Chapter 11. MECHANISMS OF CULTURAL EVOLUTION

> "Mohammedans are Mohammedans because they are born and reared among that sect, not because they have thought it out and can furnish sound reasons for being Mohammedans; we know why Catholics are Catholics; why Presbyterians are Presbyterians; why Baptists are Baptists; why Mormons are Mormons; why thieves are thieves; why monarchists are monarchists; why Republicans are Republicans and Democrats, Democrats. We know that it is a matter of association and sympathy, not reasoning and examination; that hardly a man in the world has an opinion on morals, politics, or religion that he got otherwise than through his associations and sympathies."
>
> Mark Twain, "Cornpone Opinions"
> in *On the Damned Human Race*, p. 24

> "Custom is the principal magistrate of man's life. Men do as they have always done before; as if they were dead images and engines moved only by the wheels of custom."
>
> Sir Francis Bacon, ca. 1580

I. Introduction

A. History

Culture (often under related terms like tradition, values, custom, skills, ideas, socialization, etc.) is one of the central ideas in the social sciences. Recall the discussion of Steward's ideas on the culture core as adaptation, exemplified in Chapters 3-7, and the discovery that free imitation is unique to humans.

The social sciences lack a generally accepted basic theoretical framework for understanding the processes of cultural evolution. There is no generally accepted set of mechanisms underpinning ideas about human cultural evolution or cultural adaptation that has anything like the appeal of Darwinian theory. In this chapter and the three following ones we will investigate the application of Darwin's methods to the study of culture itself. The basic hypotheses of these chapters is that the processes of cultural evolution (1) originated under the influence of natural selection and can be understood as adaptations, and (2) that cultural evolution itself is best studied using Darwinian *methods*.

Darwin himself tried to initiate the application of his ideas to humans in the Descent of Man. However, Darwin's ideas had practically no direct influence on the social sciences. Rather, evolution was treated descriptively as a series of stages, and there was little concern with mechanistic theories like natural selection. Darwin was re-introduced to the social sciences distinguished psychologist and methodologist Donald Campbell (1965), for whom evolutionary theory was a sort of hobby. Campbell criticized the prevailing social scientific theories of evolution that derived from Spencer and Morgan, including the mid-20th Century theories of Leslie White, Julian Steward, and Marshall Sahlins. Most of the work applying Darwinian theory to human behavior and cultural evolution dates after E.O. Wilson's 1975 book *Sociobiology*, which had a controversial final chapter on humans.

Campbell made a very insightful observation about stage theories, namely that they are not really theories at all. They all *describe* changes in societies over time in terms of a series of stages or grades like "savagery," "barbarism," and "civilization," essentially from simple hunting and gathering to industrial societies. Now, there is no quarrel with the fact that a trend to greater technical and social complexity characterizes human evolution, albeit not in a completely straightforward way as we saw with pastoral "regression." Dividing this rough trajectory into stages, naming them, arguing critically about the patterns that actually occurred, and so forth, is all useful work. But, Campbell said, after Herbert Spencer's 19th Century principle of universal progress was abandoned as incorrect, because no one could find any physical manifestation of his universal law of progress, nothing had really taken its place. (Spencer thought that the whole universe had a tendency to get more complex and organized with time. For those of you who know a little physics, this is the 2nd law of thermodynamics backwards. That is, Spencer was demolished utterly.) There was no explanatory principle at all in modern evolutionary theory of this tradition, there was just a descriptive account of stages. For example, Campbell criticized Leslie White's theory that evolution was driven by a drive for greater energy use. It is true, as we have seen, that greater energy use per capita is one of the trends in human evolution. But to say that a particular evolutionary pattern is caused by a drive for that pattern runs the grave risk of being circular. There is only one set of data, a trajectory of increased energy use through time. The one set of data cannot simultaneously describe the effect and the cause, if these two are different, as they must be to have a valid explanatory theory. In other words, we must have separate evidence for the existence of a cause, apart from their putative effects. The neo-Spencerian sort of evolutionary theory is still defended (Corning, 1983), but it seems to me that Campbell's critique was devastating.

The path that Campbell advocated, the use of Darwinian methods to build a theory of culture, is one we will adopt. He noticed that Darwinian theory escapes circularity quite nicely because it explains evolutionary trends in terms of ecological mechanisms. In addition to evidence from fossil records or comparative anatomy, we can get direct evidence on the mechanistic details of the processes of organic evolution through research in the field, in the lab, and through computer simulations. The whole game is to try to make the micro-and macro-evidence fit together to form a single coherent explanation.

Campbell noted the formal similarity between genes and culture. In the terms of the last chapter, both of these are systems for transmitting heritable variation. You and I resemble our parents partly because we inherited their genes, but also because we learned from or were taught by them. Parents typically reproduce some of their culture in their children, as well as some of their genes. Of course, we inherit our genes *only* from our parents, whereas a substantial amount of our culture is acquired from people other than our biological parents. Why not borrow the basic *methods* of theory building from biology, amend the models as required, and create a parallel theory of cultural evolution?

Several investigators have taken up Campbell's suggestion in various ways during the last 15 years or so, including sociobiologists, (Charles Lumsden and E. O. Wilson, 1981), economists, (R. Nelson and S. Winter, 1982), and population biologists, (M. Feldman and L. L. Cavalli-Sforza; 1981; H. R. Pulliam;,1980; Boyd and Richerson, 1985). There is presently an air of excitement in the field, complicated by some controversy and confusion (Durham, 1991 gives a recent update). It is a little like the decade after the rediscovery of Mendel's laws in genetics. There is a core of practitioners using the same basic approach, but with considerable disagreement over the general outline of what the method will discover. Not enough work has yet been done to explore all of the theoretical possibilities and to settle the empirical issues of when and where which effects are most important. This is the body of work that we'll be reviewing in the next several chapters. Be warned that we'll largely be talking about science-in-progress, not finished discoveries.

B. Work for Theory To Do

How are genes and culture related? This theory was derived by applying Darwinian methods to the problem of explaining human culture. What we want this theory to do is give us models of human adaptation. You saw the general outlines of how this might work in the last chapter. We may also need theories that account for some of the systematically *maladaptive* systems of cultural variation[1]. Even if we do not suspect much human variation is maladaptive, the practice of thinking up even far-fetched alternative models and hypotheses plays an important role in scientific skepticism and critical thinking. The key problem to solve here is how genes and culture are related. Why did selection on genes favor the development of a large culture capacity in the hominid line? How do genetic and cultural

1. Recall the previous discussion on the doctrine of signs or, for a more immediate example of maladaptive cultural behavior, consider the "War on Drugs".

influences on phenotype[2] interact to produce the behavior we see in people today?

THE KEY PROBLEM:
How are genes and culture related?

How did humans acquire sociality and symbolic behavior? Also recall the related question of the other two major points of human uniqueness besides culture itself: eusociality, and symbolic behavior. We want some sort of explanation of why these differences arose under natural selection in the first place and how they work in current microevolutionary and ecological circumstances. Why did hominids develop these adaptations, if adaptations they are, beginning around 2 million years ago? What are the adaptive benefits and costs of culture, sociality, and symbols that might explain why some creatures develop them in some environments, yet, considering animals as a whole, they are relatively rare?

C. How to Apply Darwinian Methods to Culture

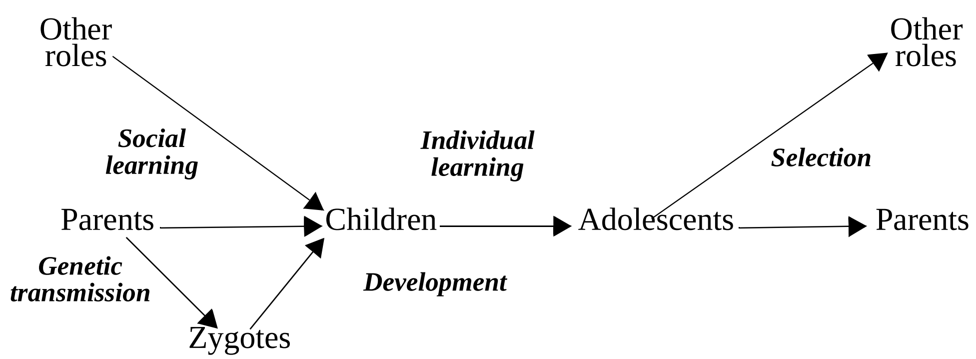
According to Campbell's argument, Darwin's same basic idea of population thinking obviously applies to culture despite the differences between genes and culture. In both cases, we have a set of variable individuals, and the variation can be transmitted to other individuals. Cultural variation, at least that having to do with the culture core, is important to how people make a living, compete and cooperate with each other, and so forth. There is no reason we can't open our Darwinian account books on cultural variation, and begin to keep track of where variants come from, what happens to individuals who possess one as opposed to another variant as they deal with the environment in their everyday lives, and what happens to variants during the imitation/socialization/cultural transmission process. This exercise ought to turn out to be quite informative. Even if it is for some reason less applicable to culture than to genes, it is hard to see how it can fail to be partially applicable. To whatever extent important information is passed forward through time, the Darwinian tactic of studying the nitty-gritty of how this passage works cannot be wholly wrong! There has been a lot of controversy over applying population thinking to culture, but to those of us schooled in evolutionary biology, it is hard to see how anyone can fail to see the need for the basic account-keeping demanded.

2. Remember that phenotype is defined as "The sum total of observable structural and functional properties of an organism; the product of the interaction between the genotype and the environment (Lincoln, Boxshall, & Clark 1982)." Note that this definition includes behavioral properties such as mating displays, foraging strategies, and aggressiveness as well as structural properties like body size, strength, and speed.

Note how utterly commonsensical the method is. Conceptually, all we want are methods for keeping track of cultural variations and what happens to them over time. *We want to identify and describe the cultural analogs of the "forces" of genetic evolution*. Each generation, selection, mutation, and other evolutionary processes cause the numbers of some genetic variants to increase, and others to decrease. If we can measure the increases and decreases, we can make a budget for the gains and losses of each variant; if we understand the ecological processes that explain why the gains and losses differ by variant, we understand an example of evolution. Nothing could be plainer, simpler, or more straightforward than the Darwinian approach to evolutionary problems. A little thought and observation should reveal a similar set of cultural evolutionary "forces."

We begin by simplifying the human life cycle thinking of all the important things that could happen to individuals carrying genetic and cultural variants at each step of their lives. An example of such a life cycle is shown below. Then we try to classify the processes of evolution using a simple taxonomy, so that we have the basis for building models of some generality. As you will see there are really two taxonomies, one for the structural features of culture and the other one for the system of forces. When this all seems too abstract, think up a personal example of each element of the taxonomy as we go along. If you get confused, go back to the basic population method. Ask yourself, what will happen to individuals that adopt different variants? What will happen when we shift our focus from one individual in the here and now to many individuals in a population over time?

Figure 11-1. The human life cycle, simplified. The first step in building an evolutionary ecological model is often to specify a life cycle for the organism under consideration. The idea is to think in an orderly way about what happens to us and our culture as we live out our lives. Where does culture come from, and where does it go?



What are the essential events of life from the point of view of cultural evolution? Genetic transmission creates zygotes that develop into children who are enculturated by a set of individuals who typically occupy certain social roles. For example, for many cultural traits the biological parents typically play the most important roles in enculturation. In other cases, individuals occupying social roles such as grandmother, teacher, or priest may be important in enculturation. children acquire some behaviors and modify others as they mature into adolescents. The result is a population of adolescents and young adults who interact with the physical and social environment. Some of these young adults acquire the resources necessary for cultural and/or genetic transmission.

The next step of population thinking is to think of what happens when these same processes apply to many individuals generation after generation. Individuals don't live in isolation. At the minimum, they acquire culture from a sample of the adult population, and most have some influence on the next generation as parents or role models. Ideas we have, say about how to make a living, make differences in our lives, differences between wealth and poverty, prestige and shame, friendship and retribution, life and death. If some ideas have systematic differences in these regards, it will not be surprising if some increase and some decrease over the generations. If the environment changes, old bad ideas can become new successes. Basic common sense, no? Now let us put some flesh on the bones.

II. Culture as a System of Inheritance

A. Culture is Broadly Analogous to Genes

Culture as a mechanism for inheritance of acquired phenotypic variation. Culture is often described as a Lamarckian system of inheritance, by which people mean it is like genes—but with the inheritance of acquired variation feature added. A formal definition of culture is a useful place to start:

Culture is socially learned information capable of affecting individual phenotypes. People acquire culture from other individuals, via teaching or imitation.

In the very simplest case, whether something is transmitted culturally or genetically makes almost no difference. For example, in some families the Christmas holiday package opening is done on Christmas Eve, and in others on Christmas morning. Rarer variants include celebrating according to the Russian Orthodox calendar, not observing Christmas by non-christians, and non-celebration of Christmas by certain Christian sects, such as Jehova's Witnesses. Traditions about Christmas tend to be transmitted by families to their kids, much as genes for eye color might be, except that they are transmitted by teaching or imitation, not as part of you DNA. Some people have adopted the term *meme* to signal this elementary similarity.

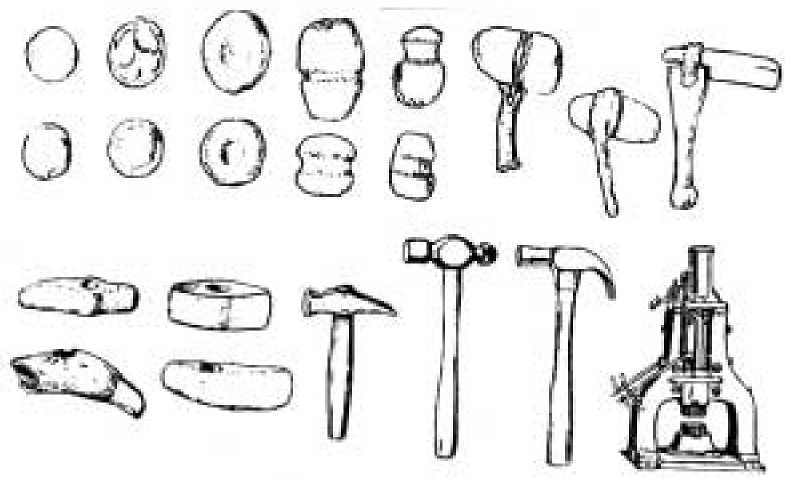
There are many dissimilarities between genes and memes, the most basic of which is that culture is a system for the ***inheritance of acquired variation.*** In the case of genes, phenotypic modifications cannot be transmitted; for example, no matter how many generations one cuts off the tails of sheep, it still has to be done again each generation to obtain tailless sheep. However, consider the family in which Mom or Pop has a job that requires work on Christmas day. They will probably adopt the Christmas Eve celebration date, even if it was not a family tradition. Unless the parents make a point of trying to maintain the Christmas Day time as an ideal not practiced, the kids are likely to adopt the Christmas Eve variant when they grow up out of habit. More generally, culture can change because people change their minds. We don't necessarily have to wait around for mutation and selection to do the work of evolution. Dad and Mom may convert to a sect that frowns on Christmas, and establish a family tradition of non-celebration.

The claim advanced by Campbell and defended here is that the differences between genes and culture are very important, but that Darwinian methods are equally applicable to both because of the key similarity of transmission of information by variable individuals through time. Figure 12-2 illustrates this idea by showing how one piece of basic cultural knowledge, how to make something with which to hammer on something else, has evolved over time. We happen to live in a time when some items of technology have changed very rapidly compared to the preindustrial era. But even now, it is almost always the case that each modification is a small step away from a pre-existing model. Modern systems of innovation may make somewhat larger steps because of formal design aids like engineering calculations based on physical principles. We certainly pack in more steps per unit time, and expose a given innovation to more potential improvers by mass distribution and mass communications. It is quite surprising the degree to which the "descent with modification" model of Darwin applies when we put even these cases under the microscope. (See Basalla (1988) for an interesting treatment of this issue).

B. Crucial Conceptual Distinctions

It is important to keep genes, culture and environment distinct in the discussions that follow. Darwin's great mistake was not to see that genes and culture are completely separate transmission systems rather than one. He thought that organic inheritance had strong effects of inheritance of acquired variation in the case of behavior, and weaker effects in the case of anatomical characters. But basically there was only one kind of inheritance system, and it was, ironically more like culture than like genes. We moderns tend to make different mistake. You've all heard of the "nature-nurture" debate. This debate is confused

Figure 11-2. The evolution of the hammer from pounding stone to 19th Century steam hammer. (Source: Basella 1988:20.)



because it lumps culture—transmitted effects that are very gene-like—with direct effects of environment on behavior through individual learning and the like. It is very important not to confuse environment and culture. There are interactions of great importance among all three of these categories, but we mustn't let the three concepts get fuzzy!

Differentiating between Genes, Culture, & Environment:

→ **GENES are a complex DNA-based system of inheritance transmitting information from parents to offspring.**

→ **CULTURE is acquired via social learning or imitation from other individuals.**

→ **ENVIRONMENT consists of things and processes external to the organism or population under study.**

Genes are a complex DNA-based inheritance system which is often associated with the concept of 'nature.' *Environment* consists of things and processes that are external to the organism or population being studied. *Culture* is acquired via social learning or imitation in a particular environmental setting. These two different concepts—culture and environment—are often lumped together as 'nurture.' However it is important for our purposes to differentiate between culture and environment.

Given the distinction between genes, culture and environment, it is important to remember that they are not isolated, but interacting parts of the human behavioral system. For example, individuals often learn for themselves. What they learn is liable to depend on the environment that they are in and the culture they've been exposed to. Genes affect our perceptual senses, and specify a reward system (some things hurt, some are pleasurable). If someone learns for themselves, say inventing a new Christmas celebration (the Christmas beach barbecue in Australia), this novel innovation may be imitated by others and spread culturally. Individual and social learning are distinct processes, but they are coupled through the inheritance of acquired variation feature of culture. To take another important example, human genes have long lived in a world in which social behavior is strongly influenced by culture. Presumably human genes are coadapted to culture due to a long history of selection to fit into a culturally determined world. Thus, much of human language capacity is underpinned by genes, and language is certainly in part an adaptation to managing a complex social life.

C. Culture Has "Population Level Properties"

Because culture transmits ideas it requires analysis at the population level. This is the more formal way of stating the argument for the applicability of "population thinking." Most animals are capable of learning, but not social learning; the learned variants die with the individual that learns them. By contrast, socially learned variants can be retained in the population by transmission. Thus the two components of "nurture" differ substantially in their properties. Not only is a population thinking approach to culture likely to be interesting, it is also likely to prove essential. Individuals "sample" their culture from the population and in turn become part of the population sampled by the next generation. We cannot understand *individuals* without understanding the properties of the population they sample. Nor can we understand *populations* without understanding how individuals contribute (or fail to contribute) to the next generation's pool of ideas. Informally, we can say that individuals are substantially the prisoners, even the brainwashed prisoners, of the culture they are exposed to. Culture gives us the very concepts we think with and nearly blinds us to other realities. On the other hand, the culture we are prisoners of was completely built by human hands one step at a time. Each individual makes a small but active contribution to the transmission and evolutionary modification of culture.

What culture an individual gets depends on the population in which it lives. Two individuals that have very similar *genotypes,* and live in the same environment, may behave quite differently if they have been socialized by different cultures. For example, the psychologist Sandra Scarr (1981) has studied trans-racial adoptions in the U.S. Black children raised by white families have IQ scores much like their white adoptive siblings, and much higher ones than Blacks typically have. The difference probably results from the greater stress on cognitive skills in white adoptive households, different socialization practices, and other cultural effects. Also, wherever sufficient records are available in the industrialized world, IQ has been increasing at the rate of about 1/3 of a standard deviation per generation. You students are on average about 5 IQ points smarter than people of your professors' generation (some of you may have suspected this already). This rate of change could only be produced by extremely strong natural selection on genes, and it seems a more reasonable inference that culture is involved. Perhaps the quality of schools has improved, or the tendency for child-rearing styles to become more relaxed is the cause. Or perhaps all that television is good for you after all!

We do not really understand what this change means (or what IQ means for that matter) but the implication that culture plays a major role in determining human phenotypes is clear. Culture evolves more rapidly than genes[3], but surely can have genetic consequences in the long run. ***We cannot understand human behavior unless we can explain the way in which cultural traits vary between populations and change over time.*** In the long run, we have to treat the problem of how genetic and cultural evolution interact (coevolve).

As with genetic adaptations, if we want to understand cultural adaptations we have to understand how the frequencies of different "culture-types" evolve in a population over time.

D. What is the Relative Importance of Culture?

How important is culture relative to genes, individual learning, and other environmental effects in explaining behavioral variation in humans? We will take it for granted that genetic variation explains very little of the behavioral variation in humans, particularly the variation between human groups. (Data like Scarr's alluded to above suggest that the genetic variation between races for IQ is negligible, but that there is some genetic variation within races for this trait.) However, it is possible to believe that there is not much heritable cultural variation. The sociobiologist R. A. Alexander has argued that cultural transmission is relatively unimportant. He hypothesized that people choose or invent whatever culture they need and are never dependent on merely imitating others.

The importance of culture is assumed by anthropologists to be huge, but do they have any empirical proof? One of the best studies on this topic was done by the psychological anthropologist Robert Edgerton (1971). He surveyed a long list of attitudes in four East Af-

3. How is it that culture can evolve more rapidly than genes?

rican tribes. Each tribe included *both* a horticultural and a pastoral group. He asked a sample of people from each group to tell little stories about pictures he gave them, for example a father confronting a misbehaving son. Then he coded their responses in categories like "attitude towards authority." To his surprise, the ecological difference between groups within a tribe explained much less of the variation for most variables than did the tribe to which people belonged, though there were usually small departures toward a common set of attitudes for pastoralists and horticulturalists. In his study, all the pastoralists were very open about conflict with their neighbors, compared to horticulturalists who are very diplomatic and whose hostility is repressed. This is presumably because pastoralists who are angry with someone in their camp can easily pick up and move, while the horticulturalists are forced to stay put because they own valuable land in the village and cannot easily get new lands elsewhere (these are highland cultivators of rich soils, not shifting cultivators). What surprised Edgerton is how few attitudes reflected the ecological pastoral/farmer difference, and how many, like attitudes to military prowess were determined by tribal history.

How does this square with Alexander's assertion that cultural transmission is relatively unimportant? The groups within the tribes Edgerton surveyed appeared to have been separated for several generations. We may therefore infer that, in the short run, cultural tradition was ***more*** important than individual or group choices, decisions, and learning. But over the longer run, changes were accumulating. This is consistent with an evolutionary model of cultural transmission. It is *not* what we would expect if people could quickly and easily choose new behaviors for new environments as Alexander's hypothesis states. Cultural evolution is most like genetic evolution when individual decisions or inventions are hard and costly to make. For example, very few of us could invent calculus just because we needed it, although most of us can acquire it culturally (though this admittedly requires considerable effort and motivation for most of us!).

There are not as many critically controlled studies like Edgerton's as one would like. All too many social scientists of culture have been content with the argument that cultural explanations are good and genetic arguments bad, and they have neglected such investigations. Recent studies by behavior geneticists (Eaves, Eysenck, and Martin, 1988) have suggested that there is more genetic variation for personality variation than anyone would have suspected a few years ago. So far, these data have not gotten the cultural anthropologists as excited as they should be.

III. Structural Properties of Culture

A. Structural Properties of an Inheritance System are Crucial

Structural properties of an inheritance system are crucial for understanding how it evolves. By "structure" we mean the pattern of transmission from one individual to another. Figure 11-1 sketched the structural properties of both cultural and genetic human systems of inheritance in the form of a life cycle diagram. The genetic system of inheritance is structurally variable, and this variation affects how genes evolve. Haploid organisms will respond differently than diploid, sexual organisms differently than asexual, large populations will respond differently than small, some kinds of population structure may lead to group selection, etc. How are the structural properties of culture different from genes? Are the differences likely to be interesting and important?

B. Major Structural Differences Between Genes and Culture

There are four major structural differences between genes and culture. Understanding these structural differences is the key to understanding how the list of forces that act on culture has to be modified and expanded beyond those we considered for genes. As we said, structural properties of an inheritance system are crucial to understanding how it evolves.

1. *The cultural "mating system":* In the case of culture, teaching and imitation are not restricted to just one or two parents. People frequently imitate many others besides their biological parents, though parents are typically very important, especially in primary socialization. We will call transmission from biological parents *vertical* transmission and from non-parental adults *oblique* transmission[4]. These terms are borrowed from epidemiology, where they describe patterns of disease transmission. In fact, as we shall see, the transmission of infections is a pretty good partial analog of cultural transmission and gene-culture coevolution. Many important evolutionary effects stem from the non-parental transmission that culture makes possible.

2. *Cultural "generation length" is variable:* The length of cultural generations can be longer than biological generations rather than shorter. People not only imitate their parental generation, they also imitate peers, slightly older children, grandparents, and long-dead sages and prophets[5]. *Horizontal transmission*—transmission of cultural information within a generation—is perhaps the most important and interesting type of transmission. Intra-generational imitation of this sort is not possible under genetic transmission. On the one hand, imitating your peers may be the best way to keep up with the times. On the other, horizontally transmitted culture is quite analogous to microbial pathogens. Heroin addiction, for example, spreads from friend to friend during the period of the addiction before the addict becomes seriously dysfunctional. This cultural "pathogen" spreads in a way that is analogous to the way a disease (e.g., mononucleosis) that has a short generation time spreads from host to host. Presumably, not all horizontal transmission is pathological. (Although it is often

4. These descriptions fit the direction of the transmission arrows in Figure 12-1.
5. Give some examples of each type of transmission.

difficult to convince parents of teen-age children of this!) Horizontal transmission is important because it allows faster evolution, but exposes people to the risk of evolved cultural “parasites” that we will discuss later.

3. Cultural transmission is sequential. Cultural transmission does not even begin until genetic transmission is complete. Then you acquire your culture in dribs and drabs over a span of many years. Some of us figure we’re still learning at 40+. As we shall see, this difference is important because it allows for decision-making rules one acquires early in life to affect later cultural transmission.

4. Culture is acquired by directly copying phenotype. Genes are segregated into the germ line early in development, and are unaffected by what happens to phenotypes[6]. As we’ve already seen, culture has the property of allowing us to inherit acquired variation**.** This property is important because it allows individual and social learning to interact. Being able to inherit acquired variation is one of the prime advantages of having a cultural system of transmission to supplement genes.

IV. Forces of Cultural Evolution

We would like initially to try to make a complete taxonomy of the possible micro-evolutionary processes, without regard to which ones are most powerful, or how they link up with genes. What are all the processes we can think of that might cause a particular cultural variant to increase or decrease in a given environment as people acquire variants, use them and become available for imitation? What should be the main gain and loss categories in our cultural evolution account-book? What are the main ways that a new variant can arise in a cultural group? Among pre-existing variants, what sorts of processes could conceivably affect which variants increase or decrease over time relative to others? We’re just going to apply a little population thinking to classify the immense complexity of cultural processes into a few basic kinds.

An understanding of what these forces of cultural evolution are, and how they function, will allow us to examine a wide variety of perplexing and interesting problems with human behavior. Some examples are: high fashion, conflict between ethnic groups, overpopulation, anthropogenic[7] environmental degradation, male aggressiveness, child rearing styles and strategies, adolescent dating behavior, crime, etc.

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6. There are two types of cells: (a) germ plasm cells from which gametes (sperm and ova) are formed, and (b) somatic cells which form the rest of the body.
7. caused by humans.

Here is a hierarchical list you can refer back to for an overview.: After you read the

THE FORCES OF CULTURAL EVOLUTION:

- **A. Accidental Variation**
- **B. Cultural Drift**
- **C. Decisionmaking Forces:**
  - **1. Guided Variation:**
  - **2. Bias Forces:**
    - **a. Direct bias**
    - **b. Frequency dependent bias**
    - **c. Indirect bias**
- **D. Natural Selection**

following sections, come back to this list and explain what each force is and how they differ from one another. You must master this information; it essentially forms the language in which the rest of the course will be conducted.

A. Accidental Variation— "Cultural Mutation"

It is unlikely that cultural variation is error free. There must be some variation created by accidents during transmission or in remembering. These errors will result in a certain amount of random variation being injected into the population each generation. Language is a good example. When linguists carefully examine our speech, they find that each person has a unique micro dialect (ideolect), presumably because of minor errors in imitation. Richerson says for***ward*** instead of the standard ***for***ward in the context of using the word as a verb as in "forward my mail, please." Another example (unfortunately) of accidental variation can be seen each quarter at exam time: we attempt to communicate new cultural information to you; you try to acquire that information; yet when we test how well this cooperative task has been accomplished, *some* level of error is almost always seen. We may mis-state or misexplain the information, or you may get the wrong idea or forget. Accidental variation creates new ideas, but unsystematically. If it were the only evolutionary process, cultural would gradually be corrupted by the accumulation of mostly useless mistakes.

B. Cultural Drift

Recall that sampling errors in small populations can substantially affect frequencies of genes[8]. Similarly, an idea can be lost by accident, since the only person who knew it might die before anyone imitated him/her. The ecologist Jared Diamond (1978) has pointed to a possible example of the effects of cultural drift. It seems from the archaeological evidence that on the Australian island of Tasmania native peoples originally arrived with a moderately sophisticated tool kit at a time when lower sea level connected Australia to Tasmania. After the Tasmanians were isolated 10,000 BP, many items, including seemingly useful ones like boats, gradually disappeared. On a small island with relatively few inhabitants, it is easy to imagine that chance would occasionally lead all boatbuilders to die before they were imitated during some generation, or for similar accidents to lead to the loss of rarer skills. We call it "drift" because, while sampling error can make the frequency of a trait increase or decrease over time. Drift alone has a tendency to reduce variation within populations, but increase variation between populations. You can see why, no?

Cultural drift can be important in populations with a high head count because the human division of labor is so extreme, and because of "many to one" transmission. Even large populations tend to have specialists of various kinds; these are in effect small sub-populations. As Cavalli-Sforza and Feldman point out, there are often only a few opinion leaders in a society, and those leaders may have a very large cultural influence. In both cases, the sub-population relevant to a particular set of cultural traits can be very small and subject to chance events.

C. Decision-Making Forces

People are not entirely passive imitators. We learn for ourselves, and select whom and what we imitate from others. We modify the culture we receive by conscious or unconscious decisions we make. Then potential imitators who observe us observe the modified rather than the original traits. Until recently we have had no hope of deliberately engineering our own genes, but we can, to some extent, engineer our culture. The closest analog of cultural decision-making forces is mate choice. To some extent, you can engineer the genes of your kids by choosing a mate with certain genes, but this is a one-shot decision, and little complex tailoring is possible, compared to the cultural case.

You have a lot of kinds of decisions you can make about adopting or not adopting a

8. Take the example of a population with, say, 20 couples where only two individuals carry the gene for red hair. If mating is truly random, the red hair trait will be conserved at about the same level over time. However, any accident that involved those two would remove the red hair variant from the population. Small sample size can be as important for populations as it is for researchers.

particular cultural variant. Hence there are several decision-making forces. They all depend upon the sequential transmission property. Before an individual can make decisions, there has to be an individual. In the case of genes, the fact that we get them all at once, and that the germ line of cells that will become the gonads are segregated early, means that it is mechanically difficult to see how an embryo's "decisions" could affect its genes. But it is easy to see how it works in the cultural case. Even infants have surprisingly active little minds. They pay attention to some things and not others, and like some things and not others. It is easier to learn to like ice cream than pickles and peppers.

Decision-making forces are derivative forces; to have a really satisfactory theory, we must explain where the rules that people use to make decisions come from. If decisions are to be other than random, they must depend on rules. So individuals first have to acquire rules before they can exercise a decision-making force. These rules may be genetic (senses of pleasure and pain, for example), or they might be cultural (religious or ethical rules that, for example, make certain potential items of diet seem disgusting). This makes the evolution of these forces a bit complex to think about, because we must attend both to what the rules do to other traits as well as where they come from (e.g. are they rooted in genes or culturally transmitted).

The decision-making forces are important because they are not present in the genetic system. The ability to use decision-making forces is (a) what causes culture to be a useful system from the point of view of genes, and (b) provides a wonderful set of complexities and twists of the evolutionary process to entertain us in subsequent chapters. Here is an overview:

> *1. Guided variation*: This is the most basic decision-making force, formed by adding individual learning to the social learning of culture. Trial and error learning or deliberate invention will generate variation nonrandomly (contrast with random variation), and acquired variations can be transmitted. This is a directional force, if environments change, cumulative individual learning could cause the evolution of new adaptations. (Or it could be a stabilizing force as people who imitate the errors of others correct them by learning.)

> *2. Bias forces:* You do not have to invent new variants for yourself in order for decision-making rules to have an effect. You can also be a smart imitator, choosing to imitate some preexisting traits or individuals you observe over others. Just as tastes, pleasures and pains can guide learning and strategizing, they can guide cultural acquisition. In general, it is probably much easier to bias imitation than it is to discover useful new variants for yourself. Thus, bias forces are perhaps usually more powerful than guided variation. There is also a technical difference of some importance here. In the case of guided variation, individuals are creating their own variation, and the rate of evolution can be rapid even if we start with no initial variation. The bias effects, like natural selection, work best when there is plenty of variation to observe. As an example

> of bias, all other things being equal, it is much easier to transmit being sexually active than being a celibate nun or priest, because of the bias imposed by sexual pleasure. Perhaps you have heard of the Shakers, who attempted, starting in the 1830s to create a society of celibates. They are famous for the furniture, but not for being a large group! The contrast with the pronatalist Mormons, who started in the same frontier revival outburst, is striking. On the other hand, if celibates have great prestige and influence because of their role in an important religion, people may choose to imitate them despite the pleasure principle. To reiterate, *biased decisionmaking is a force that DIRECTS the evolution of human culture*. In this sense, it is a little like natural selection. New cultural adaptations can arise by decision-making effects, as we saw in the last chapter.
>
> *There are three rather distinctive types of biases:*
>
> a. *direct bias:* Here a person decides whether to adopt a cultural trait on the basis of the trait itself (e.g., try out celibacy and active sex, choose whichever you find more pleasurable).
>
> b. *frequency dependent bias*: Here a person prefers to adopt whichever variant is most common (e.g., conform to the majority choosing either celibacy or sex depending on what most of your friends do.)
>
> c. *indirect bias*: Here a person uses one trait to select someone to use as a role model, then copies other traits from the same individual indiscriminately (e.g., if the most impressive person you know is a celibate, you might choose to imitate many aspects of her behavior and pick up celibacy as a troublesome byproduct.)

A hypothetical example may clarify these abstract definitions. Say you are a farmer newly arrived in the American West ca. 1875. You must produce enough food each year to support your family of six. If you fail, it is likely that at least some of your children will die from malnutrition or disease during the long hard winter. The problem with which you are faced is this: how to increase the amount of food your family produces?

> *Guided variation:* In this case, you might roam around your land, trying to figure how to improve food production by personally testing the natural plants and wildlife. You find a wild grain that seems edible and hardy, gather some, give it a taste test, then plant it to see if it can be cultivated. If you succeed, your innovation adds to the number of cultural variants (in this case, the number of different ways in which one can raise food crops). However, if you fail, the effort spent on figuring all this out and trying a new crop may be the margin that leaves your children starving come February. Developing new cultivars is in fact rarely done, presumably because it is an awful lot of effort, though folk breeders very commonly develop local varieties of old crops.
>
> *direct bias:* You could borrow some cultivated plants from neighbors, observing which seem likely to be suitable for your farm, and which not. You might plant a few test plots, try to give them equivalent water, manure, etc., and compare the yields. Since your family's lives are on the line, you would probably do this several different years in a row—if you had all the extra time and resources to experiment. In spite of your thoughtful analysis, there is still substantial potential for error, not to mention the cost of all the trials.

frequency dependent bias: You can plant the same crops as the majority of your neighbors. By and large, this is usually a safe and effective strategy for decisionmaking. Although you may not gain the extra margin of productivity that a new type of crop tailored to your own farm could give, local experience with the majority strategy indicates that your family is unlikely to starve either. If the local common strategy was terribly bad, the local folks would likely have already starved out.

indirect bias: Here you use some indicator of success to choose one of your neighbors as a model. For instance, you might choose the person who owns the biggest farm and nicest house in your region as your model[9]. You then plant whatever that person plants, use the cultivation techniques they use, store your produce in the same kind of root cellar, etc. Presumably, he has the biggest farm and nicest house because he has the best way to farm for the area figured out. Of course, this strategy has its problems. Perhaps the most apparently successful farmer was lucky in his choice of land, inherited money, or has defrauded his banker. Frequency dependent and indirect bias are cheap and easy, but are perhaps not usually as accurate as doing the work to figure out the best crop directly for yourself.

no decisions, depend on tradition: You could do exactly what you did back East where you came from and hope it worked well enough in the West.

Anglo settlers in the West did all of these things, but the successful ones tended to rely upon indirect and frequency dependent bias, at least at first. Hispanic settlers could often depend upon tradition, for they came from Spanish and Mexican farm traditions already reasonably well adapted to the arid and Mediterranean regions of the West. Western farming and ranching, of course, has quite recognizable Ibero-American features.

D. Natural Selection of Cultural Variation

It is many people's intuition that natural selection does not apply or cannot be important in the case of cultural variation. This isn't necessarily so. All Darwin's mechanism of natural selection requires is heritable variation for something important to people's lives. Take our case of farming in the America. In the 19th Century, several different ethnic groups pioneered in the Midwest in the mid-19th Century. According to rural sociologist Sonya Salamon (1985), even today, different cultural traditions regarding farming are maintained by these groups. For example, Anglo-Americans treat farming as a business. If they can't earn a good living, they quit farming and take up other occupations. German-Americans, on the other hand, brought a certain European peasant attitude to Illinois. They consider farming to be a much better way to make a living than any other job. They will accept small incomes to remain farmers, and take much more active pains to set their kids

9. In contemporary times, you might choose the person who has the most expensive new car, or most fashionable clothing, or fanciest house, or best looking spouse, etc.

up in farming. Not surprisingly, German farming communities are declining much less rapidly than Anglo, and the rural scene is gradually becoming dominated by Germans. People don't decide to be Anglo or German in farming attitude (at least this is small effect according to Salamon). It is just that culture has effects, and as a consequence some ideas increase at the expense of others. If Salamon's data is correct and the basic situation doesn't change, the Amican Midwestern farm belt will one day be entirely dominated by people with German peasant attitudes toward land ownership.

E. Individual versus Population Effects (Again)

Can you think of any more basic forces that might act on culture? Some others have been suggested, but we think they are relatively minor in importance or just variants of the above.

When you think about the evolutionary forces acting on culture, it is easy to see the differences between potential individual-level consequences but it is also important to pay attention to population-level effects. At the population level, consider the ways in which these ***"forces"*** *bias the evolution of culture over time*. In the example just discussed, think about the manner in which the population-level distribution of different variants for raising food crops among all the farmers in the region might be moved over time depending upon which decision-making rules are employed and how often. The idea is that the effects of individual decisions are cumulative if there is imitation. Even if only a few individuals each generation use only a little direct bias and guided variation, these activities will improve the pool of knowledge that is accessible to the population as a whole. Indirect bias, if it works right, can spread good ideas from one smart or hard-working individual to a number of others. By sequential improvement over many generations, very sophisticated adaptations can be built up gradually. Cultivated plants like wheat are the result of this long, cumulative improvement by many individuals over a long period of time. This is possible with genes or culture, but not with individual learning, where the knowledge gained by each learners disappears from the population when the individual dies. In the long run, the population level effects of transmitted information can be enormous, even if what happens at the individual level seems very unimpressive, say modest half-hearted attempts to collect seed wheat from superior plants. Contrariwise, without population level effects, impressive individual feats of learning lead nowhere in the long run.

V. Evolutionary Origins of Culture

A. Guided Variation and Direct Bias as Sociobiological Forces

As we mentioned in the last chapter, the basic rule-guided forces of cultural evolu-

tion are forces that link cultural evolution to genetic evolution. Imagine that selection works on the basic neurophysiology of human perceptions, senses of pleasure and pain, and so forth. These may be mostly coded by genes. Senses of pleasure and pain and so forth in turn certainly act to reinforce some behaviors and extinguish others. If you invent a behavior that is pleasurable, or observe someone else doing something that seems pleasurable when you try it, you are very likely to adopt it. The opposite is true if it is painful. Although we can all think of exceptions, most pleasurable things tend to enhance your fitness, and most unpleasant ones reduce it. For example, socializing with the opposite sex under pleasant circumstances is fun and will tend to improve your fitness, if one thing leads to another (more fun!). Thus, even the most puritanical cultures have a very difficult time suppressing the customs associated with the "mating game." This idea is the entre into investigating the way in which culture confers or does not confer advantages on a culture-bearing organism. Once we can link cultural and genetic evolution, we can study the *coevolution* of the two systems.

B. The Origins Problem

The main question is why bother with culture at all? Most animals don't. Only humans make massive use of culture. If the function of culture is just to increase genetic fitness, why not just adapt directly using genes, and forget the clumsy intermediary of culture? One could avoid long harangues from Mom and Pop, endless lectures and homework, and get straight to life's real work, eating, staying warm, making love, and raising children. Most big animals can reach sexual maturity in 18 months or so. All else equal, such creatures should easily outcompete an animal that takes 18 years! It is useful to look at culture as a problem in this way lest we just make the anthropocentric assumption that humans are just better. That really doesn't answer the question.

If culture evolved under the guidance of natural selection, it must not just do what genes could do for themselves, it must also have some positive advantages. To simplify the problem to a manageable level, let's imagine we start with a conventional mammal, that can learn for itself, but has only a very modest capacity for social learning. *Under what conditions will selection on the brain favor an animal that makes more use of social learning?* We'll proceed in two stages, first trying to figure out how social and individual learning should be balanced, then turning to the issue of the role of genes.

What are the advantages and disadvantages of individual learning? In general, the advantage of individual learning is flexibility, but the cost is that the evaluation process is costly and error prone. For example, if all red, round objects are good to eat, and nothing else is, it makes sense to save time and effort sampling oval red objects and round green ones and just depend on a “round red, eat” instinct. But if fruits come in various colors and shapes in different environments, then a good deal of sampling may be required to find out what is edible. But, if individuals are too influenced by experience, mistakes will be made. Instincts can be perfected by cumulative evolution, something not open to pure individual learning. The chance tasting of a few distasteful red fruits may cause their rejection even if the majority of such fruits are nutritious. One can take larger samples, and have fancier discrimination apparatus (more and fancier senses or elaborate statistical techniques), but all this is costly in terms of time and effort that could be devoted to growth and reproduction. Thus, it makes sense to inherit a basic idea of what is good to eat, and use learning to fine tune things. Our genes, perhaps, tell us: “Red, soft, sweet fruits are generally good to eat, eat them unless strong experiences (e.g. frequent sickness) indicate otherwise. Other colorful fruits also tend to be advertizing palatability to all comers (they want you to disperse their seeds), and are worth a try. Still other fruits are likely to be trying to avoid being eaten because they are not ripe, are interested in specialized dispersers, etc. Green, brown, and black fruits tend to be defended by tanins and poisons and are to be avoided or sampled with care. You figure out the details.”

What if we add the possibility of socially learning as a substitute for individual learning? Personal experience, and the behavior of Mom and Pop, are both potential sources of information about the right way to behave. You can mix and match. Suppose you look to Mom and Pop for an initial guess about what fruits are good to eat and then do some sampling on your own. How much weight should you give to the initial guess from Mom and Pop, and how much to your own experience? They say tomatoes are poison, but they taste all right to you. If selection can act on the genes that control how culture and individual learning are mixed, how would we expect the relative dependence on individual learning and social learning to evolve? Given that some individual learning is possible, when is it an advantage to evolve the capacity to transmit some of this learning to the next generation by imitation? The answer is relatively commonsensical. When individual learning is relatively error-prone (or when it is very costly to reduce these errors) it is useful to rely mostly on tradition. The answer also depends on the rate of change in the environment. When environmental change is slow, not much individual learning is required to keep populations near the optimal behavior, and a strong dependence on tradition is favored. In rapidly changing environments, one should think for oneself. The graph in figure 11-3 below illustrates this general pattern.

The second very important question is: *when should the individual inherit its initial guess about the state of the environment culturally and when genetically?* Should you use

Mom and Pop's genes, or their culture? The advantage of culture in the model we are considering is that the *learned behavior* of the parents can be transmitted to their offspring as the offspring's *initial guess* about what to do in a particular situation[10]. This is the inheritance-of-acquired variation difference between culture and genes. Will this not always be an advantage relative to genetic transmission? Or, when nearly pure tradition is favored, would it not be better to use the genetic system to transmit "initial guesses" about the environment, and forget about culture? (Remember, many animals have extremely complex behavioral repertoires which are transmitted almost exclusively via genes.) As transmission systems, genes and culture serve the same function, genes probably have the advantage of lower random error rates, and do not depend on a long, costly period of socialization. In contrast, culture can take advantage of the inheritance of acquired variation (and has other special properties, as we shall see). How might selection on genes trade off among these advantages and disadvantages to "design" an optimal mix of genetic transmission, cultural

10. For example, many contemporary middle class parents in this country teach their children that it is wrong to settle disputes by yelling & screaming or physical force. A young person who is out on his/her own for the first time may initially use this behavioral pattern when deciding how to settle a disagreement. After leaving home and moving into a tough neighborhood, however, they may decide that it is better to talk tough and hit first when confronted. The grandkids will then get "tough" as an initial guess.

transmission, and individual learning?.

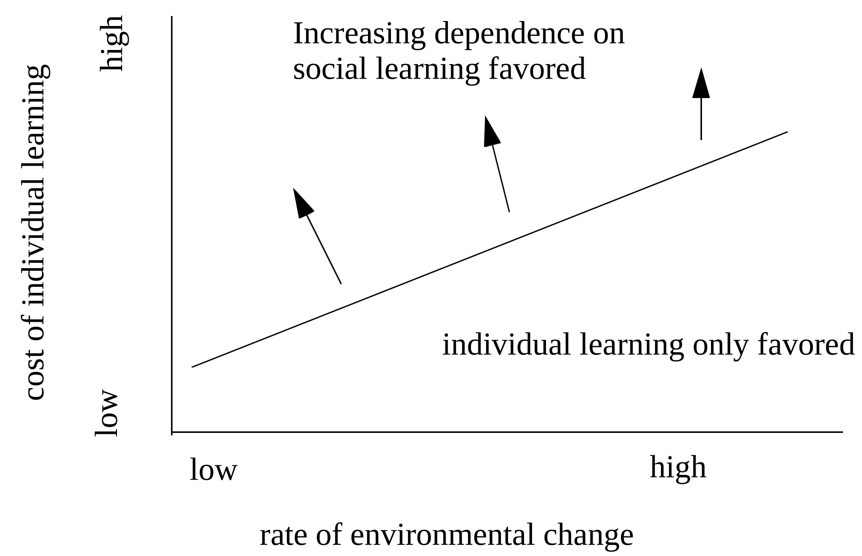


Figure 11-3. Shows a diagrammatic trade-off line describing when individual learning or social learning is favored. When the cost of individual learning is low and/or the rate of environmental change high, individuals should learn for themselves. Social learning (cultural transmission) is favored by slow environmental change and/or high costs of individual learning.

The basic logic of this trade-off has been worked out with mathematical models: Under what kind of environments would three alternative systems of inheritance and learning be favored by natural selection: (1) pure individual learning with fixed genetic initial guesses that do not evolve, (2) individual learning with cultural transmission of the initial guess, and (3) individual learning with genetic transmission of the initial guess. In case 2, both guided variation and natural selection could influence the evolution of the initial guess. In the third case, selection on genes could only influence the initial guess. In all of these models it was possible to study the *evolution* of the relative reliance on the inherited initial guess and individual learning. Boyd and Richerson (1985: Ch.4) imagined that the environment varied through time, but at different rates. When the environment changes slowly, the environment experimented by offspring are only slightly different from those experienced by their parents; when it changes rapidly, the environment of parents is very unlike that of their offspring.

The answer again is pretty commonsensical: *When environments change very rapid-*

ly from generation to generation, but without any overall trend, any form of information derived from the experience of parents via learning or selection is useless. In this situation, the fixed learning rule is best. Any evolutionary response of the initial guess is detrimental when parents' and offspring's environments are utterly different. It is best to have a fixed genetic starting point, and depend upon your own experience.

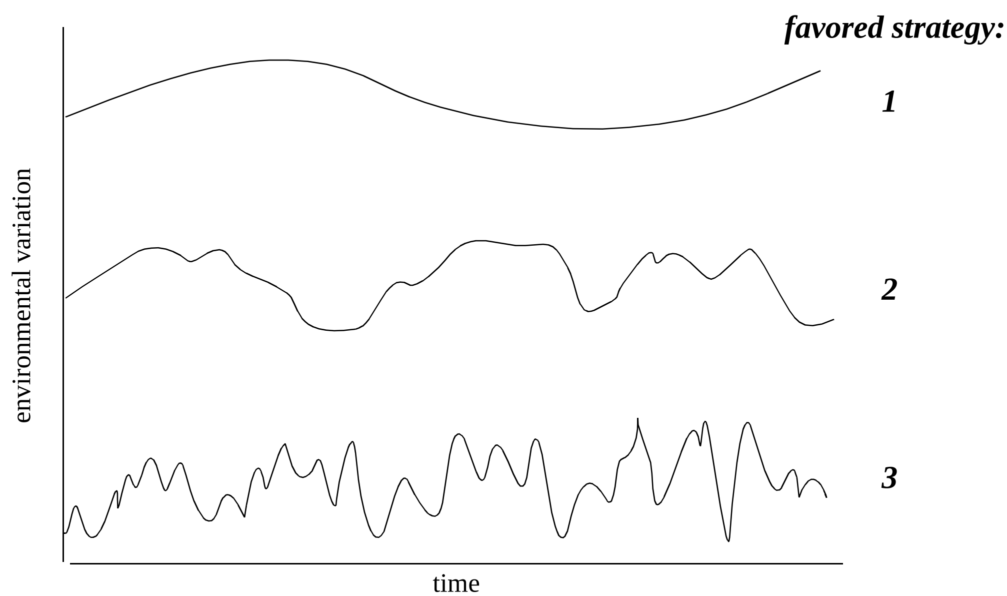
When environments change very slowly, selection on genes causes the genetically transmitted guess to track the environmental change almost perfectly, and any individual learning is disadvantageous because of the extra costs and errors caused by learning. Either a faithful adherence to cultural tradition or the genetic transmission of a high-confidence initial guess is favored. Since, individual learning aside, cultural transmission is itself somewhat more costly and error-prone than genetic transmission, in reality this presumably means that slowly changing environments favor "instincts" that evolve slowly.

When environments change at moderate rates, the inheritance of acquired variation is a virtue. Cultural transmission can track environmental change faster than genetic transmission because both guided variation and selection are acting together. There is a balance between the higher error rates due to transmitting the mistakes of individual learning, which handicaps culture in a slowly changing environment, the uselessness of depending on Mom and pop in very fast-changing ones, and the saving of individual learning effort and faster tracking of change that are the benefits of culture. Figure 11-4 illustrates these relationships.

These results suggest that cultural transmission with relatively strong traditions and weak individual learning ought to be favored in many environments of the moderately variable type. Perhaps Bacon's disparagement of tradition as quoted in the epigraph was a bit too hasty! In many kinds of environment, it may well pay not to think for yourself, but simply depend upon tradition. Of course Bacon lived at a time when rates of change were accelerating due to our own discoveries. The world was moving from more like type 2 in the direction of type 3 environments, and the need to depend more on individual experience and less on tradition turned out to be the right answer.

Although the mathematical model from which these conclusions are drawn is very basic, we think that this analysis illustrates in a general way the evolutionary advantages and disadvantages of culture. Social learning, because it is a means of the inheritance of acquired variation (and thus makes a place for forces like guided variation) can more easily track temporarily varying environments. In environments that vary moderately, this is a strong enough advantage to overcome the costs of depending on culture, of which we have only discussed the risk of making learning errors so far. Thus, a theoretical analysis of an

Figure 11-4. In what kinds of environments would three alternative systems of inheritance and learning be favored by natural selection?



Best Strategies in Three types of Environment:
1. Individual learning with genetic initial guesses that track slow change.
2. Individual learning with cultural transmission of the initial guess.
3. Individual learning with fixed instinct for the initial guess.

evolutionary process can give us some idea of how this rather odd adaptation (cultural transmission) might have arisen in the hominid past. It also suggests that humans are basically weeds, adapted to exploit rapidly changing environments with a potent, flexible mix of individual and social learning. We'll revisit this question in Chapters 24 and 25.

VI. Conclusion

By following the idea of "population thinking" one can construct a taxonomy of the kinds of structural variation in transmission and the kinds of evolutionary forces that might affect culture. Because of the general resemblance of the two systems of inheritance, the evolutionary mechanisms influencing culture and genes are roughly analogous. However, the analogy is far from exact, and several of the structural possibilities in culture do not exist in the genetic system. Furthermore, there is no parallel in genes for cultural decision-making forces.

Relative to the more common system of using only genes plus individual learning employed by almost all other organisms, there are evolutionary advantages to a system of cultural inheritance, but only in certain kinds of environments. Most of this advantage seems to arise from using imitation to cut the costs of individual learning while preserving much of the flexibility conferred by learning. It is this flexibility that enables us to meet the challenges of a variable environment. If this is the whole story, it is still something of a mystery why humans are unique in using so much culture. Were we just lucky to achieve this elegant adaptive breakthrough, or is there something wrong with culture we haven't discovered yet? We turn to this question in the next chapter.

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