical resources. A critical resource is one of which there is not enough to go around. So we compete for it. Food is often a critical resource for animal species as it is not freely available and can limit the ability of individuals to survive. On the other hand, for land animals the oxygen in the air is not a critical resource as under most circumstances there is an abundance of it.

Much of ecology and evolution is structured around this concept of competition for critical resources. It runs all the way from relations between members of the same species in the same group up through the organization of ecological systems to the level of communities, energy flow, and biogeochemistry.

At the level of relations between individuals of a single species the competition for a resource can be direct (you directly confront the other individual, like in fighting for a critical resource such as food) or indirect (you

do something that prevents the other from getting the resource, like eating the food before the other can).

Competitive behavior is an outcome of natural selection. It is favored by natural selection. Obviously, if you can't obtain a resource as well as the next fellow you are not going to survive and transmit your genes to the next generation as well as he/she does. In most species and in most instances the evolution of competitive adaptations is pretty straightforward. Suppose the individual A has a gene form (an allele, more formally, say it is called " $\alpha$ ") that lets him/her compete and so survive (reproduce to have grandchildren, more accurately) better, then that gene allele is more likely to be passed on to the next generation than the allele of C, who doesn't have the same allele of the gene and therefore doesn't survive as well. A wins, his gene alleles " $\alpha$ " become more frequent in the gene pool, and by definition his gene alleles have been selected for and evolution has occurred. Competitive behavior is influenced by genetic makeup just as is any other trait.

To cast this in human terms, if A as an individual is faced with obtaining a critical resource then A will have to compete with anyone else that is also trying to obtain that resource. The more successful A is at competing the more likely his/her gene alleles are to be passed along. So competitive behavior, influenced by the genes, will be selected for by natural selection. This works for direct or indirect competition.

The behavior of a religious leader, competing for adherents or influence, can thus be viewed as competitiveness based on predispositions to behavioral sets selected for during the course of evolution and mandated by the arithmetic of natural selection. The original genetic logic behind the competitiveness may have been lost (as in a celibate religious leader) but the behavioral sets that evolved remain and shape the competitiveness.

Leaders, of any kind, tend to use their followers to further their own ends.

That leads to the second question: what evolutionary forces would lead the followers of a religion to carry out acts to support competition by their leader? If following the leader's instructions increases their own competitive status, the answer is, as above, straightforward. But what about following the leader's instructions even though it might increase the possibility, or even make certain, that they would lose their own lives doing so?

To understand this we have to start again with the straightforward version of how competitiveness evolves: those individuals with gene forms that allow them to compete better increase their proportion in the population and so by definition have been selected for. But for the argument that follows it will make more sense if you turn this idea around and think of competition from the point of view of the gene alleles: The alleles of genes, the alternate forms of the same gene, are what compete. If the " $\alpha$ " allele can out compete alternate " $\beta$ " allele and come to constitute a greater proportion of the gene pool of the species, then the " $\alpha$ " allele wins. In this view individuals are little more than sacks of protoplasm that genes have designed to get themselves transmitted to the next generation. The gene alleles are what compete – the bodies they make are just the machinery by which they compete.

Just to say it again. This is just straightforward natural selection, but from the perspective of the gene alleles rather than the individual. And straightforward competitive behaviors among humans can be viewed in this way.

But in social species such as ourselves it can get a little bit more complicated and this is where it helps to think of things from the point of view of the gene.

Above we said that if the individual A's allele " $\alpha$ " allowed the body containing the alleles to compete better than the individual C's allele " $\beta$ ", then A's alleles " $\alpha$ " would be selected for and come to predominate in the following generations. This is straightforward natural selection.

Now what if A has a brother B, with whom by virtue of having the same biological parents he probably shares 50% of his genes. If the odds are right you can say that there will be circumstances where it is in the gene alleles's (" $\alpha$ ") advantage to have the individual A sacrifice himself if it means that his brother B (who is 50% likely to share the " $\alpha$ "\_allele) will prevail over C (who doesn't share the gene allele " $\alpha$ "). Those gene alleles the brothers share have become more frequent in the population and so the allele " $\alpha$ " of the gene has won even though one of the individuals that carried around the allele is no longer around. Self-sacrificing behaviors are generally referred to as altruistic and are thought to evolve in this way. It is a special form of natural selection that is known as group or kin selection. The principle can extend to any genetically related group, although obviously how strong the effect can be depends in part on how closely related the group is.

Behaviors which can be attributed to group selection have been found in a number of social species, not all of which are primates. There is no reason to assume group selection didn't occur in early primate societies, where there was probably at least some common genetic makeup to the group. And these early primate societies ultimately led to us. We are genetically programmed to potentially sacrifice ourselves for the good of the group.

How does this actually work in the brain? In terms of the mechanics of the development of the mind, as best we understand it, neural networks are laid down. Out of all the trillions of possible interconnections, think of these neural networks as neural circuits that are more likely to fire than randomly chosen circuits. And these networks, once formed, become more stable as, with age, alternate possible pathways are pruned away.

And, as best we understand it, these neural networks are laid down, for want of a better term, in grooves or in predispositions so that the neural networks are more likely to form in a certain ways and we are therefore more likely to learn and develop in certain ways. The development of a behavioral trait in a maturing individual, while not completely predetermined, is at least more likely to occur in some ways than in others. It is admittedly a complex interplay of genetic/neurological predisposition and the developmental history of the individual.

It seems logical, and there is some evidence to support this, that complexes of genes control these grooves or predispositions. These complexes of genes could be selected for or against just like any other gene.

Interestingly, one of the ways in which these neural nets seem to have been organized or “grooved” is so that there seems to be a predisposition for what is usually called “altruism”.

The evolution of this altruism groove, this predisposition toward altruism, made sense in a hunter-gatherer society. As we saw it could be evolutionarily advantageous for individuals not to be totally self-centered and to go so far as to lay down their lives or do anything else that allowed the gene alleles co-shared with other members of the group to become more prevalent. And so we think that this predisposition to altruism was selected for, by group selection, during the course of evolution.

But this predisposition might better be called a loyalty predisposition rather than altruism predisposition. Think of altruism as giving up something for some undefined other person; think of loyalty as giving up something for someone in your group. In our evolutionary history it may be more accurate to say that we have evolved not a predisposition to true altruism but rather a predisposition to loyalty to a group that shares our genes.

And so a predisposition to loyalty can be a successful evolutionary strategy: for A to kill C from another group so that his brother B gains the limited resource and survives and the common genes they carry are passed along to the next generation, even if it means A dies in the process. Looked at from the view of selection of genes, A is loyal to his group and group selection rewards this and the genes that cause the neural nets to be laid down with this groove are selected for. The kill-or-be-killed scenario is the easiest to understand, but for the loyalty predisposition to have evolved any behavior that degrades the other group's competitiveness even though it also degrades the individual's competitiveness could work. For example, A, getting up early in the morning might fill the water gourds at the drying up spring so his group has water, thereby depriving the other group of water, even though it means he is at somewhat more risk of being eaten by the sabre-toothed tiger hunting in the early morning light.

Perhaps this predisposition to loyalty is also the origin of the "us/them" dichotomy.

The loyalty predisposition worked quite well for humans evolving in a traditional hunter-gatherer society. When it comes off the rails is when civilization emerged some 8K years ago (perhaps a blink of the eye as far as evolution goes). Loyalty is not performing its original selective function because we no longer live in groups where we have any genetic relationships to the others in the group.

Yet the neural nets are still there telling us to be loyal and to compete and go out and push other people aside for the benefit of the group we belong to. In a sense loyalty has become, in some ways, an inappropriate trait in terms of selection. Our behavioral predisposition to loyalty motivates us to outcompete other groups even though we are not genetic members of our own group.

Under civilization the group could be a neighborhood, a community, a business/corporation, a nation, or a religion. Anything that you can feel loyalty to will function. We are predisposed to be loyal to our group and we are predisposed to take actions to ensure that our group outcompetes the other group. And killing the members of the other group at the urging of a religious leader is thus an understandable, although extreme, consequence of this predisposition. We are, in a sense, prisoners of our evolutionary history.

You as an individual may feel that you would not take part in such behavior. But if you look at history you can see that “doing the other guy in” has been a common theme in religion. Think of Islam, where it is written in the Quran that force is an acceptable way to spread the faith? Think of the Catholic Church during the Inquisition where torture and murder were acceptable ways to keep the masses in line? Think of the Reformation–Counter Reformation of the 1500’s and 1600’s where both sides waged war in the name of their particular religious group? Think of Northern Ireland? Also, think of contemporary members of our Armed Services who loyally volunteer even though they know it may mean they are asked to kill in the service of their country? Think of the drone operator who kills by remote control in the service of his/her country?

This loyalty predisposition and the behaviors it favors are a part of our biological heritage. So, yes, there is a current in our evolutionary history which predisposes us to following the orders or exhortations of our leaders, be they religious or otherwise.

You can ask if this was selected for, why hasn’t it be selected out again? First, it has been a relatively short time since civilization arose compared to the maybe 50M years or more that primates have been social. And second, something like this is now probably wired deeply into our brains; it can’t be just ripped out by itself because too many other behaviors are attached to it and taking it out would disrupt too many other things for the brain to work. Perhaps



it is like a piece of computer code that was once advantageous and has now become so deeply imbedded in the architecture of the whole system that it can no longer be removed without starting over from scratch, even though the code may sometimes cause problems. I have read that there are some parts of the BIOS that are like that. While it might theoretically be possible to start completely over with computer architecture we don't have that option with humans.

To summarize: Yes, it is understandable, in terms of natural selection and evolution, that our leaders would urge/order us to kill members of other groups. And yes, it is also understandable, in terms of natural selection and evolution, that we loyal followers would kill members of the other group at the behest of our leaders, even though it may mean sacrificing our own lives.