Chapter 5: Culture Is Maladaptive

You are engaged in maladaptive behavior right now

Many cultural anthropologists make fun of the idea that human behavior is adaptive,[1] and delight in citing examples of what seem like capricious and arbitrary differences between cultures. For example, Marshall Sahlins cites the fact that the French relish horsemeat, while Americans find it inedible as dog flesh. How could it be, he asks, that it is adaptive to eat horse in France but not in America? Moreover, such examples can be multiplied endlessly—in many societies dog meat is a delicacy. Culture, not biology, rules.

These cultural foibles may be maladaptations, or they may not.[2] But if they are, they are hardly dramatic ones. Much more hazardous to your genetic fitness is reading and writing books like the ones Sahlins writes—or more to the point, like the book you have in your hands. Most of our readers are no doubt middle-class professionals with triple-digit IQs who have (or will have) wealth beyond the imagining of most of the people who have ever lived. Most of us, however, have not used this wealth to have as many children as possible.. Like other middle-class professionals, some of us have had one, two or three children, and many us are childless. These days secular Americans average less than two children, while in Europe birthrates are even lower.[3]

Why do the modern middle classes have such low fertility? The proximate reasons are familiar to all of us. We lead busy lives. Professional work is demanding. Affluent people can afford lots of time-consuming hobbies. Travel to foreign countries, shopping for antiques, climbing mountains, excelling at dressage, and the like take lots of time and money. Since

raising children also takes time and money, we limit our fertility. The ultimate reasons for this behavior are much more mysterious. Ordinarily, natural selection should favor individuals who allocate their resources so as to have as many children as they can successfully raise. Reproductive restraint in the richest populations the earth has ever seen is a striking maladaptation. From the point of view of human threats to the global ecosystem, we may applaud such restraint, but it is not the sort of behavior we expect natural selection to favor.

Most evolutionary social scientists think that such maladaptive behavior arises because the environments in which modern humans live are radically different from those in which humans evolved. Culture is shaped by the evolved information-processing properties of human brains. These were molded in Pleistocene-epoch conditions so that they would reliably give rise to adaptive behavior patterns. Pleistocene climates were very different from recent ones, and Pleistocene societies were presumably something like the hunting and gathering societies we know from the historical and ethnographic records. Natural selection, the story goes, equipped human beings with a psychology that strives for high status, and in Pleistocene foraging societies, this psychology may have often led to higher reproductive success (as seems to have been the case in simpler societies in the recent past).[4] However, in modern societies, this psychology leads to investment in professional achievement and the acquisition of expensive toys and hobbies at the expense of our reproductive success. Some versions of this hypothesis are quite sophisticated. For example, one of the most thoughtful students of this problem, anthropologist Hilliard Kaplan, argues that in past environments, investment in one's own and one's children's skills often paid big fitness dividends; consequently, human psychology is sensitive to those dividends. Modern economies have escalated these payoffs enormously in terms of material well-being, seducing parents into investing huge amounts in honing their own

and their children's skills even though the payoff in numbers of children and grandchildren is negative.[5] Parents still *feel* right when they produce high-status, high-skilled offspring even if they must have only one or two children to do it, and those one or two show scant interest in converting wealth to grandchildren. Similar arguments can be marshaled to explain other important maladaptive aspects of human behavior, ranging from our propensity to overindulge in fast food to our ability to sustain cooperation in large groups of unrelated people, the topic of the next chapter. We will label this the "big-mistake" hypothesis, because it means that much of modern human behavior is a big mistake from the genes' point of view.

We think that the big-mistake hypothesis is cogent, but we doubt that it is the cause of most modern maladaptations. In this chapter, we will make the case that much human maladaptation is an unavoidable byproduct of cumulative cultural adaptation. Acquiring information from others allows people to rapidly adapt to a wide range of environments, but it 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. Maladaptive ideas can spread because they are transmitted differently from genes. Ideas that increase the chance of becoming an educated professional can spread even if they limit reproductive success. In a modern economy, educated professionals have high status, and thus are likely to 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 byproduct of cultural adaptation. Selection on cannot eliminate the spread of maladaptive cultural variants because adaptive information is costly to evaluate. If this *costly information hypothesis* is correct, culture capacities will evolve in ways that optimize the acquisition of adaptive information, even at the

cost of an appreciable chance of acquiring evolved maladaptations.

Explaining maladaptations is important

We have sometimes been chided for paying too much attention to cultural maladaptations. The reason is understandable. Many of our evolutionary social science colleagues think that the analysis of adaptation is the most powerful tool that evolutionary methods bring to the social sciences, and they resent the ill-informed polemics of many of their critics. They struggle with social scientists who have learned their evolutionary biology from the late Stephen Jay Gould's widely known polemics about adaptationist "excesses" in biology, not realizing that his alternative hypotheses have found scant empirical support.[6] As we said in the last chapter, the adaptation hypothesis is one of biologists' most powerful tools.

Doesn't a focus on cultural maladaptations give aid and comfort to the enemies of evolutionary analysis in the human sciences? Perhaps, but we think that the importance of understanding maladaptations outweights any such objections. Although both the critics and friends of evolutionary theory sometimes forget the point, Darwinism's theory of maladaptation was perhaps its most important achievement. In the history of evolutionary theory, Darwin's ability to account for maladaptations was more important than his ability to account for adaptation. Natural Theology had an acceptable theory of adaptation.[7] The existence of organs of extreme perfection like eyes was the main evidence for the existence of a supernatural Power that was manifestly required designed them, or so the argument went. The crudities and approximations rife in the actual design of organisms are much harder for Natural Theology. Vertebrate eyes have their nerve net lying on top of the photosensitive rods and cones, reducing their light sensitivity and requiring a blind spot where the nerves gather and dive through the

retina to form the optic nerve. Octopus eyes, otherwise quite similar in "design," are much more sensibly enervated from behind. These differences make sense in terms of the development of these independently evolved camera eyes.[8] The functionally backwards design of vertebrate eyes is only modestly maladaptative, but its transparent clunkiness betrays a history of evolution by the blind, stepwise improvement by natural selection rather that the hand of the Designer.

The same argument applies to the contemporary application of evolutionary theory to the human species. Social science has many functionalist theories that account for adaptation. However, these theories are frequently criticized for failing to account for the crude nature of social adaptations, and for their historically contingent nature.[9] If our approach is correct, adaptation and maladaptation have the same evolutionary roots. The same processes that enable us to adapt to variable environments also set up conflicts between genetic fitness and cultural success. Culture gets us lots of adaptive information, but also causes us to acquire many maladaptive traits. The big-mistake hypothesis attributes maladaptation to *individuals* misusing antique rules in novel modern environments. The costly information hypothesis attributes maladaptation to *population level* evolutionary tradeoffs that are intrinsic to cultural adaptation, and it predicts maladaptations under a much wider range of environmental circumstances. If we fail to find the predicted sorts of maladaptations that derive from the Darwinian theory of cultural evolution, the whole theory is suspect.

Why culture generates maladaptations

Biologists have traditionally said that natural selection creates well-adapted individuals, that it maximizes inclusive fitness, as the jargon goes. However, biologist Richard Dawkins points out that this is not quite right.[10] Instead, he says, think of individual genes as if they are selfish

agents trying to maximize the number of copies of themselves in the next generation. Of course, genes are not really selfish agents, but selection will play upon them and favor those that behave *as if* they were. For most genes in most organisms—whether you take the individual's or the gene's perspective doesn't make any difference —the process of cell division that produces eggs and sperm ensures that most genes have an equal chance of getting into any given reproductive cell. As long as this is true, all selfish genes should act in concert to help their host produce as many successful eggs and sperm as possible. In the metaphor of another distinguished evolutionary biologist, Egbert Leigh, the genome as a whole works best if genes collectively act as a "parliament" that "passes laws" to make sure that all genes have a fair chance of entering the crucial eggs and sperm, and otherwise police genomic outlaws.

The story changes when different genes reproduce by different pathways—then the selfish gene perspective is a very useful one. For example, most genes are carried on chromosomes in the cell nucleus. Individuals inherit one copy of each nuclear gene from each of their parents. A small number of genes reside in cellular organelles such as mitochondria (the energy factories of the cell) and chloroplasts (the light energy system in plant cells). Unlike nuclear genes, only females transmit organelle genes. Now, try to think like the corporate buccaneer of organelle genes—smart, selfish, conniving, and unscrupulous—what changes would you make? One appealing scheme would be to dispense with males. Since mitochondria are transmitted only by female offspring, any resources devoted to the production of males are wasted from your buccaneer's point of view. Better to trick your host into investing everything in females. Thus, the selfish gene approach predicts that selection would favor mitochondrial genes that suppress the production of male offspring. In fact, such sex-ratio-distorting genes are known to exist.[11] None known are so extreme as to produce no males, but then such extreme cases

would probably become extinct before a biologist chanced upon them. The contrast becomes even starker when you think of genes carried in pathogens such as bacteria and viruses. The genes of a cold virus are expressed in your body, just like the genes on your chromosomes and your mitochondria. However, they reproduce by a completely different pathway, using the resources of your body to produce many copies of themselves. From the point of view of a selfish viral gene, it's fine to harm (or even kill) your host, as long as you leave behind enough copies of yourself. .

Because such conflict can be highly destructive the parliament of the genes favors any nuclear genes that act to reduce it. Two kinds of tactics can be effective. First, nuclear genes can restructure the inheritance system so that all genes have the same reproductive interests. The elaborate, and scrupulously fair, mechanisms of meiosis did not arise by accident. Organisms with organized nuclei, called eukaryotes, first arose as a symbiosis between different bacterial species and conflict must have been rife.[12] The bacteria that became organelles lost genes, and the bacteria that became the nucleus gained the mechanisms of meiosis. Both mechanisms probably evolved because, by reducing conflict, the remaining genes could outcompete genes in other organisms. Second, genes on chromosomes can set up mechanisms such as the immune system that prevent rogue pathogens' genes from making use of the body's resources. Of course, the selfish genes in organelles and pathogens will attempt to overcome these barriers. Nowadays, organelles have so few genes it isn't really a fair fight; the parliament's rules are only occasionally evaded. Pathogens are a completely different matter; as we all know, pathogen genes all too frequently get their way. Microbial infection is the leading cause of death in most human populations, developed countries aside.

In *The Selfish Gene,* Dawkins famously argues that the same argument applies to any

replicator, particularly memes, the name he coined for the cultural analog of the gene. In spite of our reservations about this concept, this part of Dawkins's argument holds even if cultural variation is a poor analog of genes. If people other than parents play an important role in cultural transmission, selfish cultural variants can spread even though they reduce genetic fitness. You can often understand what kinds of cultural variants spread by thinking of them as selfish memes, even if the analogy is weak in other respects.

Suppose that people in two social roles, parents and teachers, influence the culture that children acquire.[13] Further suppose that personal characteristics affect who achieves the two roles. People who marry early have more children and therefore are more likely to be in the parental role. To become a teacher, people have to postpone reproduction in order to get an education and become teachers. Now suppose a cultural variant arises which leads people to postpone marriage. Such a variant can spread even if parents are more important than teachers in the teaching of basic values. The reason is that the amount of selection is important as well as the occupant of a role's probability of influencing the ideas of any given child. Few people attain the role of teacher. You have to do unusually well in school, earn an advanced degree, and compete for the job with other aspirants. On the other hand, most people, especially in more traditional societies, become parents. Suppose that parents are a random sample of the population, but only people with rare views—for example, an unusual enthusiasm for intellectual endeavors that led them to postpone marriage to obtain more schooling—become teachers. In this case, learning from parents will not affect the fraction of people who postpone marriage in the next generation, but learning from professional teachers will tend to increase the frequency of late marriages. Depending upon how strong the combination of relative selectivity and relative influence is, the frequency of beliefs that lead to delayed marriage will increase at a more or less rapid rate.[14]

Note that "teachers" here are just a stand-in for people occupying an influential role—substitute "superior officer," "boss," "clergy," "politician," "celebrity," or "pundit," and the logic will be the same. If holding any cultural variant makes it more likely someone will attain one of these roles, and if people in such roles play an important role in social learning, that variant will, all other things being equal, tend to spread. Army officers will cause patriotism to increase, bosses the work ethic, clergy the love of God, politicians secular ideologies, celebrities styles of popular consumption, and pundits fashions in high culture. Note also that as beliefs leading to delayed marriage enter the population, parents will begin to teach them as well as teachers. In *Huckleberry Finn,* Huck's unlettered Pap threatens to beat him for going to school and taking on airs, but the ex-schoolgirls Aunt Polly and Miss Watson try their level best to get Huck to pay attention to book learning.

The selfish meme effect is quite robust. Nothing in the argument depends on cultural variants being discrete, genelike particles. It works exactly the same if "memes" were continuously varying and children adopted a weighted average of their parents' and teachers' beliefs. Anytime selective forces shape which cultural variants spread, the same basic logic will arise.

Why genes don't win the coevolutionary contest

Why, you ask, doesn't natural selection favor the evolution of genes that protect their own interests by limiting the influence of people other than parents? Or, alternatively, why doesn't natural selection structure the psychology of social learning so that we pay attention to the behavior of nonparents, but only learn what is good for our genetic fitness? The answers to these

questions are at the heart of our debate with much of the rest of the Darwinian social science community.

Many evolutionary social scientists believe that the possibility of selfish cultural variants can be safely ignored. At each step in the evolution of the hominid lineage, they argue, selection would have edited the emerging psychological machinery that governed the acquisition of culture to ensure that maladaptive cultural variants were of minimal importance. As a result, selection would not likely favor a psychological system that led to the frequent spread of selfish cultural variants.[15] In ancestral conditions, our evolved psychology would protect us from selfish cultural variants. Modern environments are a different matter, but as we've said, evolutionists generally favor noncultural explanations for maladaptive behavior in complex societies. In the last chapter, we ourselves were enthusiastic users of this sort of adaptationist reasoning. If it was OK then, what is wrong with it now?

There is nothing wrong with adaptationist reasoning in general. The problem lies in applying it correctly to the evolution of culture. We agree with our colleagues that culture is shaped by psychological predispositions which are products of natural selection, and that these predispositions will frequently lead to the spread of adaptive cultural variants. However, the conclusion that evolved biases alone will determine the outcome of cultural evolution does not follow from these two premises. The reason evolved biases will not prevent the evolution of selfish cultural variants is that the structural features which allow such beliefs to proliferate *are the same features* that give rise to the adaptive benefits of cultural transmission. The nub of the matter is that selection can't get rid of cultural maladaptation without giving up the ability to rapidly track varying environments.

Adaptations always involve tradeoffs.[16] No herbivore can be as fleet as a gazelle, as tall

as a giraffe, and as powerful as an elephant. Inescapable biophysical tradeoffs ground magical organisms such as gigantic, flying, fire-breathing dragons. Pigs can't fly; even if they had optimally designed wings, they'd be too heavy.[17] Imitation is an adaptive information-gathering system, but it involves tradeoffs. Culture gets humans fast cumulative evolution on the cheap, but *only* if it also makes them vulnerable to selfish cultural variants. Four interrelated tradeoffs conspire to weaken the grip of genetically determined biases on cultural evolution. First, people other than parents are a crucial source of adaptive information. Second, content-based biases cannot be made too restrictive without becoming too costly or sacrificing the adaptive flexibility that social learning provides. Next, fast and frugal adaptive heuristics such as conformist and prestige biases have specific, unavoidable, maladaptive side effects. Finally, rogue cultural variants evolve devious strategies to evade the effects of content-based biases. Because the rate of cultural adaptation is rapid compared with genetic evolution, rogue variants will often win arms races with genes.

Learning from people other than your parents is adaptive

Most Americans (at least most American parents) mistakenly think that parents are the main source of their children's beliefs and values. True, children normally form close bonds to parents, and in some cultures, parents make strenuous efforts to shape their children's beliefs. True also that beliefs and attitudes of children and parents are often quite similar. However, much evidence indicates that parents play at best a minor role in many domains in determining the final cultural variants their children adopt.[18] Behavior genetic studies indicate that most of the similarity between the personality traits of parents and children is due to genetic inheritance, not vertical cultural transmission.[19] At the same time, these studies also detect a large amount of

"environmental" variation that is *not* shared within families. Children learn a lot from one another, and from adults other than their parents. In some domains—language, for instance—peers are much more important than parents. Immigrant children in the United States usually learn English from their peers, and come to prefer it over their native tongue. When people move from one region to another, their children usually use the local dialect rather than their parents'.[20] In other domains, transmission from nonparental adults to children is also influential, particularly when formal education is important.

Since even moderate amounts of nonparental influence can allow genetically maladaptive cultural variants to spread, why hasn't selection shaped the psychology of social learning so that children preferentially attend to their parents (instead of the reverse, if our experience as parents of teenagers is any indication)?

The reason is simple. Social learning is about collecting adaptive information from the surrounding social environment. Increasing the size of the sample increases your chance of acquiring useful information, because a larger sample makes all kinds of biased transmission more effective. These forces, like selection, depend on variation, and the more models surveyed, the more variation the bias to work with. This is easiest to see for what we call content bias—an ability to judge the utility of a cultural variant directly on its merits. Mom may be an inefficient or poorly informed gatherer, and an aunt, grandmother, in-law, or friend may be much better. But if you can only learn from Mom, you are stuck with her way of doing things. By searching more widely you increase the chance that you will observe something worth learning. Anthropologist Barry Hewlett has documented how young boys learn to hunt among the Aka "Pigmies" of central Africa.[21] Boys learn most of their hunting techniques from their fathers, but as boys get older and more independent they become willing to depart from Dad's ways, though really

everyone is hunting just like Dad. However, crossbows were a recent innovation at the time of Hewlett's study, and most fathers do not know how to make and use them. Crossbow were useful so boys learned to use them from those who know how to use them, regardless of relatedness. The "perceived advantage" (content bias, in our terms) is one of the strongest correlates of the successful spread of an innovation.[22] The same basic logic holds for conformist- and prestige-biased transmission. In each case, alternative variants are compared by some rule, and the preferred variant is selected at better than chance levels. Increasing the sample size of variants observed increases the chance that you acquire the best variant available in the population.

Biases are costly, and therefore imperfect

As far as many evolutionary social scientists are concerned, Richard Dawkins is way up in the pantheon of contemporary evolutionary thinkers. (For sure, he makes most Top Five lists.) Nonetheless, most place little stock in Dawkins's argument about rogue memes, regarding it as an imaginative device for explaining the nature of replicators, rather than a serious proposal about human cultural evolution. Instead, they tend to think that all forms of learning are processes whereby the organism exploits statistical regularities in the environment so as to develop a phenotype that is well suited to the present environment. Over time, selection shapes psychology (and other processes as well) so that it uses predictive cues to generate adaptive behavior. Social learning is just another learning mechanism that exploits cues available in the social environment. As a result, to oversimplify just a bit, most evolutionary social scientists expect people to learn things that were good for them in the Pleistocene or at least in the smaller-scale human societies that resemble those of the Pleistocene. Adaptation arises from the information-processing capacities built into the human brain by natural selection acting on genes.

These mechanisms may give rise to maladaptive behaviors nowadays, but it's got nothing to do with culture and everything to with the fact that "environments" are far outside the parameters to which our innate decision-making talents are calibrated.

This argument neglects an important tradeoff. Selection cannot create a psychology that gets you only the adaptations and always rejects maladaptive variants, because selection cannot generate accurate general-purpose learning mechanisms at a feasible cost. Why not? Think of using the taste of a substance as a guide to whether it is edible. Many toxic plants have a bitter taste, and accordingly we tend to reject foods that taste bitter. On the other hand, many toxins do not taste bitter, so bitterness is no infallible guide to edibility. Further, many bitter plants, such as acorns, can be rendered edible by cooking or leaching. Further still, some bitter-tasting plant compounds have medicinal value. People can actually grow fond of some bitter-tasting food and drink. Think gin and tonic. A bitter taste is only a rough and ready guide to what is edible and what is not. In principle, you could do much better if you had a modern food chemist's laboratory on the tip of you tongue, one that could separately sense every possible harmful and helpful plant compound, rather than having just four very general taste senses. Some animals are much better at these things than humans—we have a very poor sense of smell, for example. But the number of natural organic compounds is immense, and selection favors compromises that *usually* result in adaptive behavior and don't cost too much. A fancy sense of smell requires a long muzzle to contain the sensory epithelium wherein all those fancy sensory neurons are deployed, and plenty of blood flow to feed them. Bitter taste is a reasonably accurate and reasonably general screening device but to get the good, you have to risk adopting the bad because the evaluative machinery the brain deploys to exercise the various biases is necessarily limited. Let's see why.

John Tooby and Leda Cosmides define an adaptation as "a reliably developing structure in the organism, which, because it meshes with the recurrent structure of the world, causes the solution to an adaptive problem."[23] They give behavioral examples such as inbreeding avoidance, the avoidance of plant toxins during pregnancy, and the negotiation of social exchange. Evolutionary psychologists are prone to wax eloquent over marvelous cognitive adaptations created by natural selection. And they are right to marvel; everyone should. Natural selection has created brains and sensory systems that easily solve problems that stump the finest engineers. Making robots that can do anything sensible in a natural environment is exceedingly difficult, yet a tiny ant with a few thousand neurons can meander over rough ground hundreds of meters from its nest, find food, and return in a beeline to feed its sisters. Humans are able to solve many astoundingly difficult problems as they go through daily life because natural selection has created numerous adaptive information-processing modules in their brains. Notably, the best examples involve tasks that have confronted every member of our lineage in every environment over tens of millions of years of evolution, things such as visual processing. The list of well-documented examples that apply to humans alone is short, and once again these psychological adaptations provide solutions to problems that every human if not every advanced social vertebrate faces—things such as learning language, choosing a good mate, and avoiding cheaters in social exchange.

Cultural evolution also gives rise to marvelous adaptations. However, they are typically solutions to problems posed by *particular* environments. Consider, once again, the kayaks built and used by the Inuit, Yupik, and Aleut foragers of the North American Arctic. By Tooby and Cosmides' definition, kayaks are clearly adaptations. These peoples' subsistence was based on hunting seals (and sometimes caribou) in Arctic waters. A fast boat was required to get close

enough to these large animals to reliably hit and kill them with an atlatl dart.[24] Kayaks are a superb solution to this adaptive problem. Their slim, efficient hull design allowed sustained paddling at up to seven knots. They were extremely light (sometimes less than fifteen kilograms), yet strong and seaworthy enough to safely navigate rough, frigid northern seas.[25] They were also "reliably developing"—every successful hunter built or acquired one—until firearms allowed hunting from slower, but more stable and more widely useful umiaks. For at least eighty generations, people born into these societies acquired the skills and knowledge necessary to construct these boats from available materials—bone, driftwood, animal skin, and sinew.

Certainly, no evolved "kayak module" lurks in the recesses of the human brain. People have to acquire the knowledge necessary to construct a kayak using the same evolved psychology that people use in other environments to master other crucial technologies. No doubt, learning any craft *requires* an evolved "guidance system." People must be able to evaluate alternatives, to know that boats that don't sink and are easy to paddle are better than leaky, awkward designs. They have to be able to judge, to some significant degree, whose boats are best, and when and how to combine information from different sources. The elaborate psychological machinery that allows children to bootstrap general knowledge of the world is also clearly crucial. People can't learn to make kayaks unless they already understand something about the properties of materials, how to categorize plants and animals, and so on and on. This guidance system is not "domain general" in the sense that it allows people to learn *anything*. It is highly specific to life on earth, in a regime of middle-sized objects, relatively moderate temperatures, living creatures, manual skills, and small social groups. However, it *is* domain general in the sense that nothing in our evolved psychology contains the specific details that

make a difference in the case of kayaks—knowledge of the dimensions, materials, and construction methods that result in constructing a fifteen-kilogram craft that safely skims across the Arctic seas, making a living for its occupant, instead of an inferior vessel that leads to death by drowning or hypothermia. These crucial details were stored in the brains of each generation of Inuit, Yupik, and Aleut peoples. They were preserved and improved by the action of a population of evolved psychologies, but employing mechanisms that are equally useful for preserving a vast array of other kinds of knowledge.

Such widely applicable learning mechanisms are necessarily more imperfect and error prone than highly constrained, domain-specific ones. As Tooby and Cosmides have emphasized, broad general problems are much more difficult to solve than simple constrained ones.[26] A kayak is a highly complex object, with many different attributes or "dimensions." What frame geometry is best? Should there be a keel? How should the components of the frame be joined? What kind of animal provides the best skin? Which sex? Harvested at what time of year? Designing a good kayak means finding one of the very few combinations of attributes that produces a highly specialized boat. The combinations of attributes grow geometrically as the number of dimensions increases, rapidly exploding into an immense number. The problem would be much easier if we had a kayak module that constrained the problem so that we would have fewer choices to evaluate. However, evolution cannot adopt this solution because environments are changing far too quickly and are far too spatially variable for selection to shape the psychologies of Arctic populations in this way. The same learning psychology has to do for kayaks, oil lamps, waterproof clothing, snow houses, and all the other tools and crafts necessary to survive in the Arctic. It also has to do for birch bark canoes, reed rafts, dugout canoes, planked rowboats, rabbit drives, blowguns, hxaro gifts, and the myriad marvelous, specialized,

environment-specific technologies that human hunter-gatherers have culturally evolved.

For the same reason that evolution cannot "design" a learning device that is both general purpose and powerful, selection cannot shape social learning mechanisms so that they reliably reject maladaptive beliefs over the whole range of human experience. A young Aleut cannot readily evaluate whether the kayaks he sees his father and cousins using are better than alternative designs. He can try one or two modifications and see how they work, and he can compare the performance of the different designs he sees. But small samples, many dimensions of variability, and noisy data will severely limit his ability to choose the best design. What a bias gains in generality, it has to give up in accuracy. The repeated action of weak domain-general mechanisms by a *population* of individuals connected by cultural inheritance over many generations can generate complex adaptations like kayaks, but individuals must adopt what they observe with only marginal modifications. As a result, we may often adopt maladaptive behaviors if population level processes like selection on nonparentally transmitted variation have somehow favored them.

In the last chapter, we showed that when determining which cultural variant is best is difficult, selection favors heavy reliance on imitating others. The natural world is complex and variable from place to place and time to time. Is witchcraft effective? What causes malaria? What are the best crops to grow in a particular location? Does prayer affect natural events? The relationship between cause and effect in the social world is often equally hard to discern. What sort of person should one marry? How many husbands are best? Tibetan women often have two or three. What mixture of devotion to work and family will result in the most happiness or the highest fitness? Students of the diffusion of innovations note that "trialability" and "observability" are some of the most important regulators of the spread of ideas from one culture

to another.[27] Many important cultural traits, including things such as family organization, have low trialability and observability and are generally conservative. We act as if we know that sensible choices about such behaviors are hard to make and that we are liable to err if we try to depart far from custom.

As the effects of biases weaken, social learning becomes more and more like a system of inheritance. Much of an individual's behavior is thus a product of beliefs, skills, ethical norms, and social attitudes that are acquired from others with little if any modification. To predict how individuals will behave, one must know something about their cultural milieu. This does not mean that the evolved predispositions that underlie individual learning become unimportant. Without them, cultural evolution would be uncoupled from genetic evolution. It would provide none of the fitness-enhancing advantages that normally shape cultural evolution and produce adaptations. However, once cultural variation is heritable, it can respond to selection for behaviors that conflict with genetic fitness. Selection on genes that regulate the cultural system may still favor the ability and inclination to rely on imitation, because it is beneficial on average. Selection will balance the advantages of imitation against the risk of catching pathological superstitions. Our propensity to adopt dangerous beliefs is part of the price we pay for the marvelous power of cumulative cultural adaptation. .A saying might go, "if you evolve the adaptation, you have to pay its costs."

<B>Adaptive biases have specific, unavoidable, maladaptive side effects</B>

You might think that weak biases would just be a recipe for accepting a variety of more or less random beliefs, and while this may be true of some simple heuristics, other biases lead to systematic, predictable pathologies, a fact that allows us to check for their existence and

importance.

Conformist bias can lead to the evolution of maladaptive self-sacrifice

Recall from the last chapter that conformist rules such as "imitate the most common variant" are adaptive in any environment that also favors social learning. If a social learner has difficulty determining the best way to behave, doing what everybody else is doing is probably safe. Conformity has an important side effect: it tends to reduce the amount of variation within groups and increase and preserve variation between groups. This can, in turn, increase the importance of group selection, and if cultural rules arise that cause individuals to sacrifice their own interests for the good of the group, group selection can cause the frequency of individually costly but group-beneficial traits to increase.[28]

Suppose that two groups differ in religious belief. In one group, most people believe in a god who punishes the wicked; in the other group, most people are worldly atheists. Further, suppose that believers engage in individually costly but group-beneficial behavior—they are more honest in business transactions, less prone to hedonistic excess, and more generous and charitable. (Their religious beliefs don't have to make them angels—just a little more group oriented than their competitors.) Finally, suppose that other parts of their evolved psychology cause people to prefer deception, self-indulgence, and selfishness, and as a result, a content bias causes atheism to spread. If the content bias were the only force acting, the group benefits associated with religious belief could not spread, because atheists would quickly come to dominate. However, if people are also predisposed to imitate the majority, believers may remain common in the first group, simply because they are already common. People act as if they looked around and thought to themselves, "Everybody believes, so there must be gods who punish the

wicked." As a result, the two groups will remain different, and over the long run, the group of believers that is wealthier, healthier, and more stable will tend to replace the group of atheists.[29]

We have to be very careful with our definitions of *fitness* to keep this argument clear. If cultural group selection operates successfully, the benefits of group-adapted beliefs may raise everyone's reproductive success. Nevertheless, selection acting on genes will continue to favor atheists who take the benefits of living in a better society but evade paying the costs. Group-selected institutions may even arrange payoffs to discriminate against selfish atheists and other deviants from community orthodoxy; for example, by establishing punishment systems like the Inquisitions.[30] Even when such systems are powerful, selection acting on genes will favor any new variant that can evade the prevailing system of punishment. Thus, selection on genes still favors the evolution of individually advantageous traits, even if the collapse of religious belief would harm the reproductive success of atheists themselves in the long run, and even if none of the variants currently in the population that can escape the punishment system.

Group selection on cultural variation has been an important force in human evolution. Conformist bias and rapid cultural adaptation conspire to generate oodles of behavioral variation between groups. The conformist effect overcomes the critical problem with group selection. In the case of a genetic system of inheritance, variation between groups tends to evaporate quickly in the face of modest amounts of migration. In the case of altruistic traits, selection within groups against altruists also reduces between-group variation for altruism. The existence of large-scale cooperation in human societies invites a group-functional interpretation, and perhaps the peculiarities of the cultural system of inheritance are responsible. We develop this argument in more detail in the next chapter.

The prestige-biased force can lead to "runaway" cultural evolution

Darwin believed that sexual selection was responsible for the maladaptive elaboration of secondary sexual characters such as the spectacular tails of peacocks.[31] Males with conspicuous tails have more offspring even though they are more subject to predation, because peahens prefer males with spectacular tails. In essence, Darwin thought that evolutionary fads in sexual attractivness often led to the evolution of maladaptive fads in feathers, fur, and bug's ears. However, he did not explain why females should have such faddish preferences. The pioneering evolutionary theorist R. A. Fisher showed that there need not be any *adaptive* explanation.[32] Fisher's insight was to see that the male offspring of females who preferred showy males would tend to have both the genes for showy tails *and* the genes that caused females to prefer such males. Thus, if female choice increases the frequency of genes leading to showy tails, it may also increase the genes that cause females to prefer such tails. This will lead to progressively stronger selection for showy males that will further increase the preference for such males. The process feeds back on itself in an explosive spiral that can cause a trait originally correlated with fitness to become wildly exaggerated. This subject remains controversial in evolutionary biology, but in theory this mechanism can operate; moreover, it seems to account for otherwise mysterious characters such as the peacock's tail, the bower-bird's bowers, and the elaborate penises of many insects.[33]

Prestige-biased transmission can work in a similar way. Remember that prestige bias occurs when individuals choose models based on indicators of prestige. Suppose that people have beliefs (not necessarily conscious ones) that cause them to imitate the actions of pious people—people who devote time and resources to religious rites, are conspicuously abstemious, and are charitable. This process will cause more people to act piously, and will also increase the

propensity to imitate the pious, because people who do will acquire from them beliefs about who should be imitated, and the most pious people will prefer more piety than the population as a whole. The resulting dynamic is closely analogous to runaway sexual selection.[34] We have argued that many phenomena, ranging from maladaptive fads and fashions to group-functional religious beliefs to symbolically marked boundaries between groups, might result from the properties of indirect bias.[35]

The exaggeration of traits signaling status in human societies is virtually a truism. For example, on the island of Ponapae in the Pacific, a man's prestige is partly determined by his contribution of very large yams to periodic feasts.[36] Prize yams require up to a dozen men to carry, and their cultivation is inefficient from the point of view of food production. We imagine an evolutionary scenario in which, at the beginning, people just brought their best produce to the feast, and the size and number of yams were straightforward indicators of farming ability. Then, as the idea that the best people would contribute the biggest yams took hold, families began to devote special effort to grow big yams, and the custom of growing giant yams took off. In California, where we live, the twelve-man yam comes to mind when we see a Hummer II rolling down a Los Angeles boulevard.[37]

Cultural systems can defend against adaptive biases

Finally, cultural systems often evolve clever defenses against the action of our evolved psychology.[38] The nonparentally transmitted parts of culture are analogous to microbes. Our immune system evolved to kill microbial pathogens but it also allows us to acquire helpful symbionts. As we know all too well, microbial pathogens are common, despite the sophistication of the immune system. One reason is that we are not the only players in this game. Natural

selection helps parasites trick our immune system. Since microbial populations have short generation times and large populations, parasite adaptation can be very rapid. The psychology of social learning is like an immune system in that it is adapted to absorb beneficial ideas but resist maladaptive ones. And, like the immune system it is not always able to keep up with rapidly evolving cultural "pathogens."

Consider, for example, Christian theology. It paints a picture of eternal rewards and punishments that is convincing to the faithful. If biases are viewed as a rough-and-ready method of weighing fitness benefits and costs, a system that adds imaginary costs and benefits puts a thumb on the scale. Believers may behave in ways that cause them to perpetuate the faith at a cost to their fitness. Blaise Pascal, the pioneering sixteenth-century mathematician and scientist, wrote a famous defense of faith based upon the laws of probability that he codiscovered. In his famous wager, he invites us to weigh the finite pleasures and pains of life on earth against the infinite rewards of heaven and the infinite punishments of hell: "[T]here is an infinity of infinitely happy life to be won, one chance of winning against a finite number of chances of loss, and what you are staking is finite," concluding, "Wager then without hesitation that He is."[39] This sophisticated argument is frequently used to persuade nonbelievers and to reassure believers tempted by doubts. Pascal himself abruptly retired from secular pursuits in 1654 and spent the rest of his life defending Jansenism, an austere, Calvinist-tainted brand of Catholicism, which was eventually suppressed by the Church.[40] We ourselves are not concerned with any fitness Pascal lost in the service of his beliefs, but we regret that he was lost to science.

Pascal is in good company. Christian believers over the centuries include many awe-inspiring intellects.[41] Greek philosophy inspired early Christian theologians, most notably St. Augustine. Isaac Newton was at least as proud of his theology as his science. Proofs of the

existence of God were a staple of Pascal's philosophical contemporaries, such as Leibniz and Descartes. Modern science has the advantage of being a large, prestigious, well-funded community of highly trained rational skeptics. Even then, scientists work hard to keep "disciplines" like paranormal psychology and creation science in check. Individual skeptics can hardly be expected to make much headway against belief systems that have been buttressed by the best efforts of a succession of able thinkers.

Summing up: If information costs are high, maladaptive beliefs will spread

We submit that any feasible fitness-maximizing social learning psychology is one that leaves plenty of scope for rogue variation. Paying attention to only Mom and Dad throws away too much valuable information, so adaptive evolution will favor learning from lots of people. But, like opening your nostrils to draw breath in a microbe-laden world, nonparental cultural information will tend inevitably to be laden with maladaptive ideas. From the gene's "point of view," a bias that picks *the* fitness-optimizing trait from a large pool of potential "teachers" in every Pleistocene environment would be great to have. But, the tradeoffs inherent in learning and cognition make such biases unattainable, just as biomechanical tradeoffs prevent the evolution of fire-breathing dragons and flying pigs. The adapted mind is constrained by the prohibitive cost of vetting every cultural variant for its contribution to fitness. Our main conclusion in the last chapter was that culture is adaptive because *populations* can quickly evolve adaptations to environments for which *individuals* have no special-purpose, domain-specific evolved psychological machinery to guide them. Rigid control of cultural evolution would make the cultural evolutionary system slow and clunky. In the wildly varying environments of the Pleistocene, individuals were better off relying upon fast and frugal social learning heuristics to

acquire pretty good behaviors RIGHT NOW rather than await the perfect innate or cultural adaptation to an environment that that would be gone before perfection could evolve. Such heuristics leave space for selfish cultural variants to seep into the population—just the price of doing business in a highly variable environment where information is costly.

. This way of thinking is human evolutionary psychology done right. The comparative psychology of social learning, reviewed in chapter 4, demonstrates that humans are able to learn complex tasks by observing others. This capacity is, apparently, distinctively human; no other species is known to depend upon such a large repertoire of complex, highly evolved traditions. The evidence of chapter 4 shows how culture, because of its population-level properties, can act as a potent problem-solving device. Human cultural diversity is ample testimony to the power of culture to solve the problem of living nearly anywhere in the world. As cognitive psychologists have argued so persuasively, general-purpose, problem-solving devices at the individual level are ineffective by comparison.

Much human psychology relies on clever but simple heuristics for managing cultural transmission. Culture, then, is a sophisticated cognitive *and* social system evolved to finesse the problem that information costs preclude a general-purpose, problem-solving system inside every individual's head. The scientific enterprise itself is the ultimate example of culture's capacity to solve extraordinarily difficult problems. Given the right social institutions, quite fallible individual intellects can gradually reveal the deepest secrets of the universe.[42] The price we pay for our promiscuous lust for adaptive information is playing host to sometimes spectacularly pathological cultural variants.

Witchcraft is a simple example of maladaptive cultural variants

Pascal Boyer provides a good example of how a widely useful, general-purpose learning heuristic can sometimes lead us astray. Boyer argues that people apply "abductive reasoning" to the acceptance of supernatural ideas (and probably to much else).[43] Abductive reasoning is a form of induction in which a premise is deemed to be true if the implication of that premise is observed.[44] Arctic Americans used kayaks to hunt sea mammals. They were very successful doing so with primitive weapons. Thus, kayaks are the optimal boat for Arctic sea mammal hunting with atlatls. *Plausible*. But: People pray to gods for health and prosperity. Many sick people get well and many economic ventures succeed. People who do not pray often get sick. Prayers are answered. Thus, gods do intervene on behalf of the faithful! *Not so plausible*. Abductive reasoning ignores the cases in which praying did not result in a cure and cures occurred without prayer. Alternative hypotheses are not considered; many times prayers for good health must precede bad health. We live in a very complex world. False disconfirmations of hypotheses are common due to the operation of countervailing causes. A really good understanding of the natural world requires time-consuming observations, elaborate calculations, and controlled experiments, and these rigorous inductive methods are too costly for everyday use. Even though abduction is far from logically or empirically guaranteed to succeed, it often discovers real causal and correlative patterns, and it is easy to apply. However, if people are armed with the wrong hypotheses, abduction can easily lead them to adopt false and often deleterious beliefs. Many religious ideas seem to be good for people's mental health and for creating strong communities.[45] However, the adaptive virtue of ritually handling rattlesnakes is hard to fathom. Some of southern Pentacostalists who engage in this practice are bitten, and some die.[46]

Other supernatural beliefs seem to be deleterious. For example, witchcraft beliefs are very common in societies at all levels of organization. Anthropologist Bruce Knauft studied a simple horticultural society in New Guinea, the Gebusi, who had an elaborate system of highly formalized witchcraft inquests. Despite their elaboration, the inquests depend on abductive inference, and "evidence" to support accusations was very easy to "discover." For example, witches supposedly worked their magic by making bundles of twigs and leaves. Witchcraft investigators easy found "evidence" of such bundles in the litter of decaying twigs and leaves on the forest floor. Before contact with Europeans, the Gebusi executed many people for practicing witchcraft, and these executions ranked alongside those from malaria as one of the leading causes of death. Despite other institutions designed to increase "good company," witchcraft suspicions handicapped the Gebusi's ability to resist the depredations of a neighboring tribe, the Bedamini; Gebusi society was paralyzed by witchcraft accusations and the fear of them.[47]

The sociologist and historian of religion Rodney Stark recounts a similar story for the wave of witch executions that took place in Europe during the Reformation. Both Protestants and Catholics found compelling theological justifications for the possibility of black magic. If God is benevolent, then some powerful evil force must exist that can be blaimed for the rough nature of life on earth. If humans could gain access to the benevolent powers of God through prayer, then magic or devil worship ought likewise to be effective at calling up the evil forces. This argument was widely held by the most sophisticated thinkers of the day. These beliefs led to a steady trickle of witch trials in which most defendants confessed and promised to abstain, but a few were executed. Destructive outbreaks of witch killings sometimes occurred in small communities where unsophisticated local authorities accepted the unsupported testimony of children and the confessions under torture. The initial victims would readily implicate others to save themselves

from further torture. Killings often went unchecked until the authorities had executed some 5% to 10% of the community. By that time accusations began to be made against solid citizens, and the episode became self-limiting. Most of the destructive outbreaks occurred in the politically fragmented Rhineland where sophisticated higher authorities had a difficult time intervening.[48]

Superstitious beliefs and elaborate, potentially costly rituals exist in many societies. Nineteenth-century scholars felt very free to attribute maladaptive superstitions to "primitives." Later, anthropologists of various schools became enamored with functionalist explanations of many kinds. In the late twentieth century, scholars became sensitive to the possibility that superstitious beliefs are common in advanced societies. For example, journalist Dorothy Rabinowitz details how eerily the ritual child abuse cases of the 1980s and 1990s in the United States resemble the witchcraft persecutions of an earlier era. Seemingly sophisticated prosecutors, such as former U.S. Attorney General Janet Reno, believed what in hindsight were ludicrous accusations made by suggestible children.[49] Of course, the functions of beliefs are sometimes not easy to discern, and much work needs to be done before any sweeping generalizations are warranted.

The modern demographic transition may result from the evolution of selfish cultural variants

The contemporary drop in birthrates, which started in the developed countries but is now occurring in most of the world, attracts considerable attention from demographers. For the most part, they portray the phenomenon in positive terms. It is a concomitant of the economic changes that make people in the industrial world prosperous and prevent an undesirable overpopulation of

the world. The global environment aside, this decline in birthrate represents a failure to maximize individual genetic fitness and requires an explanation. The Catholic Church's distaste for birth control is much closer to the prediction of ordinary evolutionary theory. From the perspectives of the Pope and natural selection, the wealth of modern societies is wasted on consumerist lifestyles dedicated to crass materialism. Imagine the alarm that a virulent fertility-reducing pathogen would cause at the Centers for Disease Control and Prevention, especially if the newer strains were beginning to cause population decline over wide areas of the globe. So the Vatican must feel.

The demographic transition is at least partly caused by the increased nonparental cultural transmission associated with modernization. Modern economies require educated managers, politicians, and other kinds of professionals who typically earn high wages and achieve high status. Accordingly, competition for such roles is fierce. People who delay marriage and child rearing in order to invest time and energy in education and career advancement have an advantage in this competition. High-status people have a disproportionate influence in cultural transmission, so beliefs and values that lead to success in the professional sector will tend to spread. Because these beliefs will typically lead to lower fertility, family size will drop.

Consider the situation for the mass of people in premodern agrarian societies. In pretransition populations, most people are illiterate or poorly educated and live in relatively isolated villages. The elites to whom the average person is exposed—landowners, priests, military officers, government officials—gain their status by right of birth, not merit. That is, hereditary aristocracy, to which ordinary people cannot aspire, dominates the prestige system. The family is the most significant social institution for the majority of the population, the primary unit of production, consumption, and socialization. When cultural transmission is

vertical, selection on cultural variation will tend to favor the same behavior that selection on genes would favor—large, economically successful families. Very often a strong familial ethic encourages reproduction in order to increase the power of one's lineage or clan. Childless couples are pitied. A large and prosperous family is the greatest achievement to which ordinary men and women can aspire.

Large families under the supervision of able men and women mobilize family labor to prosper. The less able find it hard to assemble the resources necessary to marry or more difficult to support the children they have, and are more prone to become victims of the many risks to survival in traditional circumstances. Death rates are always high and spike upward during famines, plagues, wars, and natural disasters. The well-managed family is the key to survival and reproductive success in the scramble to recover from catastrophes or to become established on frontiers, and in the tight competition in a dense population near carrying capacity.[50] *Relatively* little conflict will arise between the fitness of culture and genes in such circumstances.[51] Genetic biases and cultural norms conspire to adapt reproductive behavior to changing situations. Frontiers—eighteenth- and nineteenth-century America was economist Thomas Malthus's own example—favored sheer maximization of offspring number as the critical resource; land was not in short supply. In densely populated lands—as in Ireland in the nineteenth and early twentieth centuries—delayed marriage, and other expedients produced very low birthrates and prevented families from becoming paupers.

Premodern demographic systems were no doubt complex even in the stationary and slowly growing populations of the Old World. Economist-demographer Ansley Coale notes that many combinations of mortality and fertility yield approximately zero population growth, the norm in most premodern circumstances. For example, the birthrate in China was higher and life

expectancy lower than in the countries of northwestern Europe, although all had essentially zero population growth.[52] Anthropological demographer William Skinner argues that Eurasian "family systems," the normative patterns of marriage, postmarital residence, numbers and sexes of children, and inheritance of family resources are highly variable and have large impacts on all demographic variables.[53] He provides many examples of premodern societies using fertility control, infanticide, fosterage and adoption to obtain offspring sets of desired size and composition. Some of this variation includes behavior detrimental to fitness that we will discuss a little later in this chapter, but nearly all traditional family systems were capable of rapid growth resources permitting and maintained high populations in resource-constrained times and places.

The evolution of modern industrial societies embodies two linked but imperfectly correlated revolutions. One is a revolution in production due to industrialization that boosts the material standard of living. This phase of modernity lowers death rates by raising the material standard of living and by related innovations in public health and medicine. It also provides the technical means to more easily control conception. The second is a revolution in the structure of the transmission of ideas of all sorts. Literacy rates rise as schooling becomes nearly universal. Production activity is transferred from family-dominated farms to factories and offices controlled by entrepreneurs and managers rather than a hereditary elite. The role of government in people's everyday lives increases, and bureaucratic reforms make government offices competitive posts open to aspiring educated men (and eventually women). High literacy and the industrialization of printing led first to the emergence of print mass media and later to ongoing innovations in the broadcast media and the film industry. In the contemporary world, cheap electronics bring entertainment produced in Hollywood, Mexico City, Sao Paulo, and Mumbai to the remotest villages. The rise of mass media and universal education rather suddenly exposed people to

much more nonparental cultural influence than had been experienced in more traditional societies. Proportionally, the scope for the spread of cultural variation in conflict with genetic fitness increased.

Demographers have noted the association of the demographic transition with the rise of modern industrial societies since the pioneering work of A. M. Carr-Saunders and others before World War II.[54] Most discussions cite a long list of correlates between economic and social modernization. Economic theory provides the most ambitious theoretical framework for dissecting the causal pathways from modernization to fertility decline. Economists have considered the costs and benefits of having children under different circumstances, and then attempted to test various hypotheses by examining correlations between economic variables and observed changes in fertility. For example, the shift from farm to factory work plausibly reduces the value of child labor, especially if factory work requires an educated workforce. With less need for family labor in production and the necessity to pay school fees, the benefits of children will decline and their costs will increase; ergo, fertility will fall. Most of these models assume preferences to be fixed, and the shift in fertility is assumed to stem from changes in opportunities and constraints arising from the Industrial Revolution in production. The model is cogent, but the empirical data suggest a rather more complex causal process.

The most ambitious test of the economic model was the Princeton European Fertility Project led by Ansley Coale.[55] This study investigated the fertility decline in over six hundred administrative units in Europe over the last two centuries. For most districts, Coale and his coworkers could estimate the time paths of fertility, proportion of women married, and marital fertility. The results show a striking disjunction between economic development and the onset of fertility decline. For example, the provinces that show the earliest sustained declines in fertility

are in France, where the onset of the transition dates to about 1830. The onset of the decline in Britain and Germany occurred fifty years later, and some German districts maintained high fertility until 1910–20. These trends challenge the economists' simple model in which fertility declines follow increased industrialization. France experienced an early and extreme *social* modernization, but the pace of *economic* modernization was much slower than in Britain and Germany.

Fertility patterns show a striking effect of culture—all across Europe, culturally distinctive areas tended to have a distinctive timing to the onset of their fertility decline. For example, French-speaking areas in Belgium experienced the onset of the transition in the 1870s, while the transition was delayed in Flemish-speaking areas of Belgium by as much as forty years. Hungary's transition was much earlier than the rest of Austro-Hungary, Catalonia's much earlier than the rest of Spain, and Brittany and Normandy's nearly a century later than most of the rest of France. This result should not be altogether surprising, even to economists. Modernity's emphasis on individualism and rationality has created new demands for political rights as well as demands for efficient economic organization. These pressures are filtered through the preexisting variation in values, beliefs, skills, and environments of particular regions. The common systemic features of modernity maintain a loose correlation across domains such as industrial production, literacy, and demography, but if historical differences in culture are important, each cultural region will experience any transitions at its own pace. Unfortunately, the Princeton European Fertility Project was not designed to collect the kind of data needed to understand the role cultural processes play in the fertility transition. Indeed, the demographers traditionally focus on correlations between fertility and macrosocial variables that preclude a fine-grained analysis of the causal processes that underlie them, especially if the causal processes

are evolutionary.

Modern low fertility does not maximize fitness

Before proceeding under the assumption that the demographic transition is fitness reducing, we need to be sure that it actually is. Evolutionary biologists have long known that there is an evolutionary tradeoff between the quantity and quality of offspring. In his classic study, ornithologist David Lack demonstrated that the optimal clutch size in European starlings is smaller than the maximum clutch size, because parents who lay an large number of eggs fledge fewer than those who lay an intermediate number. Similarly, if parents have just enough property to endow one child with a farm that will support a family, they should do that, rather than dividing their property among their children and giving none of them enough to make a good living. Perhaps the modern focus on producing a few healthy, well educated but expensive children just reflects a fitness-optimizing tradeoff of quality for quantity.[56] The basic idea is that when offspring quality is as important as quantity, fitness needs to be counted at the level of grandchildren, not children. Those who produce lots runty ill-educated starvelings may have more children, but those who produce a smaller number of healthy offspring will have a more grandkids.

Anthropologists Jane Lancaster and Hilliard Kaplan tested this explanation of modern low fertility in a large study of the reproductive histories of men in Albuquerque, New Mexico.[57] Anglos were found to be typically more affluent than Hispanics and have fewer children. However, Lancaster and Kaplan could find no evidence that these findings reflected an adaptive tradeoff between quantity and quality. Anglos invest more in fewer children but have fewer grandchildren than Hispanics, not more. Hispanic men have larger numbers of offspring and

grand-offspring than Anglos even when economic factors were controlled for statistically. These ethnic differences are like the results of the European Fertility Project. The inverse relationship between resources and fertility among the modern middle class is almost certainly also an inverse relationship between wealth and fitness. The continuing decline of fertility to below replacement levels in many parts of Europe (both richer and poorer parts) is unlikely ever to find a fitness-enhancing explanation.

The nonparental transmission hypothesis predicts a diverse array of rogue cultural variants

What does the nonparental transmission hypothesis predict about patterns of fertility decline? As we have seen, all the forces on cultural evolution can support the spread of rogue cultural variants under the right circumstances. The change in the relative importance of nonparental transmission in the modern period is progressive and became massive with the development of cheap mass media. And the more nonparental transmission, the greater the opportunity for maladaptive variants to spread. Innate and cultural-bias heuristics adapted to a lower rate of nonparental transmission would be ill equipped to manage a flood of newly evolved beliefs and attitudes. Selfish cultural variants should exploit a diversity of strategies in these suddenly vulnerable populations. At the same time, variation in values among groups exposed to the same variants will translate into different rates of "infection." Natural selection on vertically transmitted elements of culture will favor pronatalist values directly, and pronatalist values will tend to confer a measure of resistance to the "infection."

In what follows, we present evidence that the successful strategies of selfish cultural variants affecting fertility are indeed diverse, and that some preexisting and newly evolved

values with pronatalist effects provide some resistance to fertility-reducing effects.

Beliefs leading to the demographic transition exploit content biases

The clearest examples of cultural ideas that exploit content biases in our psychology are the basic products of the industrial and information revolutions. Modernity has made us consumers who spend a lot of time and money buying and using modern products. The desire for material possessions and creature comforts is fitness enhancing in traditional societies, and this desire is strong in almost all societies; the basic acquisitive impulses are likely innate. After the first few innovators adopt the new item, they serve as demonstrators for the rest of us, and before long another "necessity," such as the telephone or television, is born. We can remember a time when personal computers and mobile phones were undreamed-of devices. In other cases, industrial goods spread only to those rich enough (gourmet food products) or interested enough (mountaineering gear) to use them.

Economist Gary Becker has built a rational-choice explanation for the low fertility of the affluent along these lines.[58] The elite can earn fine salaries, given professional effort. Wealth permits us to consume many luxuries, but this takes time. Our work and our patterns of consumption crowd out our ability to raise children. In contrast, the poor, whose wages are low and who are unable to afford time-consuming hobbies, find raising children an enjoyable way to spend their time. Just as the rich consume less beans and beer than the poor because they can afford steak and champagne, so too do the affluent spend more time earning money and indulging costly hobbies at the expense of having children. Our preferences for children, costly luxuries, and time-consuming hobbies need not differ from person to person or time to time. As the economy undergoes a major structural change, budgets expand and universal preferences

merely lead to the substitution of more-preferred for less-preferred items in our consumption set. As the decision-making force of direct bias becomes very strong, the adoption of "traits" such as using an electric toaster becomes cultural only in a quite trivial sense. As we have said before, the rational-choice model is a limiting case of cultural evolution. Note that Becker's model is a covertly cultural evolutionary one in which all the evolutionary action is occurring offstage in the innovations that cause economic growth.

That said, modern economies certainly do produce a plethora of goods and services that appeal mightily to our preferences—universal, culture specific, idiosyncratic, and deviant. Modern business management is aimed at making as direct a connection between our preferences and the industrial production system as highly trained minds can devise. They are successful, and the results no doubt impact our fitness. Here as anywhere, those who wish to box off culture and focus on environment-contingent decisions can find plenty of phenomena that approximate the rational-choice model. Done with eyes peeled, there is nothing wrong with such efforts. The difficulty comes when rational-choice theorists lose track of which shell hides the cultural pea—particularly if the cultural pea is evolving. If we are correct, we cannot depend upon humans to have common preferences across societies or stable preferences over time.

However, the pressures and distractions of modern life cannot be the only cause of reduced fertility because Americans and other citizens of industrialized still have plenty of time for child rearing.[59]

Sociologists John Robinson and Geoffrey Godbey have collected data on nationwide samples of Americans from 1965 to the present using rather detailed time diaries, the data from which are quite different from data based on people's recollections. Similar data exist for some

European countries and Japan. Americans report that they work more than they actually do and underestimate their leisure time, leading to many media stories about overworked Americans.[60] The educated and affluent do work more than those less educated and less affluent, but they also exaggerate their work hours to a greater extent. The truth is that work hours have fallen since 1965. Hours worked by women have increased about three hours per week because of their increased employment outside the home, but the average amount of time worked by all Americans has fallen by more than three hours per week. Hours spent on housework have also fallen substantially for both men and women, mainly because there are more single people and smaller numbers of children. As a result, Americans have about five hours more free time per week than they had in 1965. This increase, however, has been entirely offset by a five-hour-per-week increase in TV viewing, which now amounts to about fifteen hours per week for the average adult. [61]

Our incomes are also ample to support larger families. Baby boom cohorts are earning substantially more than their parents—when income is adjusted to reflect the number of children in the household and the cost of living, Boomers are 50% better off than their parents. This advantage reflects sharply lower rates of childbearing and higher numbers of women in the workforce. Boomers have the financial resources to match or exceed the fertility of their parents, but choose to work more and have fewer children.[62]

Aside from sheer consumerism, there are many obvious reasons to decide to participate in modern economic institutions. Advanced medicine, better hygiene, inexpensive food, and improved shelter, contribute positively to basic components of fitness. Other things, such as reduced dependence on often whimsical or despotic family leaders, must seem like a great boon even as they remove incentives and aids to child rearing. In principle, people could carefully

evaluate modern beliefs and attitudes and selectively adopt fitness-enhancing ones. In fact, as is argued in the section below, a few cultures have created this kind of rigorously selective system. The means by which they do so are of great theoretical import.

Beliefs leading to the demographic transition exploit prestige biases

Much of the wealth of the industrial revolution flows to those who vie strenuously for competitive positions in education, business, the arts, medicine, the mass media, and government bureaucracies. Little trickles down to people occupying traditional roles, especially to those in the traditional rural trades. As we argued above, natural selection has shaped the psychology of social learning so that we are predisposed to imitate people with prestige and material well-being. Imitators using prestige as an indicator character, will tend to cause people to acquire the whole modernist corpus of values and attitudes. Modern people not only respect wealth itself but the career achievements that give rise to prosperous lifestyles. Free and inexpensive education reduces the barriers to competing for such careers. Not everyone can realistically aspire to great wealth, but a great mass of people can aspire to become respected by their professional colleagues. One of our mothers was in the habit of bragging, without irony, of her son's rather abstract and obscure achievements, "He's well known in his field."

Such new strivings reduce the desire to have children. This change is most dramatic for women. In traditional societies, women derive the bulk of their self-respect and social status from raising children and performing other domestic tasks. In most traditional cultures, a strict sexual division of labor substantially limits women's ability to compete for the most prestigious roles; those are almost entirely monopolized by men. Formal schooling radically alters this

pattern. One of the strongest correlates of the beginning of the demographic transition is women's access to education.[63] In school, girls are exposed directly to teachers (frequently women) and indirectly to others occupying prestigious modern roles. The ability of moderns to display wealth and sophistication gives such roles considerable attraction. Further, girls learn that they can succeed in doing schoolwork; what's more, if they are in coeducational schools, they discover that they are actually a little better at schoolwork than boys. Naturally enough, many school-taught girls come to aspire to paid work, to earn the money for participating in the modern economy.

<C>Natural selection on cultural variation influences the demographic transition</C>

The power of the modern prestige system to spread the demographic transition by indirect bias depends upon a reliable correlation between achievement in modern roles and small-family norms. If people from small families have an advantage in school achievement and in subsequent competition for prestige in modern social roles, then people who occupy the roles carrying the most weight in nonparental transmission will tend to come disproportionately from small families. The late demographer Judith Blake presented strong evidence of a tradeoff between family size and intellectual and educational achievement.[64] To test the hypothesis that larger sibships dilute parental resources, she surveyed a wide range of data collected mainly from large-scale U.S. surveys from the 1950s to the 1980s. The effect of family size is consistent across a variety of dependent measures. Large families have a consistent negative effect on intelligence and educational achievement. Children in large sibships (seven-plus children) receive two or three years less education than children in sibships of one or two children. Only children and those in sibships of two generally have the same years of education, but in larger sibships there is

a linear decline in number of years of education. The difference between sibships of one and seven is greater than the difference between black and white averages or between successive generations.[65] The effect of sibship size on intelligence, especially in terms of verbal ability, is fairly large, even when father's education (as a partial control for innate aspects of intelligence) was controlled for statistically. Youths' educational aspirations are directly and indirectly affected by sibship size, which in turn, negatively affects a wide variety of extracurricular pursuits, such as amount of time spent in cultural activities and reading.

Direct observations of child-rearing practices also indicate that mothers may devote less time per child to children in larger families, supporting the quantity/quality tradeoff.[66] The kinds of supportive, nonpunitive, engaged middle-class child rearing styles that produce children who perform well in school are doubtless more time consuming than punitive or negligent styles that produce less scholarly children.[67] If you want to improve your kids' genetic fitness, for goodness sake don't help them with their homework!

Data from modernizing situations suggest that fertility norms and other correlates of modern culture are transmitted in schools and workplaces.[68] In the United States, Sociologists Kohn and Schooler investigated the psychological impact of work environment. Men in professional jobs with considerable self-direction promoted this attitude toward themselves and society.[69] The same sorts of influences presumably operated in the nineteenth-century situations in Europe, where the demographic transition started.

Considerable evidence suggests that people who get advanced education tend to be from small families. Occupants of education-intensive roles will tend to have small families, articulate a preference for small families, and correctly attribute their professional success and the expected success of their children to limiting family size.

Enhanced channels of communication currently cause demographic transitions to begin at lower socioeconomic levels

Demographers John Bongaarts and Susan Watkins show that the demographic transitions now occurring in most nations in Latin America and Asia are quite different from the earlier transitions in Europe.[70] Contemporary transitions occur more rapidly and are starting at ever lower levels of socioeconomic development as measured by the United Nations Population Division Human Development Index, a linear combination of life expectancy, literacy, and Gross Domestic Product/capita. The most likely explanations for these changes are innovations that link local communities to national and international influence earlier in the development process. As Bongaarts and Watkins put it, development multiplies the channels of communication between traditional local communications networks and modernizing institutions. For example, friends and relatives discussing issues of interest in informal settings are the retail market for new ideas about contraception and fertility. As long as these markets remain closed, transitions do not occur. The process of development brings new ideas into the market via education, migration, and other forms of contact with the modernizing sector, the wholesalers of new ideas.

In recent decades, three forms of wholesale exposure to new ideas have become much more important at the local level. First, inexpensive electronic media now expose quite remote villagers to entertainment programming produced both nationally and in the developed countries. Second, most national governments have adapted neo-Malthusian policies. Local health workers and other government change agents promote contraception and extol the advantages of small families. Third, international nongovernmental organizations (NGOs) such as Planned Parenthood supplement national neo-Malthusian policies with their own propaganda campaigns.

Bongaarts and Watkins regard the legitimization of local discussion concerning the possibility of deliberate fertility reduction as the first important step on the road to widespread adoption of family size reduction. Consider the effect of nationally produced soap operas. They portray prosperous, attractive people leading modern urban lives. Extended, overt discussion of birth control may be rare in such entertainment, but the steamy romances portrayed and the scant presence of children imply it. One of us frequently travels in rural Mexico. Very often the staff of roadside and small-town restaurants are glued to the tube watching telenovelas. The explicit neo-Malthusian propaganda of governments and nongovernmental organizations fills in any blanks left by the entertainment sector.

The diffusion of innovations is by no means a simple or automatic process.[71] However, the exposure to modern ideas through a diversity of channels will eventually begin to strike cords unless local informal communications networks have powerful biases against modernism. The multiplication of these links in the last few decades is having the effect the nonparental transmission hypothesis predicts—earlier and more rapid declines in fertility.

Rare subcultures are successfully resisting the demographic transition

In modern societies, some subcultures have persistently higher birthrates than others. Groups such as conservative Protestants, Catholics, and Orthodox Jews with strong pronatalist ideologies and significant social and material support for large families have delayed and to some extent mitigated the impact of modern attitudes toward family. As late as the 1960s, Catholic women with parochial high school and college educations desired a child more than Catholics with nonsectarian educations, and nonsectarian Catholics desired more children than Protestants.[72] Sociologists Wade Roof and William McKinney's data show that Catholics and conservative

Protestants still hold a reproductive edge on other religious denominations.[73] On the other hand, formerly high birthrates in Catholic Italy have fallen well below replacement in recent years. The Muslim countries of the Middle East and North Africa have higher birthrates than most of the developing world, but most have now begun their transition. No modern transition has reversed itself once begun.[74] As we saw above, ethnicity, not income, provides the best explanation for differences in fertility among Albuquerque men.

Here we focus on two Anabaptist groups that retain very high birth rates, the Amish and the Hutterites. We think that these subcultures are the exceptions that prove the rule. Despite substantial wealth, people in these societies have not gone through the demographic transition, because Anabaptist customs block those same features of cultural evolution that make almost all modern societies susceptible to it.

The birthrates of Anabaptist groups rival those of the highest birthrate pretransition nations, while their death rates are at the levels characteristic of industrial societies.[75] Consequently, their population growth rates are exceedingly high. The Amish population increased from about 5,000 in 1900 to about 140,000 in 1992. In recent years, the population has been doubling every twenty years. The Hutterite rate of increase was a little above 4% per year, giving a doubling time of seventeen years. Hutterite and Amish losses to apostasy are not known with any certainty. Conversion to conventional conservative Protestant churches seems to be a growing problem, though these losses pose no immediate threat to the viability of Anabaptist communities. These societies are prosperous, but they have greatly restricted luxury consumption in order to support very high population growth.

Anabaptists are not relentless procreators; they are perfectly capable of reducing fertility in response to economic constraints. In recent years high land prices have greatly affected both

Hutterite and Amish societies. Hutterite total fertility rate has fallen from over nine children in the first fifteen years after World War II to only a little over six in the early 1980s as the creation of new colonies has become more difficult.[76] The Amish have responded to land price increases by taking up other occupations, including factory work and nonfarming family businesses, especially handicraft manufacture for sale to tourists, rather than reducing fertility.

Anabaptists are descendants of sixteenth-century German Protestants that rejected the institutional linkage of religion to the state. Advocates of adult baptism and pacifism, their radical espousal of a church free from state inference resulted in vigorous persecution by state authorities in Europe, but small groups perservered and a few eventually emigrated to the United States (Amish and Mennonites, eighteenth century) and Canada (Hutterites, nineteenth century). Although Anabaptists are no longer proselytizing, they continue to stress farming as a way of life. In many respects, they still resemble the sixteenth-century central European peasant societies from which they are derived. Hutterites have a communal economic system, whereas the Amish are independent family farmers.

While the archaic features of Amish life--buggies and horse-drawn farm equipment—are well-known, it is a mistake to think of these groups as isolated from the modern economy. Hutterites use modern equipment but are conservative about incorporating modern conveniences into their home lives. Telephones are generally forbidden, for example. However, both groups are actually quite tightly integrated into the modern economy. They purchase many supplies from the larger economy and sell much in exchange. Moreover, their high birthrates require the accumulation of substantial amounts of capital to expand their land base to accommodate children. Their enterprises must be as efficient conventional operations, if not more so, to support rapid population growth. Thus, the cultural separation of Anabaptists is maintained

despite their high degree of economic connection with the larger world. Likewise, Anabaptist culture is conservative and to some degree insulated from popular culture, but it is neither fossilized nor completely isolated from the influences of their host cultures.

Successful Anabaptist sects have cultural beliefs and practices that strongly bias their acquisition of culture from their host societies. For every route of exposure to fertility-reducing beliefs, there is a corresponding defense.

Anabaptist patterns of cultural transmission are nonmodern

The Amish originally sent their children to rural public schools. This is still the norm in Hutterite communities. In both cases they often had sympathetic teachers, sometimes Anabaptists themselves, in part because compact settlements often meant that children attended schools where they were a large if not dominant group. Amish and Hutterites believe that an eighth grade education is sufficient for the Anabaptist style of life, and feel that older children should attend to practical chores and participate in community and spiritual life. They also perceive that exposure to offensive modern ideas is much greater and more dangerous in high school than in grammar school. In the 1960s and ’70s, the “enrichment” of U.S. public school curricula with innovations such as movies became common, and compulsory attendance laws came to conflict with Amish desires to end education early. A U.S. Supreme Court decision in 1972 endorsed the Amish right to end schooling at age fourteen, and the Amish began a parochial school system that today educates many of their children. This system, and the lack of exposure to television and movies, means that Anabaptist youngsters (and adults for that matter) have a much smaller exposure to modern ideas than other children.

Anabaptist families are very traditional. The sexual division of labor is strong, and fathers

are important authority figures. Boys learn "manly" skills and attitudes from their fathers and other adult males, very often relatives. Girls learn "womanly" skills from their mothers and other community women. Women are encouraged to find their main satisfactions in raising children and managing the household economy. Men also take much pride in their families and their abilities to provide their sustenance. If, as the demographers' data strongly suggest, the attraction of girls to modern occupations via schooling is a potent force in the demographic transition, the curtailed, conservative education and highly traditional family structure limit the exposure of Anabaptist girls to modernizing influences.

The patterns of education and family life followed by Anabaptists provide a measure of protection from the cultural forces that drive the demographic transition. But only a measure: other rural and conservative groups have been drastically if belatedly affected, while Anabaptists still have extraordinary growth rates. More active mechanisms must play a role.[77]

Anabaptists retained the asceticism of the early Calvinist churches

In Hutterite theology, great emphasis is placed on the concept of *Gelassenheit,* a mental state of oneness with God to the exclusion of worldly concerns. Anabaptist theology holds that the corrupt world of the flesh is doomed to death and that only believers can expect the reward of eternal life. The world of the spirit is emphasized as much to the exclusion of the world of the flesh as possible. Note that these ideas go back to the sixteenth century. They were not invented to avoid the demographic transition, nor is that an articulated reason for their maintenance. To the extent that such values are operative, the gadgets, comforts, and recreations that the rest of us take for granted have little appeal. Some modern items of consumption do filter into Anabaptist

societies, but they are relatively few. Television, that great thief of time, is shunned. Modern technology is thoroughly scrutinized and is adopted if it reasonably fits into the objectives of Anabaptist communities as defined by their religious values. For example, Amish rejection of automobiles is not unthinking traditionalism. Rather, it derives from a careful analysis. Cars are avoided because even the most basic are luxuriously appointed by Amish standards. They have radios that would tempt drivers with secular ideas, and would allow people to live far from their fellow community members. The most ascetic branches of the Amish suffer the lowest losses due to apostasy. Maintaining a high standard of asceticism is an important tool in the defense against the flow of ideas from the world of the flesh. Anabaptist values immunize them against the spread of time-consuming hobbies and a taste for expensive gadgets. For the hearts and minds of the Anabaptists, the industrial designer and the advertising executive appeal in vain.

Anabaptists are socially separate from their host societies

The original separation of the Anabaptists was based on doctrinal differences with fellow Protestants. Believers wanted to protect themselves from the influence of a sinful world. Persecution by states in Europe required a high level of commitment on the part of people who stood by their faith. Symbolic markers of separateness evolved. Anabaptists wear distinctive dress, speak archaic German dialects, and accord status within communities according to criteria derived from their theology. The prestige system of Anabaptists is distinct and different from that of the host society. This prestige system defines as sinful the status gained by success in the host society and discourages anything beyond necessary contact with worldly individuals. Within the Anabaptist community, several institutions minimize competitive status seeking that might lead to sacrificing reproductive success. An all-male executive committee consisting of

preachers, top economic managers, and the settlement schoolteacher head Hutterite communities. A bishop, two preachers, and a deacon lead Amish church districts (25–35 families). Men who most exemplify Amish mores are nominated for these prestigious roles, but among those nominated, the choice of role is by lot. The emphasis is on preventing men from competing for office and preventing successful candidates from feeling too proud or mighty, a state dangerous to their souls. Since communities are small, a fairly high proportion of men will occupy prestigious positions by late middle age. Norms of modesty prevent these leaders from claiming too much authority. Since many men will achieve positions of respect and authority, selection on any selfish cultural variants would be weak. Organization above the level of local communities is weak, and no supracommunity roles exist to tempt the ambitious to sacrifice family for the pursuit of high office.

Adherents to Anabaptist ways come to have a high degree of self-confidence in their beliefs. When exposed to the wonders of modern science and technology, most have no regrets or doubts. The power of science is great, no doubt, most Anabaptists would admit, and they gratefully avail themselves of modern medical advances. But the power of God is greater, they say. Thus, the indirect-bias mechanism affects Anabaptists only weakly and is counterbalanced by a very salient system that favors Anabaptist norms.

Anabaptists demand conformity to community norms

Anabaptist child-rearing styles are rather archaic and stress respect for parental and teacher authority. Behavior that does not conform to community standards is curbed by authority figures, starting with parents who demand old-fashioned obedience from children. In these small communities deviant behavior is conspicuous. The tradition of adult baptism makes full

membership in the community conditional upon a solemn act of personal commitment to the community's values. Among Hutterites, the applicant must demonstrate an excellent knowledge of Anabaptist theology and undergo a rigorous questioning by elders concerning past behavior and future intentions. Of course, the attractions of the sinful world of the flesh do make an impression on Anabaptist youngsters, especially young adults. Life is austere and tedious in their communities. In addition, the communities do not always function smoothly; conflicts and dissention weaken people's resolve.

As is typical of deviance in any society, young men make up the bulk of defectors. Among the Amish, a period between age sixteen and the early twenties intervenes between the time of strict parental control and the baptismal commitment to the church. The Pennsylvania "Dutch" term for this stage of life is *rumspringa*.[78] During rumspringa, many Amish young adults sample the pleasures of the world with little interference from parents or the church. The Anabaptist doctrine of adult baptism emphasizes the free commitment of adults to the church, and rumspringa serves to emphasize that the renunciation of worldly life is *voluntary*. After baptismal vows are taken, the community actively and formally shuns serious deviants. Their own families are expected to refuse contact with them, while contact with even seriously deviant young adults during rumspringa is their own affair. Defectors can return, and many do, with a full confession and rededication to community practices. The high degree of conformity expected in Anabaptist communities prevents the seepage of host-society values by piecemeal adoption of innovations. In effect, social change is restricted to changes that are approved by the community collectively.

Can Anabaptists resist modernization in the end?

Both Hutterites and Amish are subject to strong modernizing forces. As we mentioned earlier, the economic viability of the Anabaptists' traditional, expansionist farming system is threatened by the acceleration of industrialized farming and rising land prices. Farm industrialization forces Anabaptist farmers to accept many innovations to remain economically viable, and these innovations threaten the separation of Anabaptist communities. Telephones that become necessary for business are tempting to use for social calls. More-sophisticated machinery requires more education. High land prices force many Amish to turn to nontraditional occupations. Serving tourists and working in non-Amish factories generate daily contact with outsiders. In the case of the Hutterites, proselytizing conservative Christian ministers welcome apostates with a theologically friendly alternative lifestyle that is much less austere. Perhaps all Anabaptist communities will eventually follow the path of the New Order Amish, whose generally less-strict rules invite more rapid penetration of many modern techniques and who suffer high defection rates.In one scenario, Anabaptist separatism could vanish, and these sects would merge into mainstream conservative Protestantism.

However, this scenario is by no means certain. For example, the extensive tourist industry on Martha's Vineyard increased rather than decreased the Vineyarders' sense of social distance from mainland New Englanders.[79] Anabaptists have maintained separateness in the face of persecution and temptation from host societies for four and a half centuries. Perhaps Anabaptists will curtail their rate of reproduction to fit the limited power of their farming economies to expand while retaining other archaic customs. Thus, even if their birthrates fall somewhat, they may remain fitness optimizing given more-severe economic constraints. Or perhaps the new economic niches that the Amish are pioneering will keep demographic expansion rapid and

permit the retention of conservative lifeways. To date, a substantial shift from farming to wage labor and the tourist trade does not seem to be causing problems for the Amish. However, the Anabaptist adaptation is predicated on a fine balance between cultural separation and economic engagement with modern society.

The Anabaptist case illustrates the manifold power of modern fertility-reducing beliefs and values to spread by highlighting how comprehensive an adaptation—or, in this case, a preadaptation—must be to resist them. Innovations in communication and transport have had the unintended consequence of unleashing the evolution of maladaptive cultural variants that seep into cultures by a number of routes. So far, only the Anabaptists, and a few similar groups like ultra-Orthodox Jews, seem to have much resistance to modernity's infections.. Anabaptism is like a tightly made kayak navigating the turbulent modernist sea. It looks so fragile but survives because it doesn't leak despite the enormous stresses it faces. One serious cultural leak anywhere and its gone. Anabaptism's evolutionary future or futures are impossible to predict. In the meantime, you can't help but admire the beauty of the design!

Cultural evolution explains the cultural complexity of the demographic transition

Given the example of the highly resistant Anabaptists, partially resistant Catholics, conservative Protestants and Muslims, and the precocious transitions today in many developing countries, the fact that the demographic transition in Europe varied greatly by culture area is not so surprising. The modernizing of the economy and of social roles are complex processes, no doubt influenced by preindustrial cultural variation. The modernization phenomenon, including the demographic transition, is driven by the fact that economic and social modernization are coupled, albeit sloppily. Social modernization can race ahead of industrial production, as in France, or

industrialization can lead more slowly to social modernization, as in Britain. Social modernization creates educated individualists who easily adapt to running factories even if their first aspiration is commerce or public service. Industrialization creates a demand for laborers and managers with education and individualistic motivations. However, the process can proceed some way on the stock of such individuals produced by traditional education systems. Aristocratic elites can shift from government service to business; middle-class clergy, doctors, and lawyers can provide managerial talent; and traditional craftsmen, with a little help from a mathematically literate middle-class manager, make acceptable engineers. In the long run, the synergy between social and economic modernization creates a strong correlation between the two, but with enough slop to preserve considerable variation between different modernized societies.

As industrial production and social modernization began to spread from their heartlands in Britain and France, respectively, they met very different patterns of resistance and acceptance. The strength and effectiveness of resistance depended upon how beliefs, values, and economic activities structured patterns of nonparental transmission of culture and generated forces that favored or resisted modern ideas. Anabaptists represent one extreme in terms of receptivity to modernism. Catholics and conservative Protestants in the United States illustrate a much more moderate, but still significant, resistance to modernism generally and the demographic transition specifically. The modern Third World includes cases in which the mass media and primary education for women are sufficient to induce the onset of a rapid fertility transition but also includes conservative Muslim societies where relatively high fertility rates persist, perhaps because these societies tend toward traditional, highly gendered roles for women.

Conclusion: Culture is built for speed, not comfort

All adaptations involve compromises and tradeoffs. Flight allows birds easy escape from many kinds of predators, and it makes long-distance migration practical. However, birds operate under many design constraints necessary to make flight possible in the low-density, low-viscosity medium of air. For example, their bones must be light but rigid—constraints are met by the fact that their bones are hollow tubes that, while light and rigid, are very delicate, failing catastrophically when bent, like aluminum lawn furniture.

In this chapter, we have argued that cultural maladaptations arise from a design tradeoff. Culture allows rapid adaptation to a wide range of environments, but leads to systematic maladaptation as a result. To turn the Willie Dixon blues classic on it head, culture is built for speed, not comfort.[80] Learning mechanisms depend critically on preexisting knowledge. If you already know a lot about a problem, learning can be easy and efficient. If you don't know much, learning can be impossible. This fact creates a severe problem for learned adaptation to environments that undergo big changes in short periods of time. Because natural selection cannot keep up with rapid environmental change, it cannot endow individuals with an evolved psychology tailored to their current environment; it can only endow them with a knowledge of the common statistical features of a whole range of environments. We think culture (both the psychological basis *and* the pool of transmitted ideas) is an adaptation that evolved to solve this problem. Accurate teaching and imitation combined with relatively weak general-purpose learning mechanisms allow populations to accumulate adaptive information much more rapidly than selection could change gene frequencies. This capacity has great benefits, allowing human foragers to adapt to a far wider range of environments than any other animal species. However, just as flight requires fragile, hollow bones, cultural adaptation entails design compromises. In

creating a simulation of a Darwinian system using imitation instead of genes, natural selection created conditions that allow selfish cultural variants to spread. If our argument from the empirical cases is correct, we do see just the sort of selfish variants this hypothesis predicts.

Our culture is a lot like our lungs. They both work great for their evolved functions, but they also make us susceptible to infection by pathogens. You would be a lot less likely to catch either a serious respiratory disease or a selfish cultural variant if you kept away from other people as much as possible. We have evolved to take much greater risks of both sorts of diseases, because contact with others has many benefits. Culture gives us the ability to imitate things essential to human life, but also makes us take up bits that cripple and kill—not unlike like the air we breathe.

The big-mistake hypothesis represents the most serious alternative attempt to account for human maladaptation. It holds that most of the information necessary to construct what we call culture is latent in genes shaped by Pleistocene environments. Its proponents argue that this information is organized into decision-making systems evolved to produce adaptive behavior during the Pleistocene epoch. In the post-Pleistocene, they argue, a sudden acceleration of cultural change transformed "environments" so that they are now far outside the ranges of evolved decision-making systems. Different evolutionary social scientists have different ideas about just where and how often big mistakes will occur. For example, the John Tooby and Leda Cosmides seem to believe that little post-Pleistocene behavior can be reliably predicted by adaptive considerations.[81] Human behavioral ecologists, by contrast, cite considerable evidence that traditional Holocene societies often seem to behave quite adaptively compared to modern societies.[82] In either case, explanation rests on a direct interaction between individual minds and the "environment," not on the evolutionary dynamics of culture.

Distinguishing between the big-mistake and explicitly cultural contemporary explanations for maladaptive behavior is important for two reasons. First, the cultural hypothesis makes systematic predictions about the details of how cultural maladaptations arise. The generic "big-mistake" hypothesis makes no such predictions, and concrete variants of it, like Kaplan's explanation of the demographic transition, have an ad-hoc quality. Indeed, since the ways that a complex, highly evolved adaptation can go wrong are huge, the big-mistake hypothesis is inherently ad hoc. Ad-hoc explanations are not necessarily wrong; environments outside the range in which a species has evolved are quite likely to result in a miscellany of breakdowns of adaptations. Humans are not the best candidates to exemplify such breakdowns, because we are a species that is superbly adaptable to variable environments, as our explosive success during the Holocene testifies. In the test case here, we think that the details of the demographic transitions fit better with our account than with explanations that rely only on preferences for wealth and prestige that have turned maladaptive in modern environments. It provides a general theory of maladaptations that gets details right.

Second, the two hypotheses make very different predictions about Pleistocene hunter-gatherer environments. The big-mistake hypothesis predicts that the behavior of Pleistocene foragers should have been adaptive most of the time. By contrast, our hypothesis predicts that as soon as social learning became significant, selection on culture capacities would have begun to favor nonparental transmission, and, inevitably, rogue cultural variants would appear. We are willing to entertain the hypothesis that modern societies have a higher frequency of maladaptive cultural variation given that the ratio of nonparental to parental cultural influence has increased so dramatically. The use of mass media for advertising fitness reducing distractions has evolved into a fine art, but on the other hand, literacy and science have scotched many harmful

superstitions by making the adaptive component of content biases more powerful.

The sharpest test of these two hypotheses would come from the existence, or not, of Pleistocene maladaptations of the sort predicted from considerations of cultural evolution. Of course, this is difficult. Behavior in contemporary foraging societies is useful but imperfect, since Holocene environments are so different from those of the late Pleistocene. The low resolution of the paleoanthropological record makes direct tests difficult. One mechanism that might permit truly large-scale and durable deviations from fitness optimization is gene-culture coevolution. Once cultural traditions create novel environments, environments that can affect the fitness of alternative *genetically* transmitted variants, genes and culture are joined in a coevolutionary dance. In the extreme case, culturally determined social traditions can select for genotypes favorable for the perpetuation of the cultural tradition.[83] Since a population of human beings is necessary to make culture work, such coevolutionary maladaptations will tend to be self-limiting and hence hard to observe based on the skimpy Pleistocene evidence. The most detectable maladaptations would be those strange ones that actually *increase* the average fitness of populations even though *selection on genes* will act against them. Human cooperation is a potential example. Humans are quite adept at cooperating in large groups with strangers and near strangers, while the theory of selection on genes suggests that cooperation should be restricted to relatives and well-known nonrelatives. As we remarked earlier, the conformity bias offers a possible mechanism to generate stable variation at the group level on which selection might act to favor in-group cooperation. Could the human aptitude for cooperation be an example of one of these seemingly paradoxical adaptive maladaptations? Can we have any confidence that human patterns of cooperation reach back into the Pleistocene? We turn to these topics in the next chapter.

1. Sahlins 1976a, 1976b; Hallpike 1986.
2. Among other anthropologists, Marvin Harris 1977, 1972, 1979 was a prominent spokesman for the point of view of taking delight in proposing functional explanations for exotic cultural practices like Aztec cannibalism and Indian sacred cows.
3. Bongaarts and Watkins 1996; United Nations Population Division 2002.
4. Irons 1979; Borgerhoff-Mulder 1988a, 1988b.
5. Kaplan and Lancaster 1999.
6. Gould 2002; Levinton 2001; Carroll 1997; Alcock 1998, 2001.
7. Cronin 1991.
8 Land and Nilssson, 2002.
9. Martindale 1960.
10. Dawkins 1982, 1976. We (Richerson and Boyd 1976, 1978) made a similar argument at about the same time.
11. Hamilton 1967.
12. As occurs today between organisms and their endosymbionts, see Werren 2000.
13. For a simple mathematical treatment, see Boyd and Richerson 1985, chap. 6.
14. We resolved not to do any math in this book. However, we found the ideas in this paragraph especially hard to express in words. So, as an example of the greater precision and clarity that math affords, here is an alternative explanation. The fertility-reducing variant will spread if
<neq>$(1 - A)p + At > 0$,</neq>
where A is a number between zero and 1 that measures the relative influence of teachers. The term $1 - A$ measures the relative influence of parents. If A is near 1, children tend to acquire the beliefs of their teachers—parents aren't important. If A is close to zero, teachers have little influence. The parameter t is the difference between the probability that a person holding the late marriage meme becomes a teacher and the probability that a random person becomes a teacher, divided by the probability that a random person becomes a teacher, and p is the difference between the probability that a person holding the late marriage meme becomes a parent and the probability that a random person becomes a parent, divided by the probability that a random person becomes a parent. This quantity is called the selection differential in population genetics. First, notice that if $A = 0$, this expression is negative. This makes sense. If ideas are acquired only from parents, an idea that reduces fertility is a sure loser. On the other hand, if teachers do have some influence, the belief in late marriage can spread. Note that this can occur even if parents have a bigger influence on their children's most basic attitudes than do teachers. That would mean that A would be smaller than $1 - A$. However, the process of attaining social roles like that of teacher can be very selective. Marrying young and starting a family might be a quite big handicap in obtaining the education to become a teacher. If so, t will be bigger in absolute value than p. If this effect is large enough to overcome the differential in the importance of parents in teaching basic family values, the whole expression can easily be negative, causing the late-marriage norm to spread. For the full development of the model, see Boyd and Richerson 1985, chap. 6.
15. Alexander 1979, 1974; Irons 1979; Durham 1976, 1991.
16. Parker and Maynard Smith 1990.
17. Pterosaurs of the genus *Quetzalcoatlus* were probably the heaviest flying creatures that have ever lived on earth. These soaring reptiles had eleven-meter wingspans and are estimated to have

weighed a pig sized one hundred kilogramsor so. The greater oxygen content of the atmosphere during the later Mesozoic probably facilitated flight in such large creatures, both because it allowed higher metabolic levels and because denser air made flight easier (Dudley 2000).
18. Boyd and Richerson (1985, 53–55, 180) list a number of studies documenting the importance of vertical, horizontal, and oblique cultural transmission. Also see Harris 1998.
19. Feldman and Otto (1997) maintain that models with explicit terms for cultural transmission suggest that culture plays a larger role than typical behavior genetics studies suggest.
20. Labov 2001, chap. 13.
21. Hewlett and Cavalli-Sforza 1986.
22. Rogers 1983, 217–18).
23. Tooby and Cosmides 1992, 104.
24. Atlatls are also called spear throwers. A piece of light wood, bone, or ivory about the length of the forearm is equipped with a hook at one end that engages the butt of a light spear, the dart. Holding the end opposite the hook, the thrower uses the length of the atlatl to increase the velocity of his throw. The hitting power of such a fast, relatively heavy dart is greater than that of an arrow, a consideration when the prey is a large, blubber-padded sea mammal.
25. Arima 1975, 1987. While this was being written on a sunny May day in Berlin, the US Weather Service was reporting ten-foot seas and thirty-knot winds in the Bering Sea.
26. Tooby and Cosmides 1992, 104–8.
27. Rogers 1983, 231–32.
28. “Own interests” here refers to whatever outcomes are favored by within-group processes. Boyd and Richerson 1982; 1985, Soltis, Boyd, and Richerson 1995, and Sober and Wilson 1998 present the case for cultural group selection.
29. Stark 1997 argues that early Christianity increased rapidly following a scenario much like we outline, and Wilson 2002 makes a similar case for Calvinism during the Reformation.
30. Stark 2003 (chap. 3) provides an interesting perspective on the function of the Inquisitions as institutions of social control in the early modern period. He dismisses much of the conventional wisdom about them as anti-Catholic propaganda.
31. Darwin 1874.
32. Fisher 1958 [1930]. Fisher could not explain why exaggerated traits could persist at equilibrium, but recently Iwasa and Pomiankowski 1995 and Pomiankowski, Iwasa, and Nee 1991 describe two different mechanisms that solve this problem.
33. Eberhard 1990.
34. Boyd and Richerson 1985, chap. 8.
35. Boyd and Richerson 1987; Richerson and Boyd 1989a.
36. Boyd and Richerson 1985, chap. 8.
37 Costly signaling provides another process with a maladaptive runaway inherent in it. We think of this as the “rocks in your packsack” hypothesis. If Rob can demonstrate his physical prowess relative to Pete by routinely carrying heavier burdens, he can advertise his better genes (or his better training regime). If Rob gets the girls or the cultural prestige by carrying one rock, Pete will respond by carrying two, and Rob will have to increase his load to three. The competition will only come to a halt when both of us are carrying a huge load of useless rocks, but one can carry just a bit more than the other. The only way an observer can be sure which competitor is better is if we can carry enough rocks to make a serious contest. In an evolutionary

context, wasteful displays will evolve to guarantee the veracity of signals, much as in the Fisherian process. After some rounds of evolutionary bidding in the prestige auction, the benefit from having good genes or good culture will be entirely consumed in the wasteful display to advertise that you have them. In other words, Hummer II owners are likely to have pretty good incomes, but also likely be up to their big pocketbooks in debt. The economist Spence 1974 originally proposed this idea. Biologists later applied the same logic to sexual selection (Zahavi 1975; Zahavi and Zahavi 1997; Grafen 1990a, 1990b), and Smith and Bliege Bird 2000 have applied these ideas to explain a variety of exaggerated displays in small-scale human societies. Ryan 1998 describes a third explanation based on the idea that exaggerated characters signal genetic quality or byproducts of selection on female sensory systems. In all three hypotheses the exaggeration is maladaptive. . For an excellent nonmathematical treatment of modern sexual selection theory, see Miller 2000.

38. Richerson and Boyd 1989b. See Boyer 1994 for a discussion of the role of abductive reasoning in providing support for religious beliefs.

39. Pascal 1660, §233.

40. There is the problem, if you want to accept Pascal's side of the wager, of deciding exactly what beliefs God intends to reward and punish in the afterlife! The Pope believed that Jansenism was a grave danger to the souls of its practitioners. Perhaps God really rewards all the humble seekers after the truth with heaven, even agnostic scientists, and sends all dogmatists who presume to know his mind to hell, Pascal and Pope alike.

41. As Max Weber 1951 noted, the rationalist approach to ultimate questions, especially to the elaboration of theistic notions that are so prone to doubts, is more pronounced in Christianity than in other religions. Nevertheless, other religions, even quite "primitive" ones, have evolved in their appeal to hard thinkers, not just the credulous. See, e.g., Barth 1990. Stark 2003 (chap. 2) notes that many pioneering scientists like Newton had theological agendas comparable to Pascal's.

42. Campbell 1974.

43. Boyer 1994.

44. That is: A implies B. Observe B is true. Therefore A is true.

45. Sloan, Bagiella, and Powell 1999 provide a skeptical review of the psychological health literature. On community-level functions see Stark 2003 and Wilson 2002.

46. Schwartz 1999.

47. Knauft 1985a**.**

48. Stark 2003, chap. 3.

49. Rabinowitz 2003; see also Linder 2003. As of this date, the reasoning of those who still believe that ritual child abuse did occur in these cases is easy to find on the Web.

50. Lindert 1985 describes the population cycles in England from the late medieval to modern times. The Malthusian pattern obtained until the Industrial Revolution was well under way.

51. Reducing the importance of nonparental transmission reduces the *risk* of maladaptive cultural variants evolving, much as reducing the size of organelle genomes reduces the risk of sex ratio distortion. Some evidence suggests that premodern populations were fairly frequently the victims of maladaptive reductions of fertility. Bruce Knauft 1986 argues that relatively high birthrates and relatively high death rates in preindustrial cities made them demographic black holes. The prestige system of the Roman Empire and early modern England made such places a magnet for

country folk and sustained themselves by recruiting from the countryside despite an excess of deaths over births in Rome and London. Coale and Watkins 1986 (14–22, and chap. 3) and their colleagues uncovered some rural as well as urban populations in Europe in which fertility fell below replacement levels well in advance of the main demographic transition. These included a number of rural cases in which one- and two-child families became the norm, while death rates remained at preindustrial levels. Such populations shrank rapidly, selecting against the norms that supported such practices.
52. Coale and Watkins 1986, chap. 1.
53. Skinner 1997.
54. The following discussion is based upon Alter 1992; Pollack and Watkins 1993; Kirk 1996; Bongaarts and Watkins 1996; and Borgerhoff-Mulder 1998.
55. Coale and Watkins 1986.
56. Rogers 1990a..
57. Kaplan et al. 1995.
58. Becker 1983.
59. Robinson and Godbey 1997.
60. E.g., the well-known account in Schor 1991.
61. This change in TV viewing is especially interesting, because it is among the lowest rated leisure activities. Indeed, in most surveys many work activities, including child care, rank as high as TV viewing in reported enjoyment. TV's constant availability, low cost, and curiously addictive hold on our attention apparently allow it to crowd out more highly rated activities, such as social activities away from the home.
62. Easterlin, Schaeffer, and Macunovich 1993.
63. Kasarda, Billy, and West 1986, chap. 6.
64. Blake 1989.
65. Belonging to a pronatalist faith reduces the effect of family size. Catholics, particularly high-status, educated one, show a smaller effect of sibship size on educational attainment than Protestants, but the family-size effect remains significant.
66. Hill and Stafford 1974; Lindert 1978.
67. Witkin and Berry 1975; Witkin and Goodenough 1981; Werner 1979.
68. Inkeles and Smith 1974; Jain 1981.
69 Kohn and Schooler 1983.
70. Bongaarts and Watkins 1996.
71. Rogers 1983.
72. Westoff and Potvin 1967.
73. Roof and McKinney 1987.
74. Bongaarts and Watkins 1996.
75. Our discussion based upon Peter 1987; Hostetler 1993; and Kraybill and Olshan 1994, Kraybill and Bowman, 2001.
76. Nonaka, Miura, and Peter 1994.
77 Even in ordinary modern societies, the effect of families on the propensity to have children is marked. Psychologist Lesley Newson collected some very interesting data relevant to childbearing and patterns of cultural transmission in contemporary Britain. Questionnaire data indicate that men and women with relatively more contact with

relatives marry earlier. Women with such contact have earlier first pregnancies and have more children. In a role-playing experiment, Newson asked mature women to write down what sort of advice they thought an older woman would give to a younger woman (either her daughter or a younger friend) in one of four situations. In each of the scenarios, women who imagined giving advice to their daughters were more likely to advise behavior consistent with reproductive success (Newson 2003). Comparable data from an Anabaptist community would be most interesting.

78. See *The Devil's Playground,* an excellent documentary film on rumspringa made by Lucy Walker, at http://www.wellspring.com/devilsplayground/.

79. Labov 1973.

80. The first verse:

<pon>Some folk built like this, some folk built like that
But the way I'm built, you shouldn't call me fat
Because I'm built for comfort, I ain't built for speed
But I got everything all the good girls need</pon>

81. Tooby and Cosmides 1989, 34–35.

82. Borgerhoff-Mulder 1988a and 1988b.

83. Laland, Kumm, and Feldman 1995 provide a model and a test case, societies with much female infanticide and apparently a sex ratios at birth skewed in favor of males. However, Skinner and Jianhua's 1998 data from China, where female-biased infanticide has long been practiced, suggest that the actual sex ratio at birth is not skewed and that statistics to the contrary result from concealed infanticide, not genetic changes. The model is nevertheless indicative of what can happen.