Human Culture, an Evolutionary Force

[This is a letter that Scott H. sent to friends on March 2, 2010, which comments on an (included) article in the *New York Times* that day with the same title.]

Hi science fans,

The perpetual battle between those who favor "nature" or "nurture" as *"the cause"* of human behavior of course continues. But as our knowledge of our human biological, psychological and cultural nature gets deeper, and as we deepen our understanding of the multiple and complex processes involved in our evolutionary development, it seems to be getting clearer and clearer that *both* biology and culture are important to our makeup. Indeed these two forces often interpenetrate.

The article below, from today's *New York Times*, brings out a new aspect of this that has only recently dawned on evolutionary science: Over time our culture also serves to change our own biology to considerable degrees.

A few comments:

1) There is still a tremendous bias among "evolutionary psychologists" in particular (including those who formerly called themselves sociobiologists), that biology is far more important than nurture and culture when it comes to determining human behavior.

2) This bias is due in part to the continuing need of the ruling capitalist class to show that "human nature" is inherently selfish and that therefore only capitalism can function as a workable economic system. (And this in spite of the fact that during more than 99% of human history capitalism did not even exist! And also in spite of the fact that, as we enter the early stages of a new great depression, capitalism itself is currently becoming far more dubious as a "workable" economic system!)

Nevertheless, the erroneous argument that cooperation and socialism "go against human nature" is still strongly dominant in contemporary society.

3) There is indeed such a thing as "human nature", which does ultimately have some biological roots. But what bourgeois ideologists are not able to accept are:

A) These biological roots include *both* cooperative aspects and selfish aspects, and

B) The existing culture dominates the biological roots and determines the form that "typical human nature" takes at any given point in history.

As Marx put it, in criticizing the semi-anarchist Proudhon, "Herr Proudhon does not know that all history is but the continuous transformation of human nature."

4) The completion of the Human Genome Project, and the only extremely limited usefulness of

the results of that project so far (with regard to showing why humans behave as they do), has forced the biological determinists to retreat somewhat from their almost exclusive focus on genetics. For example, we now hear more and more about how the *proteome* (the totality of the proteins present at a given time in cells) is the "true cause" of why the body functions as it does, including why human beings behave as they do.

While proteomics, *evo-devo* (evolutionary developmental biology), etc., are now supplementing genetic determinism, biological determinism as a whole is still extremely simple minded. The real situation is that there are many levels of phenomena that determine human behavior including multiple layers of biological determination *and* multiple layers of cultural determination.

One would think the absurdities of biological reductionism would be obvious by now!

5) The article below does show that evolutionary science as a whole (if not yet the sub-sphere of evolutionary psychology) is beginning to understand that biology and culture are not mutually exclusive, that they do indeed interpenetrate. This is definitely an advance in our conceptions.

It is perhaps true that one of the subconscious motives here is to retreat somewhat in the direction of the notion that "genetics is everything", by implying that while human culture is important, it may mostly be important insofar as it leads to changes in the genome. That of course is not really the case. That is indeed an important result of human culture, but it is only one of many important results.

6) There is one very important example of the ability of human culture to affect human biology (including genetics) that is dear to my heart and which I have been arguing for for a long time now. The article didn't mention it, but I think it is much more important than the things they did mention, at least with respect to the biological aspect of human nature.

And that is what we call the *conscience*. The conscience is an agency of the mind/brain that allows society (usually a child's parents initially) to attach emotional responses to certain behaviors (or even to the *thought* of performing such behaviors). Harming someone else or killing them, for example, becomes associated with emotions of revulsion, dread, remorse and the like.

That is, the conscience is programmable, though once it is initially programmed it can only be reprogrammed with difficulty. The conscience thus makes it more difficult for us to do things which society views as wrong (such as harming other people) even if it on occasion becomes in our selfish interest to do so.

However, *intellectually* we can fairly easily come to change our minds about whether something is right or wrong. Thus while we are taught to think that killing people is wrong, the government—through patriotic indoctrination—can easily convince most young people that it is OK to kill their enemy in whichever war is underway. But it is much harder for the government to reprogram the consciences of the soldiers in this regard. (The extreme techniques used in boot camp, as illustrated for example in the movie *Full Metal Jacket*, show the techniques that must

be used.) If the techniques of ferocious indoctrination are not used, the conscience can still be reprogrammed to agree with the intellect. Thus we gradually reprogram our own consciences to comply with our changing intellectual ideas, but it takes a fair amount of time to do so. And sometimes our lagging consciences force a reversion to our older ideas!

Anyway, getting back to my main theme, my theory on how this biologically-based organ, the conscience, evolved is this: First human (or actually proto-human) society developed a form of existence that was strongly social and cooperative. (Hunter-gatherer society carried on by bands of people working and living together.) That is, we developed what even for some non-human animals (such as wolves) is properly described as a *socially cooperative culture*. But social cooperation is difficult to maintain, for all the reasons that the bourgeoisie likes to emphasize, and there remain strong pressures toward individual selfishness and cheating. In other words, various forms of reinforcement for this social cooperation were needed and highly useful once they developed. And one of these was the conscience. In other words, the conscience evolved to support the social form of existence that our ancestors had already developed.

Actually there was another type of reinforcement of cooperation that probably developed even before the conscience, namely *ideology*. Ideologies of sharing and cooperation (that such things are *good*, for example) depend of course on human language. Language almost certainly developed because we are social animals and need to cooperate in our activities. But once the medium became available, ideologies surely also soon developed to reinforce that social way of life.

I suppose it is remotely possible that the conscience evolved (or began to evolve) before language, but certainly the existence of language and ideology would serve to facilitate the evolution of the conscience.

In any case, I suggest that the human conscience, which is a biologically-based agency within the brain, is another example of how culture led to biological (and genetic) changes in human beings.

Scott

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Human Culture, an Evolutionary Force

By Nicholas Wade

As with any other species, human populations are shaped by the usual forces of natural selection, like famine, disease or climate. A new force is now coming into focus. It is one with a surprising implication — that for the last 20,000 years or so, people have inadvertently been shaping their own evolution.

The force is human culture, broadly defined as any learned behavior, including technology. The evidence of its activity is the more surprising because culture has long seemed to play just the opposite role. Biologists have seen it as a shield that protects people from the full force of other selective pressures, since clothes and shelter dull the bite of cold and farming helps build surpluses to ride out famine.

Because of this buffering action, culture was thought to have blunted the rate of human evolution, or even brought it to a halt, in the distant past. Many biologists are now seeing the role of culture in a quite different light.

Although it does shield people from other forces, culture itself seems to be a powerful force of natural selection. People adapt genetically to sustained cultural changes, like new diets. And this interaction works more quickly than other selective forces, "leading some practitioners to argue that gene-culture co-evolution could be the dominant mode of human evolution," Kevin N. Laland and colleagues wrote in the February issue of Nature Reviews Genetics. Dr. Laland is an evolutionary biologist at the University of St. Andrews in Scotland.

The idea that genes and culture co-evolve has been around for several decades but has started to win converts only recently. Two leading proponents, Robert Boyd of the University of California, Los Angeles, and Peter J. Richerson of the University of California, Davis, have argued for years that genes and culture were intertwined in shaping human evolution. "It wasn't like we were despised, just kind of ignored," Dr. Boyd said. But in the last few years, references by other scientists to their writings have "gone up hugely," he said.

The best evidence available to Dr. Boyd and Dr. Richerson for culture being a selective force was the lactose tolerance found in many northern Europeans. Most people switch off the gene that digests the lactose in milk shortly after they are weaned, but in northern Europeans — the descendants of an ancient cattle-rearing culture that emerged in the region some 6,000 years ago — the gene is kept switched on in adulthood.

Lactose tolerance is now well recognized as a case in which a cultural practice — drinking raw milk — has caused an evolutionary change in the human genome. Presumably the extra nutrition was of such great advantage that adults able to digest milk left more surviving offspring, and the genetic change swept through the population.

This instance of gene-culture interaction turns out to be far from unique. In the last few years, biologists have been able to scan the whole human genome for the signatures of genes undergoing selection. Such a signature is formed when one version of a gene becomes more common than other versions because its owners are leaving more surviving offspring. From the

evidence of the scans, up to 10 percent of the genome — some 2,000 genes — shows signs of being under selective pressure.

These pressures are all recent, in evolutionary terms — most probably dating from around 10,000 to 20,000 years ago, in the view of Mark Stoneking, a geneticist at the Max Planck Institute for Evolutionary Anthropology in Leipzig, Germany. Biologists can infer the reason for these selective forces from the kinds of genes that are tagged by the genome scans. The roles of most of the 20,000 or so genes in the human genome are still poorly understood, but all can be assigned to broad categories of likely function depending on the physical structure of the protein they specify.

By this criterion, many of the genes under selection seem to be responding to conventional pressures. Some are involved in the immune system, and presumably became more common because of the protection they provided against disease. Genes that cause paler skin in Europeans or Asians are probably a response to geography and climate.

But other genes seem to have been favored because of cultural changes. These include many genes involved in diet and metabolism and presumably reflect the major shift in diet that occurred in the transition from foraging to agriculture that started about 10,000 years ago.

Amylase is an enzyme in the saliva that breaks down starch. People who live in agrarian societies eat more starch and have extra copies of the amylase gene compared with people who live in societies that depend on hunting or fishing. Genetic changes that enable lactose tolerance have been detected not just in Europeans but also in three African pastoral societies. In each of the four cases, a different mutation is involved, but all have the same result — that of preventing the lactose-digesting gene from being switched off after weaning.

Many genes for taste and smell show signs of selective pressure, perhaps reflecting the change in foodstuffs as people moved from nomadic to sedentary existence. Another group under pressure is that of genes that affect the growth of bone. These could reflect the declining weight of the human skeleton that seems to have accompanied the switch to settled life, which started some 15,000 years ago.

A third group of selected genes affects brain function. The role of these genes is unknown, but they could have changed in response to the social transition as people moved from small hunter-gatherer groups a hundred strong to villages and towns inhabited by several thousand, Dr. Laland said. “It’s highly plausible that some of these changes are a response to aggregation, to living in larger communities,” he said.

Though the genome scans certainly suggest that many human genes have been shaped by cultural forces, the tests for selection are purely statistical, being based on measures of whether a gene has become more common. To verify that a gene has indeed been under selection, biologists need to perform other tests, like comparing the selected and unselected forms of the gene to see how they differ.

Dr. Stoneking and his colleagues have done this with three genes that score high in statistical tests of selection. One of the genes they looked at, called the EDAR gene, is known to be involved in controlling the growth of hair. A variant form of the EDAR gene is very common in East Asians and Native Americans, and is probably the reason that these populations have thicker hair than Europeans or Africans.

Still, it is not obvious why this variant of the EDAR gene was favored. Possibly thicker hair was in itself an advantage, retaining heat in Siberian climates. Or the trait could have become common through sexual selection, because people found it attractive in their partners.

A third possibility comes from the fact that the gene works by activating a gene regulator that controls the immune system as well as hair growth. So the gene could have been favored because it conferred protection against some disease, with thicker hair being swept along as a side effect. Or all three factors could have been at work. "It's one of the cases we know most about, and yet there's a lot we don't know," Dr. Stoneking said.

The case of the EDAR gene shows how cautious biologists have to be in interpreting the signals of selection seen in the genome scans. But it also points to the potential of the selective signals for bringing to light salient events in human prehistory as modern humans dispersed from the ancestral homeland in northeast Africa and adapted to novel environments. "That's the ultimate goal," Dr. Stoneking said. "I come from the anthropological perspective, and we want to know what the story is."

With archaic humans, culture changed very slowly. The style of stone tools called the Oldowan appeared 2.5 million years ago and stayed unchanged for more than a million years. The Acheulean stone tool kit that succeeded it lasted for 1.5 million years. But among behaviorally modern humans, those of the last 50,000 years, the tempo of cultural change has been far brisker. This raises the possibility that human evolution has been accelerating in the recent past under the impact of rapid shifts in culture.

Some biologists think this is a possibility, though one that awaits proof. The genome scans that test for selection have severe limitations. They cannot see the signatures of ancient selection, which get washed out by new mutations, so there is no base line by which to judge whether recent natural selection has been greater than in earlier times. There are also likely to be many false positives among the genes that seem favored.

But the scans also find it hard to detect weakly selected genes, so they may be picking up just a small fraction of the recent stresses on the genome. Mathematical models of gene-culture interaction suggest that this form of natural selection can be particularly rapid. Culture has become a force of natural selection, and if it should prove to be a major one, then human evolution may be accelerating as people adapt to pressures of their own creation.