Evolution: The Darwinian Theory of Social Change, An Homage to Donald T. Campbell

Peter J. Richerson
University of California Davis

Robert Boyd
University of California Los Angeles

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Introduction

One of the earliest and most influential papers applying Darwinian theory to human cultural evolution was Donald T. Campbell's paper "Variation and Selective Retention in Sociocultural Systems." Campbell's programmatic essay appeared as a chapter in a book entitled *Social Change in Developing Areas* (Barringer et al., 1965). It sketched a very ambitious project to apply Darwinian principles to the study of the evolution of human behavior. His essential theses were four.

First, human sociocultural evolution should be studied using Darwinian methods. Human culture is information transmitted from person to person via teaching and imitation, much as genes are information transmitted from person to person in the course of reproduction. Like genes, sociocultural evolution has a pattern of descent with modification. Of course, the evolution of culture and social institutions differs in many ways from the evolution of genes. Perhaps most important, culture is a system for the inheritance of acquired variation. What individuals learn for themselves by hard effort others often imitate, typically at much less cost. Several researchers, beginning with Cavalli-Sforza and Feldman's (1973) pioneering paper, have followed up this thread of Campbell's essay by developing formal models of the cultural evolutionary processes. These models are designed to explore the abstract principles of culture evolution using the modeling techniques population biologists use to study organic evolution. Note that Campbell's (and our) concept of culture encompasses all the things that we learn from each other as opposed to learn for ourselves or inherit genetically. As such, it includes technical knowledge, our specific language, the habits, sentiments and ideas that guide our participation in social and political life, belief systems like religion, and artistic traditions. This concept of culture is not limited to the symbolic and meaningful elements or to elements on which there is wide consensus within a culture.

Second, cultural and genetic evolution are linked. Culture differs from genes in that people are passive recipients of their genes but active agents with respect to culture. We can pick and choose among the cultural variants that are on offer in the population, and

often modify what they originally imitate on the basis of experience. The various active decisions that individuals impose upon their culture act as evolutionary forces shaping culture. Each individual's marginal choices have only a small effect on the cultural traditions of a society, but, by cumulating over repeated passage through many minds, individuals' decision may ultimately transform their culture. The rules that guide decision-making are various and have to come from somewhere. At least some of the rules are rooted in genes. Senses of pleasure and pain often cause people to prefer one cultural variant over another, thought the results are often surprising, as in the prevalence of pain inducing spices in many cuisines. The linkage of culture and genes is a two-way street. Culture is an important factor in the environments in which people live, and generates selection pressures on genes. A simple example is the high frequency of genes that allow adults to digest milk sugar in societies with a long tradition of dairying (Durham, 1991).

Third, Campbell maintained that natural selection remained the master force in cultural evolution. He was the first person to clearly see how a system for the inheritance of acquired variation would work. Natural selection is the ultimate source of the rules that proximally guide the evolution of culture. As evolutionary psychologists subsequently argued at length (Thornhill, et al., 1997), human psychology shows many signs of being shaped by natural selection. Thus natural selection has shaped the innate rules that in turn shape cultural evolution. Campbell called the decision-making forces "vicarious selectors" because they reflect the action of natural selection and tend to favor the same behavior as selection would if it had to act. Most evolutionary students of human behavior (e.g. Alexander, 1979, Lumsden and Wilson, 1981, Hirshleifer, 1977) hold that this is the main story. Human psychology must have been under the influence of natural selection throughout the period when capacities for culture evolved. At each step in the evolution of more sophisticated psychologies, selection would have favored only those psychological variants that increased genetic fitness. We call this the "argument from natural origins."

Fourth, Campbell argued that natural selection also operates directly on cultural variation. Some people are prone to drink and drive. Suppose this habit is mainly cultural, not genetic. The higher rate of death of drinker-drivers will remove them from the pool of people who might be imitated just as surely as it removes their genes. Selection on cultural variation is just as much an ultimate a cause as selection on genetic variation. Since cultural environments can generate selection on genes, and what favors genetic fitness can sometimes differ from what favors cultural fitness, the full gene-culture coevolutionary system is liable to be rich in phenomena that would not be predicted by the argument from natural origins. People who don't have any children at all can still be imitated and transmit their culture. Selection on culture might even favor variants that compete for roles with great cultural influence even at a cost to their genetic fitness. We call this the "dual inheritance argument." Our own work has been substantially directed at exploring the dynamics of the dual inheritance system (Boyd and Richerson, 1985).

The Utility of Darwinian Models

The seeming imperialism of claims made by Darwinian theorists often provoke hostility and disbelief among social scientists using other theoretical frameworks. This fear of imperialism is partly justified. The claims of Darwinian theory are bold. The claim that natural selection is the ultimate explanation for the properties of all organisms including humans is a very grand (Mayr, 1982: 67-71), but one that is accepted by most biologists. The claim appears less grand when one understands how investigators make the abstract concept of natural selection concrete. Natural selection is whatever happens to individuals carrying heritable variants as a function of that variation. Gory auto wrecks are selection, and so are the effects of a virtually every everyday activity. So long as people are behaving differently because of cultural or genetic factors and succeeding differentially because of those factors, selection is operating. Social scientists of every stripe are watching natural selection its companion Darwinian processes (random variation, the effects of decision-making forces) all the time.

What social scientists are not in the habit of doing is using Darwinian methods to analyze their data and make evolutionary inferences from it. What evolutionary biologists have found very useful is an accounting system for heritable variation. Because the effects of evolutionary processes are usually quite small individual by individual and from generation to generation, one has to apply a calculus that deduces population wide and long-term changes from small changes measured on a sample of individuals over a short span of time. A very substantial amount of effort has gone into developing the appropriate theoretical and empirical tools and using them to understand the organic evolutionary process. Looked at this way, all Darwinian social scientists are advocating is adding some new tools to those already used in the social sciences. The basic idea is to do a kind of painstaking quantitative micro-history. Every moment of micro-history we can capture is a two or three freeze-frame portrait of the evolutionary processes that, in the long run, result in complete transformations of societies. Formal theory, constrained by the data from micro-historical studies and by the long-term trends studied by historian, archaeologists, and paleoanthropologists, is the bridge between the historical and experimental social sciences. On the argument that we are what our past history has made us, even as our own activities shape our descendants' futures, the application of evolutionary analysis will be an exciting intellectual endeavor that will help us understand human behavior. Looked at from the point of view of an ambitious social scientist, evolutionary biology is a treasure trove of concepts and techniques that can be pirated for use in understanding sociocultural processes.

The Darwinian project for the social sciences is also less revolutionary than it first appears since several productive research programs in the social sciences are models of evolutionary analysis. Weingart et al. (1997: 292-297) note seven cases of research programs independently and unknowingly developing Darwinian methods. For example sociolinguists have dissected in some detail the microevolution of dialect by investigating the kinds of decisions that affect the spread or failure to spread of individual level dialect innovations. Students of the diffusion of technical innovations have investigated how the economic environment interacts with individual decision-making processes to cause new technologies to spread or not. In our own work (Boyd and Richerson, 1985), we found

such studies to be extremely useful for grounding our theoretical models with empirical verisimilitude. What we, at least, advocate is formalizing and generalizing methods already proven useful in particular fields of investigation.

On the theoretical side, what is needed is a complete list of the evolutionary processes that act on heritable variation to cause evolutionary change. These are the accounts in the Darwinian bookkeeping system. Changes are attributed to pre-defined processes (which experience may well dictate need change or refinement). The empirical project is then to produce generalizations about what processes are most important under what circumstances. This is a huge and open-ended project. In our 1985 book we proposed a taxonomy of evolutionary "forces" operating on cultural variation that was intended to be complete a certain level of analysis. Our scheme is shown in Table 1. The reason that the project is open ended is because even if a taxonomy like this is complete at a high level of generalization, each of its categories is likely to be divisible into many subcategories. "Natural selection," for example, collects many rather different processes under one term. Evolutionary biologists recognize sexual selection, artificial selection, frequency and density dependent selection, hard and soft selection, disruptive, stabilizing and progressive selection, group, individual, and genic selection, truncation and gaussian selection and so forth. Biologists continue to add terms as the intricacies of organic evolutionary processes have become clearer.

Table 1 about here.

The important message for social scientists is that the spirit of Darwinism is inclusive not exclusive. Any mechanism that conceivably can cause cultural change belongs in Table 1. Darwinism plays its fundamental synthetic role in biology because its calculus is really quite neutral with respect to the substantive issues of the relative importance of and interaction between the processes. Thus, Gould and Eldredge's's (1977) punctuated equilibrium theory, proposing that species level rather than individual level selection plays a dominant role in evolution in the long run, was a bold and innovative challenge to the conventional wisdom but certainly accessible to test by Darwinian methods. In the event, it has not fared especially well under empirical scrutiny, but it certainly received a thorough airing (Carroll, 1997, Levinton, 1988). An arch-critic of the early work in human sociobiology, Marshall (1976a), argued that cultural change is mediated by a system of meaningful symbols operated upon by "cultural reason." What exactly Sahlins meant by cultural reason is not crystal clear, but we believe that our model of "indirect bias" (see table 1) is in spirit of his suggestion (Boyd and Richerson, 1985:Ch. 8). We believe the indirect bias process is important in the evolution of ethnic and other symbolically marked ingroups. We have also made models that have a social constructionist flavor. For example, we have shown how the social norms might be imposed upon human genes in the coevolutionary process (Richerson and Boyd, 1989). Suppose, for example, a tendency to be more cooperative arose through natural selection on cultural variation. A cultural environment might thus arise in which excessively belligerent or selfish individuals suffered discrimination or ostracism, reducing their

chances of acquiring mates. A population composed of more compliant personalities would follow, perhaps quite rapidly on the paleontological time scale. Here the coevolutionary aspect of dual inheritance evolution bites hard. Darwinians aim for a *comprehensive* theory of organic and cultural change. Our boast is that we can model and investigate empirically *any cogent* proposed mechanism of change. Try it, you'll like it!

We believe that adaptationist evolutionary social scientists have sometimes done the larger Darwinian social science project a substantial disservice by stressing the substantive rather the methodological side of Darwinism (for a extended review, see Weingart et al., 1997). Some portray both the methodological and substantive limits of the field in exceedingly narrow terms (e.g. Thornhill, 1997). They have taken evolutionary theory solely as an engine for finding adaptations in the conventional inclusive genetic fitness sense, which it is, of course. But, as important as the idea of adaptation is, Darwinism is equally a theory of maladaptation. In the 19th Century context of the debate between materialist and supernatural explanations for the living world, Darwin's better account of the flaws and historical peculiarities of organisms was his strongest card. A rather crude natural process of random variation and blind selection better accounted for the vestigial organs, historically constrained structures, and wasteful sexual conflicts common in actual organisms. A supernatural Creator would have done a much better job. So to it is with sociocultural systems. We have to explain why they function at all but also but also their crudity and susceptibility to failure and collapse.

The Place of Darwinian Theory

The imperialism of Darwinism is further tempered by the fact that Darwinian dynamics are only one of five classes of dynamic processes that are of interest to biologists and social scientists. The others are:

> (1) *Developmental processes*. Developmental biologists study the dynamics of cell differentiation, and tissue and organ growth, in the embryo. Psychologists have concentrated on behavioral development, both in the sense of anatomical maturation and in the sense of learning and other developmental responses to variable environments. In the special case complex societies, both human and non-human, there are also large-scale developmental processes. When a new city, corporation, or beehive forms, a set of existing institutions are used to charter the new organization, which in turn self-organizes using special mechanisms for instituting a new organizational "individual." The units of analysis are individual and subindividual, and the time scale is one generation, and the multi-individual organizational analogs thereof.
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> (2) *Game dynamics.* Individuals must make dynamic adjustments to each other's behavior, for example finding a place in a dominance hierarchy. Members of the same social group, other conspecifics and other competitors, and predators and prey may all play "games" with each other. In some solitary species, these dynamics may be relatively simple and even unimportant. In social species they are complex and important. Dynamic social adjustments are extra-ordinarily

important in human societies, more important than in other complex animal societies because potential and actual conflicts of interest are stronger in human societies than in more perfected ultra-social animals like ants, bees and termites (Richerson and Boyd, 1998). In our societies market mechanisms and political systems can create very large-scale complex game dynamics that dynamically integrate entire societies, even the world. If hidden and unhidden hands are working correctly, conflicts between private and public interest are minimized in such dynamical systems. Economists have raised the study of market dynamics and game theory to a very high art indeed, and their concepts and methods have been imported into many social science disciplines to good effect. Coleman's (1991) is perhaps the most ambitious of these. The typical foci of attention in studies of game dynamics are individuals and small groups, but ranging up to much larger units in the human case. The time scales of interest are matter of hours to a generation.

(3) *Ecological processes*. Populations grow, compete, prey upon one another, extend their ranges or go locally extinct. Collections of species on the landscape (ecologists' "communities") can change rather dramatically due to these processes. In the human case, our demographic dynamics are extremely important. Populations grow, shrink and migrate. Our renewable resources and domesticated species have population dynamics linked to human dynamics. Typical units of analysis are populations, and the time scales of interest are a few to many generations. Demographers, geographers, resource biologists, and agronomists are among the scientists that investigate these sorts of dynamics.

(4) *Geochemical dynamics.* The earth itself is a dynamic system. On the very long term, the luminosity of the sun changes, the earth cools, and the continents drift. On the human evolutionary time scale, local geological catastrophes impact populations, soils weather, harbors silt up, and climates change. Geologists and climatologists have revolutionized our understanding of these processes in the last quarter century. If any change process is more ultimate than natural selection, it is the evolution of the physical earth. Independently of anything organisms have done, the geochemistry of the earth creates the raw environment to which organisms adapt as best they can. Arguably, the human species is itself a product of the highly unstable Pleistocene climate that put a premium on the rapid evolutionary adjustments made possible by culture (Richerson and Boyd, in press a).

Even without any changes in culture or genes, life on earth would be dynamic. Of course, none of these dynamic processes operates entirely autonomously. All of them impact Darwinian processes, and biotic and cultural evolution affect most of them in turn. Humans are now a significant geochemical player, witness our effects on greenhouse gasses in the atmosphere and our major role in the earth's nitrogen budget. We thus have great sympathy for Professor Kornai's systems approach to social change. Explaining any given case of social change is likely to involve considerations of all of the dynamic processes we have discussed.

What is striking about this list of processes is that processes 1-3 are each the subject of a large body of sophisticated research by social scientists. In biology, evolution is also quite well covered. In the social sciences, evolutionary dynamics have been relatively quite neglected. Only a few scientist-lifetimes of work have so far been invested in the Darwinian approach to cultural evolution and related investigations. Historical happenstance plays a significant role in cultural evolution, including, it seems, the evolution of the sciences!

The Central Role For Natural Selection

What do we make of Campbell's claim for natural selection as the ultimate causal process in organic and cultural evolution, given its place amid other dynamic processes? The concept of "ultimate" is dubious when we realize that the source of selective pressure generally turns out to be other dynamic processes. Physical-environmental and ecological processes are obvious sources of selection pressures on culture or genes. We have already seen that culture based institutions can exert coevolutionary selective pressures on genes.

Less obviously, developmental and game processes are sources of selection. An old argument going back to the psychologist Baldwin holds that learning or any other type of adaptive developmental flexibility can have a big impact on evolution (Wyles, et al., 1983). Consider a population of tropically adapted humans stranded on the wrong side of a mountain range or ocean basin by a sudden climate cooling. Such people might well invent better shelters, more efficient hearths, and warmer clothing and survive the change, perhaps only barely. Their companion tropical plants and animals, without the same inventive capacity, will be replaced by temperate species. By contrast, the now still ill adapted human population will come under selection for shorter, broader bodies and shorter extremities to conserve heat. Skin pigmentation will lighten so that heavily clothed bodies can still photosynthesize adequate vitamin D. Soon the population will be well adapted to the cold environment. Our inventiveness, based upon developmental flexibility amplified by culture, leads humans into new niches, leaving selection to fix the residual problems that culture cannot. Hence humans are biologically a quite diverse species. Any sort of system for adaptive plasticity has the same new adaptation generating potential; human culture is just an extreme case. Odling-Smee (1994) argues that the "niche construction" activities of organisms are ubiquitous and unduly neglected by evolutionists. Likewise, students of game dynamics argue that social interactions lead to self-organization that in turn generates selection (Page and Mitchell, 1991). The self-organizing structure of markets generates strong competition between economic agents, and often to high rates of innovation and rapid change.

Even in the systems view of evolution, natural selection plays a pivotal role. Seldom will a single selective pressure act on a given cultural or genetic trait. Rather the evolution of the trait will respond to the sum of many different effects. The survival or failure of business enterprises of a given form will often be affected by market conditions, worker morale, random catastrophes, government regulation, and so forth. Natural selection is an account in the evolutionary bookkeeping system that collects all the deterministic factors that impinge upon the survival and reproduction of heritable variants of a population of

evolving entities, not including random factors and adaptive adjustments made by learning or (in the case of culture) various kinds of biased acquisition of new ideas. Natural selection is the net effect over all the impinging positive and negative effects on survival and reproduction of behaving a certain way, averaged over all the entities that behave that way, adjusted for the degree to which descendant entities behave like their ancestors. We cannot do evolutionary accounting without at least implicitly computing the effect of natural selection.

The reason that natural selection is a key term of evolutionary account is that it defines the problem that any evolving entity in the last analysis has to solve—survive and reproduce. In the human case, we might suppose that Campbell's vicarious selectors have supplanted natural selection. Guided variation and biased transmission by individual humans and by larger scale organizational entities might be making all of the cultural evolutionary adjustments that natural selection might otherwise impose. We in fact make mighty efforts in that direction. Firms expand, sell subsidiaries, reorganize, do research, and hire new CEOs in order to avoid bankruptcy (and better, to succeed spectacularly). Individuals seek jobs with the best companies, and not a few use what they have learned at the best companies to create start-up businesses. Governments sponsor research on natural hazards and adopt building codes and other regulations to mitigate their effects. Individuals seek remedies for infectious diseases that their immune systems fail to destroy and for the many non-infectious ailments like myopia where their genes have let them down in other ways.

We are fond of a Sempé cartoon from the New Yorker that portrays two men sitting in a large, well-furnished living room. One says to the other "Natural selection, I'm afraid, no longer has a significant part to play." Sempé's character could be right, but only if natural selection were truly all powerful. If in the past natural selection had favored the right genes and the right mechanisms of phenotypic flexibility that did successfully defend every significant breach through which the raw impact of selection would have impacted the population, then selection would not act in the present. It is in this sense that Mayr and Campbell mean that natural selection is the ultimate force. We may use our formidable cognitive and organizational talents to recognize and solve a completely novel problem before it exerts the slightest selective effect on us, but only because natural selection in the past caused the evolution of efficient proximal vicarious selectors that make us effective agents of deliberate change. The recent detection of the effect of chlorofluorocarbon gasses on the Earth's ozone layer, and the international protocol to remove them from the manufacturing stream are a spectacular example of Spencerian selection addressing a problem before natural selection (deaths from skin cancers) became an important force. Still, in our evolutionary history selection certainly acted to give us the raw intellectual and social skills to cause the problem in the first place and then to solve it. International institutions—partly winnowed by their uncommon successes and frequent failures in preventing international anarchy—evolved, if not directly by natural selection, under the close threat of it. In the long run, the future success of the decision-making forces is measured by how much natural selection they prevent. To the extent that they fail to prevent it, the blind effects unsuccessful versus successful trials and errors will do the evolutionary adjusting instead.

Natural selection is thus a theory of purpose or function. Natural selection is a completely natural process with no overarching or long run goal. It is just the effect of the sum total of all the things an evolving population of entities does that affect its persistence given its current environment. It is liable to be fickle, jostling populations about randomly as environmental parameters vary randomly. Evolutionary biologists find that the effect of natural selection in the wild is often strong, even on characters that change very slowly in the long run (Endler, 1986): taller this generation, shorter the next. "Invest in stocks!" we're told in boom times as the timid watch the bold buy new houses and cars. "Invest in government bonds!" we're told after big crashes, when the bold are bankrupt or dead beneath their office windows. What selection in the long run does do is create organisms that are highly purposive. They are well adapted to survive and reproduce. Evolutionary functionalism is what licenses the search for adaptive explanations of organic form, a very important and successful part of evolutionary biology.

Human Cooperation and the Origins of Spencerian Selection

Sociologist Jonathan Turner (1995) and anthropologist Christopher Boehm (1996) have recently convinced us that table 1 lacks a whole class of evolutionary mechanisms that Turner calls "Spencerian selection." Turner and Boehm argue that societies are organized decision-making entities. People in simple societies often gather to discuss matters of moment. Even when the institutions of collective decision-making are exceedingly informal, groups can reach a consensus about a course of action. If action includes adoption or invention of new ideas, durable changes of behavior will ensue from collective decisions. Complex societies have much more formal mechanisms for reaching collective decisions about change. Modern societies have research universities devoted to inventing new culture across the spectrum from technology through basic science to the arts and humanities. They have sophisticated business organizations devoted to designing, manufacturing, and promoting the "latest." They have governmental institutions prepared to foster change and adapt to it via new legislation. Our list of decision-making forces of cultural evolution needs to be doubled. Every individual-level process in table 1 has a society level mate. For example, the Meiji Restoration in Japan in 1868 began an energetic, centrally sponsored, Japanese attempt to imitate things Western. The military prowess of the European nations, made obvious by Perry's naval "visit" a few years before and by the ongoing victimization of China, led the new Japanese government to adopt a wholesale policy of Westernization. In the terms of table 1, this policy was a mixture of collective direct and indirect bias. Spencerian selection has only the weakest analogies in ordinary biological systems.

The origin of a capacity for Spencerian selection is a major evolutionary puzzle. The super-organismic functional integration necessary for the institutions supporting it must have required quite an unusual evolutionary scenario. Sociobiology, the rigorous application of adaptive functionalism to animal behavior, was quite successful because theory made quite elegant and largely correct predictions about cooperative behavior. W.D. Hamilton's (1964) used mathematical arguments to show that costly cooperation between close relatives is possible because relatives share the same genes because of common descent. This effect is quite strong if the degree of relationship is high, as it is in

most social insect colonies and among other kinds of highly social creatures. Note that Hamilton's theory is also a theory of maladaptation. It suggests that we should not find much cooperation between unrelated individuals, even if they would be better off if they could cooperate. Games like Prisoner's Dilemma normally penalize cooperators and prevent cooperative adaptations from arising. This prediction is borne out, for example in primate social organization. In some cases, males remain on their parents' territories and females disperse to other groups. Chimpanzees often exemplify this pattern. It leads to considerable cooperation between males, who are highly related at least at the well-studied Gombe population, in territory defense and hunting, but little cooperation between females, who are generally unrelated. Many monkeys tend to have the opposite pattern. In such species, coresident related females form tight attachments with each other, and collectively defend the rank of their matrilineage against other matrilineages in the same group. Almost vertebrate societies are quite small because, unlike the social insects, most vertebrates have not found a mechanism to create large numbers of closely related worker individuals. One species, the naked mole rat, does have fairly large colonies with sterile workers exactly on the social insect plan.

Wilson and Hölldobler (1988) note that complex animal societies evolve rarely, but are ecologically common and successful. The ants are one of the most abundant groups on earth, yet they evolved only once. Most likely, many species are maladaptively uncooperative. Baboons hunt baby antelope that they relish eating. They are well equipped with long canines, and have the anatomy and intelligence to make superb cooperative hunters, much as wild dogs are. But male baboons in a troop are unrelated immigrants from other troops and cannot cooperate effectively, whereas wild dog packs are built around a pair bonded male and female who raise litters with the help of their grown siblings, whom the parents dominate and prevent from reproducing. Thus, the maladaptive side of Hamilton's seems to be empirically correct too. Darwinian processes seem to chronically undersupply cooperation because they cannot readily overcome a selfish pre-occupation with individuals' own survival and reproduction. Human success as a species is at least in part due to our ability to form a division of labor and cooperate in the production of subsistence. In the simplest case, hunting and gathering people divide labor by age and sex, cooperate to hunt large game, and form band and tribal scale mutual aid systems in order to exploit high-risk, high-high payoff resources like big game. More recent complex societies greatly extend these same basic strategies. We are a primitive primate ant, so to speak.

Most evolutionary biologists subscribe to a classic argument of G.C. Williams (1966). Williams chastised biologists of that era for interpreting adaptations in terms of high-level functions, especially "for the good of the species." Adaptations, he claimed, only indirectly benefit the species, their direct function is the survival and reproduction of an individual's genes. Selection on groups to favor groups that work better than other groups is a potential source of functional behavior by larger scale units, but the conditions under which inter-group differences can arise and persist long enough to be subject to significant selection are quite onerous. This view, quite reminiscent of the common assumption of selfish rationality by social scientists, has critics in biology (Sober and

Wilson, 1998). Many more people believe that human societies are an exception (e.g. Mansbridge, 1990), but many individualists among social scientists skeptical.

The point of this debate for social scientists is that Darwinian methods furnish us with the tools we need to dissect the problem of human cooperation. We need to hunt for evolutionary processes that might expand the support for institutions of cooperation, coordination, and the division of labor in human societies. It cannot be kinship like the social insects; the evolutionary mechanism must be different. As we have already noted, the human form of complex sociality has no close parallels among other highly social animals. Many students of the problem find Richard Alexander's (1987) concept of multi-person indirect reciprocity, built on Robert Axelrod's (1984) pair-wise reciprocity, to be persuasive. Our own investigations of the problem tentatively convince us that indirect reciprocity is unlikely to be strong except in very small groups (Boyd and Richerson, 1989).

Our hypothesis for the evolutionary origin human ultra-sociality begins with the results of models of culture group selection (Boyd and Richerson, 1985: Ch. 7). The models study populations playing the repeated prisoners dilemma game using strategies that are culturally transmitted. The problem with the operation of group selection on genetically transmitted variants is that migration between groups rapidly erodes variation between groups. In the case of costly cooperation, selection within groups tends to favor those who defect, making the evolution of cooperation even more difficult. The transmission mechanics of culture differ from those of genes, and the right sort of bias rules can preserve plenty of variation in the face of migration and selection. The example we have investigated most extensively is the conformity variant of frequency dependent bias as defined briefly in Table 1 (Henrich and Boyd, 1998). We show that using a conformity rule is highly advantageous in spatially and temporally varying environments. Since all the other adaptive biases, guided variation plus selection itself tend to make the adaptive behaviors common, surveying a number of people and adopting the commonest trait is a generally useful bias rule. The conformity rule protects between-group differences from the effects of migration and within-group selection as a byproduct. Thus selection probably has considerably more purchase on cultural groups than genetic groups. The group extinctions involved in cultural group selection need not be biological extinctions. All that the process requires is that losing groups go socially extinct. In fact, in primitive war genocidal extinctions of groups seem to be rare. Rather, groups that suffer from repeated defeats taking a few percent of the population each break up and throw themselves on the mercy of other groups in which they have friends and relatives. Often, families can even invoke ties to enemy groups and join the victors. So long as refugees are few relative to hosts, the conformist transmission rule will discriminate effectively against such cultural practices as might have contributed to their defeat. The same is emphatically not true for their genes. Primitive warfare would seem to increase genetic migration rates, not decrease them. Although some scholars have imagined that organized human warfare might be enough to make group selection function in humans, the data suggest that primitive warfare is not nearly sufficiently genocidal to play such a role.

We have also studied models of the origin of symbolic markers between groups (Boyd and Richerson, 1987). Human populations are typically divided into subgroups that are marked by differences in dialect, dress, social customs, and so forth. Tribes, ethnic groups, religious communities, castes, classes, and professional groups are examples. The model investigates the role that symbolic marking of group boundaries might have on adaptation to spatially varying environments. We assumed that children learn a marker trait, such as a dialect variant, from their parents when young, and later are biased against imitating the subsistence traits of people who have a different dialect. The model shows that in a spatially variable world symbolic markers have the effect of protecting local ecological adaptations from dilution by cultural traits diffusing in from other local populations adapted to different ecological niches. If local populations have solved games of coordination in unique ways, symbolic marking will also tend to prevent people from learning the solutions common and adaptive in other groups but maladaptive in their own group. In other organisms, new species are typically required to exploit new ecological niches. Humans have evolved a fast, flexible mode of cultural "pseudospeciation" that supported our vast ecological range, even as hunter-gatherers. Of course, pseudospeciation tends to make cultural groups more nearly closed and sharply bounded, hence tending to increase inter-group differences.

Soltis, et al. (1995) tested the cultural group selection model using ethnographic reports of rates of group extinction due to warfare in Highland New Guinea. The Highlanders were un-contacted Stone Age tribal people until Dutch and Australian patrols penetrated the region after WWII. Although they were horticulturalists not hunter-gatherers, they are the simplest societies for which pre-contact patterns of warfare and group extinctions are known in any quantitative detail. The data suggest that new, group advantageous cultural traits might originate and become common in a population of groups in about a millennium. This rate of evolution seems to us just about the right rate of change to account for the broad features of sociopolitical evolution. Five millennia elapsed between the origins of plant cultivation and the first city-states, and another five millennia have elapsed between the first city-states and the rise of the modern liberal capitalist societies.

How Large a Role For Spencerian Selection?

The Systems-Transformation, Modernization, and Development paradigms all assume that social change is driven by purposive human choices. Each attempts to explain the economic and political changes that began in Europe about 1500 and to explain the deliberate imitation of at least selected aspects of European societies by other societies. Most people everywhere feel that more productive economies, innovations in health, political liberalism, and related trends are at least in part desirable. Most also feel that the positive changes involve costs that they wish to avoid to the extent possible. Such costs include high population densities, pollution, high rates of violent intra- and international conflict, and great disparities in incomes and overall quality of life. Each of these three paradigms is descriptive, seeking to account for the growth of modern economies and related sociocultural phenomena. They are also prescriptive, recommending policies that less developed or formerly socialist countries might follow to achieve the successes of the West. In their infancy, these three approaches seem to have shared a faith that sensible policy was largely what was responsible for the pioneering success of the West,

and sensible policies would bring the living standards of poorer nations up to the Western standard. The state, using macroeconomic policy, strategic investment in infrastructure, human capital formation, and direct management of production (in socialist models), was imagined to be the leading agent of change. For such hopes to be true, the formal institutions of change leadership—the state and institutions advising states—have to be powerful relative to other evolutionary forces acting on the cultural system.

Each of our colleagues describes reservations and problems that have arisen with these three paradigms concepts that seem to us to suggest that Spencerian selection has strict limits. Professor Srnivasan describes a disillusion on the part of Development theorists with the state as a leading institution. State institutions are often weak and corrupt. Professor Therborn's concept of "multiple modernities" drops the normative stance as unsuitable for a culturally diverse world and regards Modernization as synonymous with cultural change. Professor Kornai argues that the knowledge that Western experts brought to the former socialist countries to assist with their desired transformation to capitalism were wanting, and that successful advisors instinctively relied upon the common sense of the systems method. As in the highly variable economic growth paths of the Third World, the experience with the transformation to capitalism of the Second World is extraordinarily variable, ranging from smooth successes in Hungary, the Czech Republic, and Poland to rocky, painful, and slow, as in Russia. The faith that the pioneers of these paradigms had that democracy, the state, economic theory, and science and technology were an easily transferable package of techniques that would put each society's evolutionary destiny in its own hands is naïve in retrospect.

Spencerian selection is certainly a powerful force in some domains. The ability of states to mobilize for the conduct of war illustrates how the collective decision-making and cooperative action of large social systems can have consequences for human life equivalent to the forces of nature. The advanced capitalist societies are able to harness liberal political institutions, research and development institutions, market economies, and macroeconomic management to the cart of economic growth and keep it moving forward more or less routinely. The deliberate engineering of technical advance and the management of the knock-on changes that ensue is spectacular example of collective, deliberate, cultural change. If there were much choice, only the adventurous would willingly ride such a cart, perhaps, but the alternatives are all worse. In fact, by dint of proper policies, most countries of the world are currently on an economic growth path that will lead to an advanced capitalist economy in the foreseeable future, if current trends continue. The conspicuous exceptions are the sub-Saharan countries and the laggardly former soviet socialist states.

Whether things are so well in hand as to declare, with Fukuyama (1992), the "end of history" is, to our minds an extremely interesting question. To pose the question sharply we need to know the evolutionary origins of a capacity for Spencerian selection, for it is surely an outcome of the selective forces that generated complex human societies. We also need to have at least a rough idea of what competing or potentially competing evolutionary processes might threaten to undermine Spencerian selection.

The first puzzle of Spencerian selection is to understand how institutions for adaptive decision-making at the group level can arise at all. We believe that the existence of high levels of cooperation and trust is a necessary foundation on which to erect institutions of Spencerian selection. We believe that group selection on cultural variation is the ultimate source cooperation that leads trust between people and legitimacy for collective decision-making systems. As Fukuyama (1992) observes, the raw strength of state versus grass roots institutions is, at best, only part of the story. The second puzzle is to understand why the variation in the quality of Spencerian selection is so great in time and space. Why is the state management of the economy and economic change so successful in some countries at some times but catastrophic in other places at other times? Professor Tilly describes for some of the variables that must play a role. Societies with more open political systems better earn the trust of citizens and can successfully make peaceful Spencerian changes that command widespread support. Superficially stronger authoritarian states are prey to revolution and counter-revolution; change happens by more Darwinian struggle for political existence. Still, cultural group selection can hardly be the main engine for the evolution of improved social institutions on the short time scales such as the last half millennium. For one thing, revolutions usually lead only to the temporary eclipse, not extinction, of political ideas overthrown. Clearly, other processes, derived from cultural group selection perhaps, play important roles at sub-millennial time scales.

We believe that the answer to the second question is to be found in the human "social instincts." Many social scientists rebel at the notion of humans having social instincts, but the idea that we have some sort of innate capacities to create and imitate specifically human social institutions is inescapable. Human researchers have raised members of other ape species, especially chimpanzees, both in their homes as if they children and under captive conditions with rich, daily contact with humans. Human reared apes do learn some amazing things, such as the rudiments of symbolic communication. But their capacity for imitation and their abilities to acquire human social graces are limited (e.g. Tomasello, 1996). Among other things, chimpanzees never become docile enough to make good house pets. Chimpanzee behavior has likely been evolutionarily more conservative than human behavior, so chimpanzee is a rough approximation to the behavior of our ancestors. As humans evolved they acquired both an enlarged capacity to imitate, and a level of docility and social sophistication that permits us to live in rather larger and more cooperative societies than chimpanzees. These latter differences are all we mean by "social instincts."

Good evidence does suggest that human social life is indeed constrained by ancient social instincts we share with our common ancestor with the other apes. For example, kinship is important in human societies. Some excellent evidence from studies of adoption in Polynesia (Silk, 1980) and patterns of domestic violence in Canada and the US (Daly and Wilson, 1988) show that kinship remains exceedingly important. Silk's study reanalyzed data that Sahlins (1976b) argued was fatal to the application of sociobiology to human behavior. She shows that Polynesian adoption is far from Sahlins' picture of a response to free cultural play with concepts of relatedness. Children are adopted when mothers are too young to perform as competent mothers and similar reasons. Adopting families are

almost always close relatives of the child they adopt. Daly and Wilson show that risks of homicide and child abuse are much greater for unrelated than related individuals in the same household. Men most frequently kill and abuse their wives and their stepchildren, sparing biological parents, offspring, and siblings.

Evolutionary theory predicts that human kinship should be part of our social instincts because in one important sense human social organization is still quite primitive compared to other ultrasocial species like ants. In human societies there is no analog of the sterile castes of the social insects or their analogs in the other highly social animals. Human "workers" normally must reproduce themselves. Human genetic fitness is still a direct result of our own reproductive efforts to a substantial degree, and selection throughout human history must always have acted strongly on factors that contributed to individual and family success. As Donald Campbell (1983) expressed it, in humans there is reproductive competition among the cooperators, a unique pattern among the highly social animals. Has human ultra-sociality somehow arisen in spite of ancient social instincts like strivings for individual reproductive success and kin solidarity?

We think that something like that has occurred (Richerson and Boyd, 1998). The paleoanthropological evidence is clear that production of symbolic artifacts goes back at least 50,000 years. The people who used symbolic artifacts also acquired raw materials from great distances, suggesting far-flung social networks. We imagine that the beginnings of cultural group selection and the beginnings of use of symbols to demarcate group boundaries go back tens of millennia, if not hundreds of thousands of years, before the final emergence of peoples whose bones and stone tools strike paleoanthropologists as fully modern. The among the better-known fully modern people are the Aurignacian invaders of Europe, who arrived about 40,000 years ago and rapidly displaced the large-brained but anatomically and behaviorally archaic Neanderthals. Over the long period leading up to the Aurignacians and their kin, genes were likely subject to selection pressures arising from cultural institutions that were increasingly subject to group selection. People would have suffered the costs and benefits of group membership. Culturally group selected institutions demand altruistic acts, for example aid to the starving in subsistence emergencies or to the refugees from a neighboring raided camp. If too few people responded, groups would go extinct in the face of competition from more cooperative groups. This, in itself, would have generated only weak group selection directly on genes because, at least if the demography of such groups is anything like that of living people, intermarriage across social boundaries would have been to great to give groups much *genetic* isolation. Social isolation and the resultant group selection on *cultural* variation is another story. People would gradually have come to discriminate ingroup members from outgroup members. Those who failed to understand what group they belong to, in circumstances as today when what "ingroup" means is liable to be quite context dependent, might find themselves treated as an outsider by everyone. Prosocial institutions no doubt had a coercive element. Policing is one of the most important forms of cooperation. People collaborate to bring down bullies and exile thieves. Boehm (1993) argues that, despite a strong tendency of mentally and physically superior individuals to exert dominance, hunting and gathering societies and other simple societies are generally highly egalitarian. The relatively weak combine against the domineering, leveling

reproductive opportunities within groups, perhaps exaggerating the effect of selection between groups. Thus, people who were chimpanzee-like in their social instincts—too belligerent or too suspicious to respond to the dictates of cultural norms for cooperation—would tend to suffer discrimination and punishment by those more disposed to go along.

In the end, we suggest, people came to have a new set of social instincts constructed by coevolution with cultural group selection. We call them the *tribal* social instincts (Richerson and Boyd, in press b). The tribal instincts probably, roughly, operate on the "principles and parameters" plan that Noam Chomsky proposed for the innate and cultural aspects of language. Human individuals are innately prepared to follow group norms, behave altruistically to ingroup members, and to keep track of considerable nuance as regards both norms and groups. Cultural traditions define group norms and the groups themselves. The general tendency of people to cooperate and to be trustworthy, at least as regards their ingroups, makes Spencerian selection possible. The cultural variability in the parameters of cooperation explains why some societies are nearly incapable of Spencerian selection. In one limit, the ingroup can reduce to the family. In some feuding societies, the scale of cooperation is reduced to nearly these limits, and the capacity for trust and cooperation is drastically reduced compared to modern liberal democratic societies. In the other limit, some people promote moral systems that include all of humanity or even all of creation.

In between, a spectrum of societies exists, with various scales of dominant ingroups ranging from villages and triblets to nation-states, not to mention a host of other cultural variables that might affect the Spencerian process. Societies that have primary loyalties to small groups will have correspondingly limited scope for Spencerian solutions to larger scale problems like the economy and defense. For example, the poor economic performance of African societies is often attributed to the fact that traditional African social organization is frequently strong at the tribal or smaller scale and that historically states were rare, small, and ephemeral. To the extent that traditional social institutions persist and to the extent that institutions better adapted to the national scale at which modern economic management is conducted are absent, African economic progress is perhaps bound to be slow. On the other hand, if the Swiss, with their experience building a wealthy modern nation composed of highly autonomous cantons, had been the dominant colonists and post-colonial advisors in Africa, we might be writing of the "African Lions" of economic development as well as the "Asian Tigers!" A fit between traditional political culture and a nation's consitution may be more important than the exact locus of the strongest sense of ingroup solidarity. The economic performance of Indian Reservations in the U.S. varies greatly depending upon the vagarities of the fit between the official tribal constitution and the traditional forms of governance (highly variable at the time of European conquest). Reservations with current governments in conformance with traditional political culture do much better than those with reservation government at variance with tradition Cornell and Kalt (1997). Perhaps the artificiality of African postcolonial boundaries and constitutions with respect to their traditional tribal political cultures is likewise their greatest handicap to operating effective Spencerian

institutions. Most likely, path dependence due to cultural traditions is a strong constraint on Spencerian selection as it is more generally in organic and cultural evolution.

Because of the continuing fact of reproductive competition among the cooperators, the tribal instincts cannot replace the ancient social instincts that we inherit from our primate ancestry. The tribal instincts are often in conflict with the ancient instincts. Human individuals are also the locus of conflict between different social groups since more than one ingroup can lay claims to an individual at the same time. As a result, human ingroups are more or less riddled with conflict. In simpler societies, people typically lived in segmentary societies with a more or less hierarchically nested set of groups. In any given situation, the demands of a person's family might conflict with what is best for the rest of the band, but also what is best for the band might not be best for the tribe. This last problem becomes especially acute in the complex societies of the last few thousand years (Richerson and Boyd, in press). The hierarchy of units becomes deeper and the nesting of the hierarchy less perfect. Groups in key positions very frequently appropriate a suspiciously large share of the joint products of the social system. Or perhaps only seem to from the point of view of other subgroups. Widespread trust is difficult to sustain in any human society, and the difficulties are compounded by size and complexity.

The capacity of modern societies to deploy strategies of Spencerian selection to guide their evolution must be seen against this evolutionary background. To a Darwinian, the fact that complex societies function at all appears to defy forces as fundamental as gravity. The feat is only possible when cultural institutions have evolved sophisticated "work-arounds" that minimize the drag of smaller-scale advantage on the larger system. That is, in highly functional complex societies like modern liberal democracies, a complex set of cultural institutions minimize the conflicts between individuals and their "tribes," and generate a sense of belonging at the level of the nation-state. Work-arounds in part use the social instincts and in part finesse them. If they worked perfectly, individuals would never sense any conflict between their roles as family member, churchgoer, local government participant, ethnic group member, and national citizen. In temporary emergencies, such as wars, conflicts between roles do considerably recede. In other situations, internal conflicts tear societies apart. Seemingly well-regulated societies, such as Belgium in recent decades, can suffer from the renewed salience of internal tribal divisions and from a loss of confidence in public institutions due to simple defects like petty corruption. Even the best complex society is like a buggy airplane. On a good day when everything is working right, they do seem to annul the laws of nature. When things go wrong, they limp, sink, and crash, terrifying and often killing the people aboard. No human constructions are more triumphant in success or pitiful in failure than airplanes and states.

Fukuyama's (1992) end of history thesis exemplifies one take on the capacity of modern societies to successfully practice Spencerian selection. One way to view the history of complex societies is that steady progress has been made in the quality of institutions so that Spencerian selection has gradually become more powerful relative to natural selection and more directly derivative processes, such as the individual level cultural evolutionary forces in Table 1. Tilly's account of European history has such a progressive

flavor. The contrary hypothesis is that progress is, if not illusory, at least fragile and no sure sign of the future of complex societies. Pessimists point to the rise of immensely destructive political systems in the 19th and 20th Century—colonialism, fascism, and communism. Perhaps the present triumph of liberal democracy is just the lull between storms. We take neither side in this debate. At best, evolutionary theory is only weakly predictive, even in the case of organic evolution. Cultural evolution is, as yet, an infant science by comparison.

We do think that Fukuyama has put his finger on a key issue. The strength of modern liberal democracies is their ability to command a sense of legitimacy. Democratic institutions, for the first time since complex societies arose, give followers some of the same control over dominant political leaders that people in simple societies exercised over their leaders. People have the sense that wrongs committed by selfish individuals and narrow groups can be righted. Leaders take a long and tolerably unselfish view. They create welfare measures, progressive taxation, "affirmative action," and philanthropic organizations that give ordinary citizens real benefits from the system and an open path to advance into an achievement oriented elite. Given that the reality of modern complex society remains—unavoidably as far as we know—deeply hierarchical and quite inegalitarian, liberal democracies perhaps do as well as can be done. At any rate, alternative schemes that promised to do better have actually been much worse.

Applying the Darwinian Method

The contribution we think Darwinian theory can make to this debate is mainly its methodological approach to change. Darwinism is a collection of concepts, mathematical tools, and empirical methods designed to understand the dynamics of genetic and cultural evolution. If cultural evolution is an important process of change in human societies, then it needs to be studied with the proper tools. Conventional economic theory will not do. Economic theory is immensely better developed than cultural evolutionary theory, but it addresses market dynamics and related issues. It is an awkward tool for studying medium- and long-term change (Nelson and Winter, 1982).

What can the evolutionary theory of cultural aspire to learn about cultural change? The core exercise is to estimate the strength of forces acting on cultural variation. Given measures of the strength of the forces acting on a given set of alternative cultural variants, we can cumulate across all forces and estimate the instantaneous trajectory of that part of the cultural system. Projections from the instantaneous trajectory give us an idea where the system will end up in the future. Such projections are not much more complex than demographic analysis and projection and share much conceptual and mathematical machinery.

For the case at hand, we can make some crude estimates of some of the evolutionary forces that are hostile to the end of history. Religious fundamentalism is a set of cultural movements that is rather profoundly hostile to a central institution of liberal society, freedom of conscience and belief (Marty and Appleby, 1991). Christian Fundamentalists in the US want to use the power of the state inculcate morals and beliefs congenial to their reading of Christian texts and reverse what they see as the moral decay of America.

Fundamentalists attack practices, especially abortion, that liberal institutions have tolerated under the doctrines of privacy and separation of church and state. They attack scientific ideas at the core of modern biology, especially evolution, and seek to have them removed from school curricula. Many have apocalyptical views, including belief in a Second Coming in the near future. Their commitment to Spencerian institutions of change is correspondingly reduced. Fundamentalists enjoy the religious tolerance of liberal regimes but themselves have weak a commitment to tolerance.

In the US, the tolerance for Christian Fundamentalism is far from complete. Finke and Stark (1992: 218-223) describe the long period during which the Federal, later National, Council of Churches, representing the culturally dominant liberal and moderate Protestants fought a strenuous battle to marginalize conservative Protestant groups. For example, for many decades the Council was able to prevent conservatives from readily using broadcast media while protecting their own monopoly on public service broadcast slots. The liberal elite appears to have reasoned that Fundamentalism was a relict of the past not suited to a modern liberal society. The last judgment may be correct, but the former has proven inaccurate. It is the liberal churches that have withered and the conservative that have flourished. The liberal churches quite deliberately hitched their star to liberal democracy and made a bid to become among the central institutions of civil society. Elite consensus and activism in favor of this move makes the attempt an act of Spencerian selection. What went wrong?

Most commentators seem to assume that the battle between the various American churches for members is a battle for the hearts and minds of believers by active church proselytizing. The reality is more complex. Roof and McKinney (1987) investigated the demographics of religious change in America. The results of their investigation are summarized in Tables 2 and 3. Looking first at births, we see that a considerable difference exists between the birth rates of the various denominational groups. Birth rates (Table 2) among people stating no religious preference is hardly better than half the rate among conservative Protestants in the under 45 age category, with other groups variously in between. Table 3 displays the gains and losses due to switching from one denominational category to another. Clearly American religion is rather dynamic. The overall pattern is rather striking. The big gainer due to choice is “no religious affiliation,” though elite liberal churches still attract considerable numbers of converts, especially from moderate denominations. The conservative Protestants have only a small net intake from conversion, much smaller than the differential effect of higher birth rates. If Roof and McKinney’s data are correct, the pro-family, pronatalist values of conservative churches have a strong impact on behavior, while the impact of their militant proselytizing is only just enough to prevent net losses to more liberal belief. Conservative Protestant churches are growing because the have higher birth rates and because they manage to keep most of their kids faithful. At the present time, we have to say the conservative doctrines are fitter than liberal ones. Darwinians can take perverse comfort in the idea that the main reason that conservative Protestants are succeeding in the US is natural selection! Smith’s (1991) more comprehensive analysis of the available survey data suggests that the fundamentalist increase is more modest in the aggregate that the figures of Roof and McKinney imply, although some smaller fundamentalist

denominations, most notably Mormons, are growing rapidly. He attributes the rising visibility of Fundamentalism more to increased political sophistication and hence influence of Conservative Protestant churches rather than numerical growth.

Tables 2 and 3 about here.

More generally, the liberal democracies around the world have sharply declining birth rates that show no signs of leveling off at replacement (Bongaarts and Watkins, 1996). Most likely, as in the US, those individuals that are most committed to liberal democratic values also tend to have the fewest children. On the other hand, around the world masses of Third World citizens aspire to live in liberal democratic countries. Secular liberal values exert an enormous attractiveness, as the trend to non-observance in the US testifies. Even US conservative Protestants have dramatically reduced their birth rates, as the relatively small numbers in Table 2 attest. According to Bongaarts and Watkins no society that has embarked on the demographic transition has ever reversed course. Currently the only groups known to have fully resisted it within the developed countries are Anabaptist sects—Hutterites, Mennoites, and Amish. These groups are currently tiny despite high growth rates and no reasonable projections can be made about their potential for success if they were to become large. If some brand of fundamentalism does manage to substantially resist the demographic transition while the supporters of liberal traditions continue to have ever fewer children, in the end liberal democracy will disappear. Contrariwise, if liberal democratic values continue to attract adherents with more traditional higher fertility backgrounds, liberal democracies may be stable indefinitely.

Other empirical data suggest that liberal democratic societies do have real vulnerabilities that new ideologies might exploit. Frank and Cook (1995) and Easterlin (1995) call attention to the problem of happiness in liberal democratic societies. The free-market economics of these societies is one of the main engines of their success. The utilitarian foundations of modern economic theory and practice are enshrined in the slogan "a rising tide lifts all boats." The rub comes if human wants are substantially comparative, driven by pride and envy, not the satisfaction of wants that do not excite such ethically dubious pleasures and pains. Unfortunately, the evidence from surveys of human happiness suggests that comparative wants are all that one can detect. Happiness in the developed countries where the data is the best vary up and down, but are better correlated with responses to questions of interpersonal trust that to indicators of economic growth. For example, during the extraordinary growth of the Japanese economy from the 1950s to the 1980s, happiness reported to opinion surveyors was dead flat! The data seem to suggest that happiness has little or nothing to do with conventional economic growth, at least over the ranges exemplified by post WWII Japan.

Worse, Frank and Cook argue, the expansion of the mass media, the professionalization of entertainment, and the creation of global competition for knowledge-based skills could lead to massive destruction of happiness via "winner-take-all games." In a local community, most individuals can take pride in being good at several things, and perhaps best at one. However, as the scale of competition and comparison increases, fewer and

fewer individuals can meet the standards of "good at" and "best." Before mass communications many singers and actors might attract the acclaim of their audiences. As films and records begin to distribute the performances of the world's best to larger and larger audiences, a few individuals begin to reap a disproportionate share of the income and glory of performance. If there are diminishing returns to income and glory, and if the differences between very good and world class performances are lost on most consumers, the creation of larger scale winner-take-all games will greatly diminish the happiness of hundreds of thousands of performers at trivial per capita increases in the happiness of audiences.

The institutions of liberal democracy that provide its legitimacy—open economies and open civil life—promote rapid evolution. Open economies promote rapid technological change, and technological change will tend to stimulate social change. Marx' argument along these lines has ample empirical support (e.g. Steward, 1955). Today, the falling prices for shipping and especially the falling cost of information transmission and processing are "globalizing" economic organizations. The ultimate consequences of such new arrangements are impossible to predict. Open civil life tolerates ideological evolution that can easily turn in directions hostile to liberal society. Perhaps imperialism, communism, and fascism are not the last ideological outbursts to afflict liberal democracies. William McNeill's (1980: 71-75) intuitions about the strengths and weakness of liberal institutions contrast sharply with Fukuyama's. Our point is that it is practical to put such intuitions to test by estimating the balance of the evolutionary forces tending to one trajectory as opposed to the other.

Any sort of long-term predictions on the basis of the data we have reviewed here are quite unwarranted. First, far too little work has been done. As we have seen, sociologists of religion disagree about the current growth of Christian Fundamentalism in the U.S. The pursuit of Darwinian studies of cultural evolution will eventually allow us to have a much more sensitive finger on the pulse of the evolutionary process. Second, human cultural evolution is probably massively subject to path dependence and similar processes that place fundamental limits on the predictability of evolutionary trajectories (Boyd and Richerson, 1992). Take the powerful but fickle force of Spencerian selection. Much about the future presumably depends upon whether or not liberal policy-makers can build legitimacy for international institutions to regulate the process of globalization. In the 20th Century the occurrence of unexpected shocks—the destructive duration of WWI, the Great Depression, the rise of Fascism and the devastation of WWII, a long, costly Cold War—have repeatedly overwhelmed fragile international institutions, throwing a highly interdependent world system back on a reliance on national institutions, some of them quite illiberal. With a little more luck, policy makers might have avoided any one of these historical shocks, and the present dominance of liberal democratic ideas might have occurred sooner. The future likely depends upon policy makers' luck as well as acumen in shepherding still-vulnerable international institutions through shocks that we can imagine but not predict, such as a global financial panic or a regional nuclear war. Indeed, perhaps the most important applied challenge for evolutionary social science is to discover the limits of predictability. Once we know what we can't know, policy makers can devise strategies to minimize the impacts of adverse uncertain outcomes. Geologists

cannot predict when earthquakes will occur, but engineers can design buildings that minimize their casualty toll.

Conclusion: Cultural Evolution Is a Darwinian Process

Darwinian theory is an ambitious attempt to understand organic structures in terms of their evolutionary history. A complex of processes shape the inherited determinants of behavior in response environmental imperatives. Natural selection is the process responsible for adaptive change that results in organisms' success in reproducing themselves. Human social change differs from the standard case of organic evolution because our technology and social institutions involve cultural as well as genetic determinants. Indeed, virtually all contemporary social and technical and change are surely due to cultural rather than genetic evolution. Most attempts to understand social change in the social sciences have actively avoided using Darwinian theory as a foundation. We argue that it is much more natural to build a theory of cultural evolution on an explicitly Darwinian framework. The virtues of this approach are several.

1. Darwinian theory integrates genetic and cultural determinants of behavior using coevolutionary models. These models show, for example, how cultural evolution could have generated pro-social genetic instincts in the course of human evolution. Even our innate social instincts are likely as much a product of cultural as genetic evolution.
2. Darwinian theory highlights the other dynamic processes that are necessary to have a complete theory of social change. The dynamics of social games, demography, ecology, and development interact with Darwinian mechanisms to produce new social institutions.
3. Darwinian theory makes strong inferences about the function and purpose of evolved entities. Natural selection is not itself teleological, but produces organisms with purposive behavior. In species without culture, purposive behavior is limited to biological individuals and to certain special cases of multi-individual societies, such as the social insects. Human societies exhibit purposive behavior at the individual and institutional levels. Darwinian theory provides an explanation for multi-level teleology in human societies, including the problems of failures as well as successes of higher level functions.
4. Darwinian theory is synthetic. Other social science theories of social change are typically subsets of Darwinian theory, not alternatives to it. For example, rational choice theory draws upon the purposive decision-making capabilities of individuals. As important as individual choice is, by itself it is not a theory of social change. The instantaneous equilibration of the social system assumed by rational choice limits analysis of historical change to comparative statics. By treating individual rationality as a constrained, marginal process, Darwinian theory produces models with explicit historical dynamics.
5. Darwinian theory reveals important new empirical problems for the social sciences. From it we can derive a taxonomy of evolutionary forces that cause social change. The relative strength of these forces can only be guessed at given existing data. For example, we would like to know how strong is natural selection on cultural variation

relative to forces that derive from human agency, and we would like the answers to span all facets of culture and as many types of cultures as possible.

6. Darwinian theory highlights to practical problems and ethical dilemmas of social change. In an ideal world, we would replace the blind and often terrible force of natural selection with deliberate, controlled social change. This is what the paradigms of Development, Transformation, and Modernization aspire to. Individual level choice processes are not sufficient to obviate the effects of natural selection. For example, even when human agency succeeds via Spencerian selection in producing large-scale societies, these societies struggle with each other in Darwinian competitions. Individuals will not lightly give up their autonomy and cultures often generate fierce loyalties to beliefs and doctrines that others too often find objectionable, exploitable, and threatening. Minimizing the impact of natural selection upon our lives requires the fullest picture of the processes of social change that we are capable of constructing.

Our basic claim in this chapter is that cultural evolutionary processes drove the evolution of human ultra-sociality. Cultural transmission itself has adaptive advantages in highly variable environments like the Pleistocene. Some of these processes have the effect of making group selection *on cultural variation* possible and the use of *cultural cues to structure populations* common. As cultural group selection began to produce primitive patterns of ingroup cooperation and outgroup hostility, human cognitive capacities, presumably coded in large measure by genes, responded to adapt people to living in culturally defined cooperative groups.

The multi-level nature of the human evolutionary process is a recipe for a messy coevolutionary game. Human individuals are in the position of having strong claims on their allegiance from a hierarchical series, or even a cross-cutting complex, of organizations ranging from our families to culturally defined ingroups as large as our country. In many circumstances, the benefits of cooperation induced by culture greatly outweigh the genetic fitness costs, but the costs have to be paid. A relatively few and simple gene-culture coevolutionary processes generate the bewildering variety and rapid dynamics of human political institutions. Our social cognition is adapted to manage, as best it can, lives lived in an inherently conflict-ridden and unstable social environment, albeit one in which much of the instability arises because large-scale cooperation, supported by altruistic motives, is common. The very large scale and deeply hierarchical structure of modern societies presses the envelope of what is psychologically possible for an animal originally adapted to live in much simpler societies, much as modern mathematical, literary and athletic training explore the outer limits of human minds and bodies.

Unless we are badly misled by our data, the levers of Spencerian selection that are currently deployed to guide the evolution of liberal democratic societies rest on a foundation of cultural values that is evolving in uncontrolled and unpredictable directions. As Darwinian anthropologists, the idea that humans are still fundamentally wild animals, subject to the dictates of natural selection, is a stirring prospect. The dynamism and diversity of human cultures make up a splendid tapestry, even stained as it

is with spilt blood. That tapestry is the main subject of our adopted discipline, anthropology, and the sole excuse for its existence. As liberal democrats, the lack of interest of so many of our colleagues all the social science disciplines about the processes underlying uncontrolled evolutionary dynamism of our species is frightening. Gandhi is supposed to have remarked when asked about European civilization "It would be a good idea!" The 20th Century shows that no existing culture on Earth can stake a serious claim to be civilized. The French have Le Pen. We are all barbarians, even those most ardent pursuers of civilization have not yet earned the gold. The reaction of most commentators on the existing state of our barbarism is either optimism or pessimism about the future. We are moved much less by either sentiment than by our anthropologists' curiosity, and by the conviction that curiosity about how cultural evolution works will have a greater impact on how things turn out than either celebration or hand wringing.

Dedication

This paper is dedicated to the memory of Donald T. Campbell, with gratitude for his insights and thanks for his steadfast support of our and our colleagues' work.

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I. *Random forces*

A. *Cultural mutation*. Effects due to random individual level processes like misremembering an item of culture.

B. *Cultural drift*. Effects due to statistical anomalies in small populations. For example, in simple societies some skills, like boat-building, may be practiced by a few specialists. If all the specialists in a particular generation happen, by chance, to die young or to have personalities that discourage apprentices, boat-building will die out.

II. *Decision-making forces*

A. *Guided variation*. Effects due to non-random learning, invention, and modification of cultural variants.

B. *Biased transmission*

1. *Direct bias.* Individual choice among pre-existing cultural variants based on a direct assessment of the costs and benefits of alternatives.

2. *Frequency dependent bias*. The use of the commonness or rarity of a cultural variant as a basis for choice. For example, the most advantageous variant is often likely to be the commonest. If so, a *conformity bias* is an easy way to acquire the correct variant.

3. *Indirect bias*. The possession of advantageous traits may be correlated with some indicator trait. If individuals have a hard time evaluating each of the traits that make a person appear successful, a strategy that imitates as much as possible about successful people will work well to acquire useful ideas.

III. *Natural selection.* As we have said, natural section will work on any form of variation that causes patterns of resemblance between "ancestors" and "descendants." Imitating the good or bad habits of friends and acquaintances creates ancestor-descendant relationships every bit as subject to selection as the genes passed from parents to offspring.

Table 1. A taxonomy of processes that can cause culture to change.

Table 2. Average number of births per woman by religious family. After Roof and McKinney (1987)

Family	*All*	*Age 45+*	*Under 45*
Liberal Protestants	1.97	2.27	1.60
Moderate Protestants	2.27	2.67	1.80
Black Protestants	2.62	3.08	2.24
Conservative Protestants	2.54	3.12	2.01
Catholics	2.20	2.75	1.82
Jews	1.69	1.96	1.37
No Religious Preference	1.39	2.30	1.18
National	2.25	2.75	1.73

Table 3. Percentage of individuals surveyed who had switched denominational families. After Roof and McKinney (1987)

Family	*All*	*Age 45+*	*Under 45*
Liberal Protestants			
From other families	34.3	24.3	44.7
From non-affiliation	2.2	2.8	1.5
To other families	-24.8	-25.0	-24.5
To non-affiliation	-8.0	-11.5	-4.5
Net gain or loss	3.7	-9.4	17.1
Moderate Protestants			
From other families	18.2	19.0	17.5
From non-affiliation	2.2	2.2	2.1
To other families	-20.4	-18.3	-22.4
To non-affiliation	-5.8	-9.0	-2.9
Net gain or loss	-5.9	-6.1	-5.7
Black Protestants			
From other families	2.2	2.5	1.9
From non-affiliation	0.2	0.4	0
To other families	-8.9	-7.6	-10.4
To non-affiliation	-4.2	-6.8	-1.2
Net gain or loss	-10.7	-11.5	-9.6
Conservative Protestants			
From other families	23.8	21.3	27.0
From non-affiliation	2.3	2.5	2.0
To other families	-19.4	-16.3	-23.3
To non-affiliation	-3.9	-5.6	-1.7
Net gain or loss	2.8	1.9	4.0
Catholics			
From other families	8.3	7.3	9.7
From non-affiliation	0.9	0.7	1.2
To other families	-7.2	-7.2	-7.1
To non-affiliation	-7.3	-10.0	-3.1
Net gain or loss	-5.3	-9.2	0.7
Jews			
From other families	5.3	7.0	4.2
From non-affiliation	0.8	1.8	0
To other families	-3.4	-4.1	-3.0
To non-affiliation	-10.1	-13.5	-7.7
Net gain or loss	-7.3	-8.8	-6.5
No Religious Preference			
From other families	209.0	257.1	124.3
To other families	-53.5	-46.6	-65.7
Net gain or loss	155.6	210.5	58.6