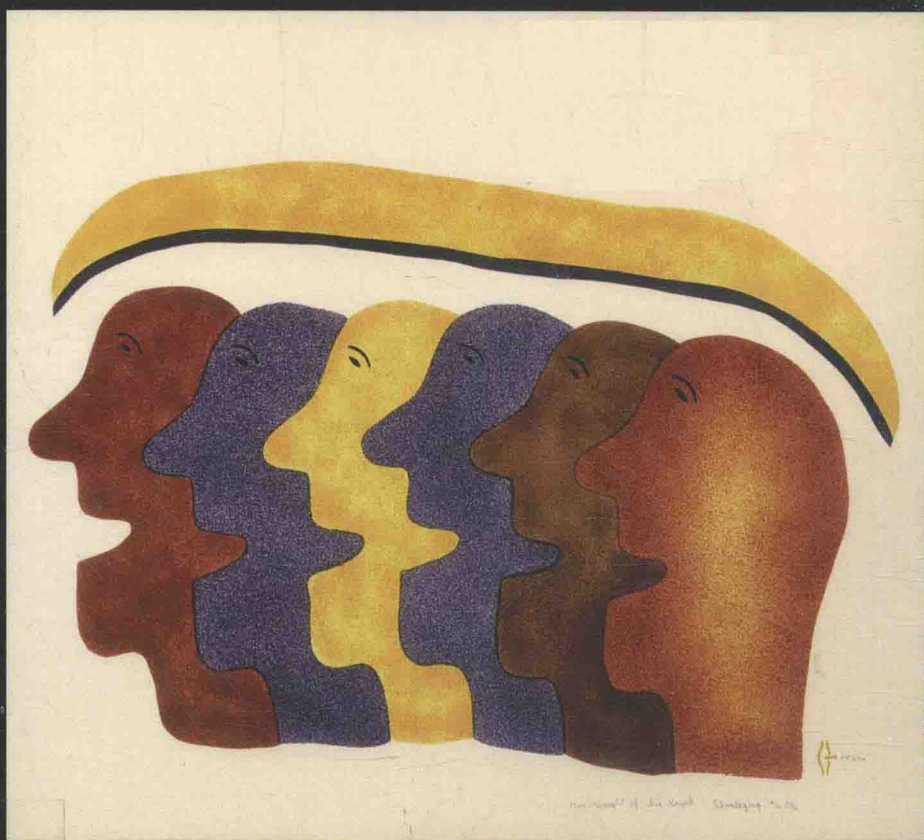


The Origin and Evolution of Cultures



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- 4: P. J. Richerson and R. Boyd. Climate, culture, and the evolution of cognition. In: *The Evolution of Cognition*. Celia Heyes and Ludwig Huber, eds. Cambridge, MA: MIT Press, 2000.
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- 6: R. Boyd and P. J. Richerson. The evolution of ethnic markers. *Cultural Anthropology*, 2:65–79, 1987.
- 7: R. McElreath, R. Boyd, and P. J. Richerson. Shared norms can lead to the evolution of ethnic markers. *Current Anthropology*, 44:122–130, 2003.
- 8: R. Boyd and P. J. Richerson. The evolution reciprocity in sizable groups. *Journal of Theoretical Biology*, 132:337–356, 1988.
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- 20: R. Boyd and P. J. Richerson. Memes: Universal acid or a better mouse trap? In: *Darwinizing Culture: The Status of Memetics as a Science*. R. Aunger, ed. Oxford: Oxford University Press, 2000, pp. 143–162.

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The Origin and Evolution of Cultures

Introduction

Over the last 30 years, we have worked to develop a theory and supporting evidence to account for the evolution of the human capacity for culture and how this capacity leads to distinctive evolutionary patterns. Much of our early work is summarized in our book *Culture and the Evolutionary Process*, published in 1985. Since that time we have published numerous articles that expand the theory and discuss relevant data. We think that these articles fit together to tell a consistent story about how the capacity for culture evolved in the human lineage and why it has led to evolutionarily novel outcomes like large-scale cooperation. However, because this work is relevant to scholars in disciplines ranging from evolutionary biology to archaeology to economics, these essays are scattered among an equally wide range of journals. As a result, the overall story is not so easy to discern. So when Steve Stich suggested that we might bring a sampling of this work together in a single volume of his *Evolution and Cognition* series, we jumped at the chance.

Our research program can be summarized in five propositions:

1. *Culture is information that people acquire from others by teaching, imitation, and other forms of social learning.* On a scale unknown in any other species, people acquire skills, beliefs, and values from the people around them, and these strongly affect behavior. People living in human populations are heirs to a pool of socially transmitted information that affects how they make a living, how they communicate, and what they think is right and wrong. The information thus stored and transmitted varies from individual to individual and is a property of the population only in a statistical sense.

2. *Culture change should be modeled as a Darwinian evolutionary process.* Culture changes as some ideas and values or “cultural variants,” become more common and others diminish. A theory of culture must account for the processes in the everyday lives of individuals that cause such changes. Some of these processes arise from human psychology because some ideas are more readily learned or remembered. Other processes are social and ecological. Some ideas make people richer, live longer, or migrate more often, and the resulting selective processes generate culture change. While making frequent use of ideas and mathematical tools from population biology in modeling such culture change, ultimately the theory must derive from the empirical facts of how culture is stored and transmitted.
3. *Culture is part of human biology.* The capacities that allow us to acquire culture are evolved components of human psychology, and the contents of cultures are deeply intertwined with many aspects of our biology. What we learn, what we feel, how we think, and how we remember are all shaped by the architecture of human minds and bodies shaped over the millennia by the ongoing action of organic evolution. As a result, much cultural variation can be understood in terms of human evolutionary history.
4. *Culture makes human evolution very different from the evolution of other organisms.* Humans, unlike any other living creature, have cumulative cultural adaptation. Humans learn things from others, improve those things, transmit them to the next generation, where they are improved again, and so on, leading to the rapid *cultural* evolution of superbly designed adaptations to particular environments. This ability has allowed human populations to become the most widespread and variable species on earth. At the same time, because cumulative cultural evolution makes available ideas that no individual could discover and technology that no individual could invent, it requires a degree of credulity. While individuals are not passive receptacles of their culture, they cannot vet every belief and value their culture makes available, and this opens the door to the spread of “maladaptive” ideas, ideas that would never evolve in a noncultural organism. Moreover, the fact that much culture is acquired from people other than parents means that such maladaptive ideas tend to accumulate.
5. *Genes and culture coevolve.* Because culture creates durable changes in human behavior, human genes evolve in a culturally constructed environment. This environment, in turn, generates selection on genes. The evolution of language is an example. We apparently have a complex innate system for hearing, speaking, and learning language. This capacity would likely be useless without complex languages to learn. Primitive languages presumably created a cultural world in which better innate language skills were favored by selection. Through repeated rounds of coevolution, complex languages and the costly apparatus necessary to operate them emerged. Such effects are

probably pervasive. The existence of complex technology depends upon great facility in observational learning, and complex social institutions depend on people being adept at learning the rules of social games. Our ape relations can learn only rudimentary bits of language and rudimentary technical and social skills. They have only rudimentary cultural traditions of any kind. Most of what *human* organic evolution has been about is the coevolution of capacities for culture and cultural traditions.

The first two propositions have to do with how culture works, and the last three have to do with how cultural evolution interacts with genetic evolution.

Both of us have a background in biology, and our first work was published during the heat of the sociobiology controversy, so you might think, as many do, that our work arose from an interest in culture and genetic evolution. However, the truth is that our entrée to the subject came from trying to understand how cultural evolution worked to generate human behavior, especially behavior affecting the environment. Our collaboration began in 1974 when we co-taught Environmental Studies 10, a survey of environmental studies for nonmajors at U. C. Davis. At that time Pete was an assistant professor in Environmental Studies and Rob was a finishing graduate student in the Ecology Graduate Group. ES 10 was typically organized around a series of environmental problems—the population explosion, resource depletion, air and water pollution, and so on. We had the idea of organizing it around the principle that individual, goal-seeking behavior sometimes led to outcomes that were bad for everyone and in this way bringing together ideas from ecology and economics. However, we also wanted to discuss human impacts on the environment in ancient and contemporary nonindustrial societies, so this meant going beyond economics. We knew that one of the then-dominant schools in anthropology, cultural ecology, held that much cultural variation could be understood as adaptations to local environments, so this didn't seem like it would be much of a problem. Such is the way of young men.

When we actually sat down to learn what the social sciences had to say about culture, and how cultures adjusted to their environment, we were frustrated and disappointed. Cultural ecologists provided lots of interesting empirical examples of how behavioral variation could be understood as adaptations to environmental differences. However, there was little discussion, and no consensus, about *how* such adaptation occurred. To make matters worse, prominent authors like Marvin Harris explained some behaviors in terms of their function at the group level (the male supremacist complex in the Amazon conserved game) and others in terms of individual advantage (Indians do not eat cows because they are more useful for traction). Since environmental problems often arise because the interests of individuals and groups conflict, we found this more than disconcerting. Other social scientists, symbolic anthropologists, social anthropologists, and many sociologists, refused to explain culture in terms of individual decisions and characteristics as a matter of principle. (A distinguished sociologist once astounded us with the claim that it had been *proven* that it was impossible to do so.)

Of course, the rational actor model that predominates in economics and political science provides a very clear picture of how aggregate behavior arises

from individual choices. Human actors are assumed to come equipped with preferences that describe how they rank outcomes and beliefs that express what they think is the connection between their actions and outcomes. Behavior emerges as people rationally choose the actions that produce the best mix of outcomes. Variation between groups of people arises because different groups face different conditions. The problem is that rational actor theorists do not offer an account of where the preferences and beliefs come from. Scholars working in such traditions usually don't deny that culture is real and important but maintain that worrying about how it gives rise to preferences and beliefs is just not part of their job description.

Darwinian students of human behavior proposed to rectify the lack of a theory of preferences and beliefs with evolutionary theory. Organisms should prefer to maximize their genetic fitness, or rather prefer and believe things that would have led to fitness maximization in the past. This is a strong theory, and certainly part of the answer. Darwinians, like economists, do not usually deny that culture plays a role in the formation of preferences and beliefs. But, like economists, they seldom enter terms representing culture into their models or collect much data about cultural variation.

This benign neglect of culture is usually accompanied by a largely unarticulated prejudice against cultural explanations. Confronted with differences in marriage systems, inheritance rules, or economic organization, such scholars prefer almost any economic or ecological explanation, no matter how far-fetched, over explanations that invoke cultural history. From table talk we gather that one reason is that those students of human behavior who aspire to "hard" scientific explanations are reacting to the "soft" methods of the historians, anthropologists, and sociologists who frequently propose cultural explanations. Blaming the messengers, if such is the case, seems to us unwise.

We think the way to make cultural explanations "hard" enough to enter into principled debates is to use Darwinian methods to analyze cultural evolution. Think of culture as a pool of information, mainly stored in the brains of a population of people. This information gets transmitted from one brain to another by various social learning processes. We define culture as follows: *Culture is information capable of affecting individuals' behavior that they acquire from other members of their species by teaching, imitation, and other forms of social transmission.* By "information," we mean any individual attribute that is acquired or modified by social learning and affects behavior. Most culture is mental states, but not all. Think of the blacksmith's proverbial muscular arms or the model's waif-like figure—essential parts of their crafts. We often use everyday words like *idea, knowledge, belief, value, skill, and attitude* to describe this information, but we do not mean that such socially acquired information is always consciously available, or that it corresponds to folk-psychological categories. People in culturally distinct groups behave differently mostly because they have acquired different beliefs, preferences, and skills, and these differences persist through time because the people of one generation acquire their beliefs and attitudes from those around them.

To understand how cultures change, we set up an accounting system that describes how cultural variants are distributed in the population and how various

processes, some psychological, others social and ecological, cause some variants to spread and others to decline. The processes that cause such cultural change arise in the everyday lives of individuals as people acquire and use cultural information. Some values are more appealing and thus more likely to spread from one individual to another. These will tend to persist while less attractive alternatives tend to disappear. Some skills are easy to learn accurately while others are likely to be transformed during social learning. Some beliefs cause people to be more likely to be imitated, because the people who hold those beliefs are more likely to survive or more likely to achieve social prominence. Such beliefs will tend to spread while beliefs that lead to early death or social notoriety will disappear. We want to explain how these processes, repeated generation after generation, account for observed patterns of cultural variation.

We find it hard to recollect the exact pathway that brought us to this way of thinking. For sure, we were influenced by Donald T. Campbell's famous 1965 essay, and by an early (1973) article of Luca Cavalli-Sforza and Marc Feldman. The general idea was somehow in the air in the early 1970s as F. T. Cloak, Eugene Ruyle, Richard Dawkins, Bill Durham, and Ron Pulliam and Christopher Dunford published work espousing a similar approach to culture. Somewhat later (in 1978), we were fortunate to sit in on a class taught by Cavalli-Sforza and Feldman that was very helpful, especially in adapting models from population genetics to model the population dynamics of cultural variants. We recall thinking that applying the evolutionary biologists' concepts and methods to the study of culture was a rather obvious thing to do. We were more than pleasantly surprised that our predecessors had left so much relatively easy and interesting work undone. As Geoff Hodgson and Robert Richards have discovered, a properly evolutionary social science formed in the late nineteenth and early twentieth centuries before dying an untimely death.

As we were first thinking these thoughts, what came to be called the sociobiology controversy burst into full bloom. The mid-1960s saw the birth of the modern theory of the evolution of animal behavior. Bill Hamilton's seminal articles on inclusive fitness and George Williams's book *Adaptation and Natural Selection* were the foundations. The next decade saw an avalanche of important ideas on the evolution of sex ratio, animal conflicts, parental investment, and reciprocity, setting off a revolution in our understanding of animal societies, a revolution still going on today. By the mid-1970s a number of people, including Dick Alexander, Ed Wilson, Nap Chagnon, Bill Irons, and Don Symons, began applying these ideas to understand human behavior. Humans are evolved creatures, and quite plausibly our societies were shaped by the same evolutionary forces that shaped the societies of other animals. Moreover, the new theory of animal behavior—especially kin selection, parental investment, and optimal foraging theory—seemed to fit the data on human societies fairly well. The reaction from much of the social sciences was, to put it mildly, pretty negative.

The causes of this reaction are complex, as Ullica Segerstråle has shown. The association of biological ideas with racist, eugenicist ideas during the early part of the last century surely played an important role. Another big problem was that many social scientists mistakenly thought about these problems in terms of nature versus nurture. On this view, biology is about nature; culture is about

nurture. Some things, like whether you have sickle-cell anemia, are determined by genes—what we call nature. Other things, like whether you speak English or Chinese, are determined by the environment—nurture. Evolution shapes genetically determined behaviors, but not learned behaviors. Social scientists knew that culture played an overwhelmingly important role in shaping human behavior, and since culture is learned, evolutionary theory has little to contribute to understanding human behavior.

The problem was that this argument cut no ice with anybody who knew much about evolutionary biology. Although the nature-nurture way of thinking is common, biologists know that it is deeply mistaken. Traits *do* vary in how sensitive they are to environmental differences, and it is sensible to ask whether differences in traits are mainly due to genetic differences or differences in the environment. However, the answer you get to this question tells you *nothing* about whether the traits in question are adaptations shaped by natural selection. The reason is that *every bit* of the behavior (or physiology or morphology, for that matter) of every single organism living on the face of the earth results from the interaction of genetic information stored in the developing organism and the properties of its environment, and if we want to know why the organism develops one way in one environment and a different way in a different environment, we have to find out how natural selection has shaped the developmental process of the organism. This logic applies to any trait, learned or not. Moreover, biologists have been quite successful in applying adaptationist reasoning to explain learned behavior.

Because it was framed in terms of nature versus nurture, the evolutionary social science community by and large rejected the idea that culture makes any *fundamental* difference in the way that evolutionary thinking should be applied to humans. The genes underlying the psychological machinery that gives rise to human behavior were shaped by natural selection, so, at least in ancestral environments, the machinery *must have* led to fitness-enhancing behavior. If it goes wrong in modern environments, it is not culture that is the culprit, but the fact that our evolved, formerly adaptive psychology “misfires” these days.

We think that both sides in this debate got it wrong. Culture completely changes the way that human evolution works, but not because culture is learned. Rather, the capital fact is that human-style social learning creates a novel evolutionary trade-off. Social learning allows human *populations* to accumulate reservoirs of adaptive information over many generations, leading to the cumulative cultural evolution of highly adaptive behaviors and technology. Because this process is much faster than genetic evolution, it allows human populations to evolve (culturally) adaptations to local environments—kayaks in the arctic and blowguns in the Amazon—an ability that was a masterful adaptation to the chaotic, rapidly changing world of the Pleistocene epoch. However, the same psychological mechanisms that create this benefit *necessarily* come with a built-in cost. To get the benefits of social learning, humans have to be credulous, for the most part accepting the ways that they observe in their society as sensible and proper, but such credulity opens human minds to the spread of maladaptive beliefs. The problem is one of information costs. The advantage of culture is that individuals don’t have to invent everything for themselves. We get wondrous

adaptations like kayaks and blowguns on the cheap. The trouble is that a greed for such easy adaptive traditions easily leads to perpetuating maladaptions that somehow arise. Even though the capacities that give rise to culture and shape its content must be (or at least have been) adaptive on average, the behavior observed in any particular society at any particular time may reflect *evolved* maladaptations. Empirical evidence for the predicted maladaptations is not hard to find.

Much of our work has been directed at understanding the evolution of the psychological capacities that both permit and shape human culture (see part I). Most evolutionary thinkers approach this problem by first asking how evolution should have shaped the psychology of a group-living, foraging hominid. Then, having answered that question, they ask how the evolved psychology will shape human culture. The implicit evolutionary scenario seems to be that Pleistocene hominids were just extra-smart chimpanzees, clever social animals in whom *social learning* played a negligible role until the evolution of our brain was more or less complete. *Then* we took up culture, whose evolution is completely controlled by the preexisting evolved mind. *First*, we got human nature by genetic evolution; *then*, culture happened as an evolutionary by-product.

This way of thinking neglects the feedback between the nature of human psychology and the kind of social information that this psychology should be designed to process. For us to take bitter medicine, our psychology has to have evolved both to learn socially and to let social learning override aversive stimuli from time to time. As we discuss in chapters 1 and 2, social learning can be adaptive because the behavior of other individuals is a rich source of information about which behaviors are adaptive and which are not. We all know that plagiarism is often easier than the hard work of writing something oneself, and imitating the behavior of others can be adaptive for the same reason. The trick is that once social learning becomes important, the nature of the behavior that is available to imitate is itself strongly affected by the psychology of social learning. Suppose, for example, that everyone relied completely on imitation. Then, even if we somehow started with highly adapted traditions, behavior would gradually become dysfunctional as the environment changed and errors crept into the traditions. To understand the evolution of the psychology that underlies social learning, one must take this sort of feedback into account. We want to know how evolving psychology shapes the social information available to individuals and how selection shapes psychology in an environment with direct information from personal experience *and* the potential to use the behavior of others at a lower cost but perhaps greater risk of error. The research reported in these chapters suggests that this kind of reasoning leads to conclusions quite different from those of other evolutionary theories of human behavior. Under the right conditions, selection can favor a psychology that causes *most* people to adopt behaviors "just" because the people around them are using those behaviors. Weak psychological forces that derive from people occasionally tweaking their traditions in adaptive directions are sufficient to maintain the tradition in an adapted state so long as the environment is not changing too rapidly and the cultural analog of mutation is not too disruptive.

If the only processes shaping culture arose from our innate evolved psychology, then culture would be a strictly proximate cause of human behavior.

However, not all of the processes shaping culture arise from our innate psychology. From the beginning of our work, we have emphasized that culture leads to the spread of maladaptive cultural variants (see Richerson and Boyd 1976, 1978). Culture is not always, or even typically, transmitted from parents to offspring. Instead, cultural variants are acquired from all kinds of people. This is a good thing because sampling a wider range of models increases the chance of acquiring useful information. However, acquiring adaptive information from others also opens a portal into people's brains through which maladaptive ideas can enter—ideas whose content makes them more likely to spread, but do not increase the genetic fitness of their bearers. Such ideas can spread because they are not transmitted as genes are. For example, in the modern world, beliefs that increase the chance of becoming an educated professional can spread even if they limit reproductive success because educated professionals have high status and thus may likely be emulated. Professionals who are childless can succeed culturally as long as they have an important influence on the beliefs and goals of their students, employees, or subordinates. The spread of such maladaptive ideas is a *predictable* by-product of cultural transmission.

Selection acting on culture is an ultimate cause of human behavior just like natural selection acting on genes. In several of the chapters in part III we argue that much cultural variation exists at the group level. Different human groups have different norms and values, and the cultural transmission of these traits can cause such differences to persist for long periods. The norms and values that predominate in a group plausibly affect the probability that the group is successful, whether it survives, and whether it expands. For illustration, suppose that groups with norms that promote patriotism are more likely to survive. This selective process leads to the spread of patriotism. Of course, this process may be opposed by an evolved innate psychology that biases social learning, making us more prone to imitate, remember, and invent nepotistic beliefs than patriotic beliefs. The long-run evolutionary outcome would then depend on the balance of these two processes. Again, for illustration, let us suppose that the net effect of these opposing processes causes patriotic beliefs to predominate. Then, the population behaves patriotically *because* such behavior promotes group survival, in exactly the same way that the sickle-cell gene is common in malarial areas *because* it promotes individual survival. Human culture participates in ultimate causation.

This way of thinking about cultural evolution leads to a picture of a powerful adaptive system necessarily accompanied by exotic side effects. Some of our evolutionist friends take a dim view of this notion, seeing it as giving aid and comfort to those who would deny the relevance of evolution to human affairs. We prefer to think that the population-based theories of cultural evolution strengthen Darwin's grasp on the human species by giving us for the first time a tentative picture of the engine that powered the furious pace of change in the human species over the last few hundred thousand years. Compare us to our ape cousins. They still live in the same tropical forests in the same small social groups and eat the same fruits, nuts, and bits of meat as our common ancestors did. By the late Pleistocene epoch (say 20,000 years ago), human foragers already occupied a much wider geographical and ecological range than any other vertebrate