Cultural Evolution:
How Darwinian Theory Can Explain Human Culture and Synthesize the Social Sciences

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Preface

The year 2009 was the 150th anniversary of the publication of Charles Darwin's *The Origin of Species*. As was the case for the 50th and 100th anniversaries in 1909 and 1959, the 150th anniversary was celebrated with lavish events and prestigious meetings at universities and learned societies around the world, as well as TV series and a movie biopic of Darwin. Few other scientists, and even fewer books, warrant such long-term attention. But this is not merely hero worship on the part of scientists. It is the recognition of a major scientific advance. In *The Origin*, somebody had set out for the first time a tenable scientific explanation for two phenomena that had predominantly been, and often still are, attributed to supernatural, mystical, or religious forces. The first phenomenon is the incredible diversity of biological organisms that we see in the natural world. This diversity ranges from beetles to cacti to hummingbirds to algae to gibbons, to name just a few random examples. Prior to Darwin, the accepted explanation for this diversity was simply that God had created these species in their present forms, for whatever reason he saw fit (he works in mysterious ways, after all). The second phenomenon that Darwin explained was the often intricately complex adaptations that these diverse organisms possess, such as eyes, wings, echolocation systems, and brains. As many

theologians have noted, such adaptations have multiple, functionally interrelated parts that appear to work perfectly together, seemingly betraying clear evidence of having been designed by an intelligent being.

Darwin's genius—the reason he is still celebrated today—was to provide the first coherent and workable scientific explanation for these phenomena. According to Darwin, the diversity and complexity of the natural world could be explained using a handful of simple principles, all of which could be demonstrated empirically to be operating in nature: first, that variation exists between individuals; second, that a "struggle for existence" occurs due to limited resources, such as food, nesting space, or mates, and ever-increasing population sizes, such that not every individual has an equal chance of surviving and reproducing; and third, that characteristics are inherited from parent to offspring during reproduction. The consequence is what Darwin called "natural selection": those characteristics that increase an individual's chances of surviving and reproducing are more likely to be inherited by the next generation, and such characteristics will increase in frequency within a population. Over time, beneficial characteristics gradually accumulate and combine to generate the eyes, wings, and so on that had previously been attributed to the actions of a creator. Darwin's work has stimulated a century and a half of enormously productive research in evolutionary biology, which has been devoted to working out the details of Darwin's principles, such as the genetic basis of inheritance, of which Darwin was only dimly aware.

In this book I survey a growing body of scientific research that is based on the fundamental premise that cultural change—by which I mean changes in socially transmitted beliefs, knowledge, technology, languages, social institutions, and so on—shares the very same principles that Darwin applied to biological change in *The Origin* a century and a half ago. In other words, *culture evolves*. This is not a new idea by any means. In fact, Darwin himself would later draw parallels between biological evolution and cultural change, specifically language change:

> The formation of different languages and of distinct species, and the proofs that both have been developed through a gradual process, are curiously parallel . . . The survival or preservation of certain favoured words in the struggle for existence is natural selection.[1]

Darwin wasn't just using an analogy here for purposes of exposition. Language change isn't "a bit like" natural selection, or "resembles

in some respects" natural selection, it "is" natural selection, plain and simple. And many other illustrious scientists since then have made similar observations, such as William James, one of the founders of psychology:

> A remarkable parallel . . . obtains between the facts of social evolution on the one hand, and of zoölogical evolution as expounded by Mr. Darwin on the other.[2]

Despite these early pronouncements by prominent scholars of a curious and remarkable parallel between biological and cultural change, only now are scholars beginning to properly apply Darwinian methods, tools, theories, and concepts to explain cultural phenomena. This book is an attempt to summarize and synthesize this growing movement.

In many ways, the problem that Darwin set out to solve—the diversity and complexity of biological organisms—is echoed in the problem faced by those studying culture. Human culture, too, shows enormous diversity: there are approximately 10,000 different religions currently practiced in the world, almost 7,000 different languages spoken, each one of which contains around half a million words, and 7.7 million patented items of technology in the United States alone. Human culture also shows often astounding complexity, such as the intricately detailed ecological knowledge of the behavior of other species that is passed from generation to generation in many hunter-gatherer groups, technological artifacts such as computers or space shuttles that are composed of countless functionally interlinked parts, and political and financial institutions that successfully organize (at least to some degree) the lives of millions of people. This body of diverse and complex culturally transmitted knowledge has allowed our species to successfully colonize virtually every terrestrial environment on the planet, from freezing poles to scorching deserts, from tropical rainforests to mountain ranges. Chapter 1 is devoted to more precisely defining this phenomenon that we call "culture," as well as demonstrating empirically that culturally acquired knowledge significantly shapes various aspects of human behavior, from society-wide patterns of aggression and cooperation to fundamental psychological processes such as how we perceive objects and interpret other people's actions.

In chapter 2, I outline the argument that Darwin's explanation for the diversity and complexity of biological life also applies, in a broad sense, to human culture. That is, cultural change—changes in beliefs, knowledge, technology, social institutions, and so on—shares the

same principles that Darwin laid out in *The Origin*. First, culturally acquired traits show variation in their form and expression; second, there is some kind of competition between these cultural variants due to finite resources, such as space in memory, so that not every variant is equally likely to survive and spread; and third, cultural variants are passed from person to person due to cultural transmission. Chapter 2 is devoted to expanding this basic proposition and showing that the resulting theory of cultural evolution is empirically well supported—at least as well supported as the equivalent argument that Darwin made for biological species in *The Origin*.

Equally important as the basic similarity between biological and cultural change, however, are the differences. Beyond the theory outlined by Darwin in *The Origin*, many of the details of biological evolution that have been worked out by biologists since then, such as particulate inheritance (the existence of discrete particles of inheritance, genes), blind variation (new genetic variation is not generated to solve a specific adaptive problem), or Weismann's barrier (the separation of genotypes and phenotypes such that changes acquired in an organism's lifetime are not directly transmitted to offspring), may not apply to cultural evolution. But, crucially, this does not invalidate the basic argument of chapter 2 that culture evolves. It just means that the details of cultural evolution may be different from the details of biological evolution, and it is up to social scientists to fill in those details, just as biologists have done over the past 150 years.

With this in mind, chapter 3 outlines the microlevel details of cultural evolution, drawing on groundbreaking mathematical models developed in the 1970s and 1980s by a handful of pioneering researchers based in California. Some of these resemble the underlying processes of biological evolution, such as drift (changes due to chance events in small populations) or vertical cultural transmission (from one's biological parents, just like genes). Others are unique to culture, such as the Lamarckian-like process of guided variation, where people modify what they learn from others before passing it on. Each of these microevolutionary processes has distinct population-level consequences for cultural evolution, consequences that could only have been worked out with formal mathematical models borrowed from population geneticists.

Chapters 4 and 5 examine cultural macroevolution, which describes the large-scale, long-term patterns and trends that are documented by anthropologists, archaeologists, historians, and linguists. Of course, scholars in these fields have long described and explained large-scale

patterns of cultural change without any reference to cultural evolution. Yet these explanations are typically based on informal and nonquantitative methods. We will see how cultural evolution researchers are using rigorous, quantitative methods originally designed to detect and explain patterns and trends in biological evolution, such as phylogenetic analyses and neutral drift models, to uncover patterns and trends in cultural macroevolution with greater certainty than is possible with traditional, nonevolutionary methods.

Chapters 6 and 7 concern two specific methods for studying cultural microevolution: lab experiments and ethnographic field studies. Experiments can be used to simulate cultural evolution under controlled conditions in the lab. This brings all kinds of benefits over purely observational or historical methods. With experiments, for example, we can manipulate variables to determine the causes of cultural phenomena, we can "re-run" history several times to see whether trends are meaningful or due to chance, and we can obtain uninterrupted and complete behavioral data—none of which is possible with purely observational or historical studies of actual cultural change. Ethnographic field studies complement experiments by tracking cultural change within small communities of people, addressing such questions as whether people learn primarily from their parents or from their peers, and how such transmission pathways affect within- and between-group cultural variation.

Chapter 8 examines recent efforts to model economic change as an evolutionary process. Traditional economic theory is not very good at explaining change over time, instead focusing on whether an economic system is in an optimal state at any one point in time. This is problematic when economies are constantly changing, for example, in response to rapid technological change (e.g., in telecommunications or computing), and evolutionary economists have begun to construct an evolutionary theory of economic systems in which change rather than stasis is the default. Other researchers have argued that cultural evolutionary processes, specifically the process of cultural group selection, can potentially explain puzzling findings from various economic experiments that suggest that people are typically far more cooperative than they should be if they are just maximizing their own utility in a purely self-interested manner, as assumed by traditional, nonevolutionary economic theory.

Chapter 9 asks whether any species other than humans have culture. To a large extent, this depends on how we define "culture" to start with. It is clear, however, that a surprisingly large number of

other species possess at least some of the key elements of human culture, such as the ability to learn from other individuals and to maintain stable between-group differences in behavior that might be described as cultural "traditions." Yet only humans appear to have *cumulative* culture, where modifications are built up over successive generations. Why only humans have cumulative cultural evolution is at present a mystery, but this avenue of study promises to shed light on the origin and basis of human culture.

In the final chapter, I argue that all the research that I have discussed here is indicative of a coming "evolutionary synthesis" for the social sciences. For all the brilliance of *The Origin of Species*, it was not until the so-called "evolutionary synthesis" of the 1930s and 1940s that evolutionary biology really took off as a coherent and successful discipline. Prior to this synthesis, biology was fractionated into several isolated disciplines composed of experimentalists, theoretical modelers, field naturalists, paleontologists, and so on. Each discipline had its own theoretical assumptions that often conflicted with those of other disciplines. During the synthesis, scientists within each discipline came to accept the same basic assumptions, thus synthesizing biology within a single Darwinian theoretical framework. More specifically, it was recognized during this period that broad trends and patterns in biological macroevolution, such as patterns of adaptive radiation in the biogeographical record or periods of change and stasis in the fossil record, could be explained in terms of the small-scale microevolutionary processes studied by experimentalists and model builders, processes such as natural selection, sexual selection, and drift. I argue in chapter 10 that the social sciences are currently in a similarly fractionated state as the biological sciences were prior to the 1930s. However, if culture does indeed evolve in a similar way to species, then a similar "evolutionary synthesis" might be possible for the social sciences. That is, large-scale trends or patterns of cultural macroevolution, as studied by archaeologists, historians, historical linguists, sociologists, and anthropologists, might be explained in terms of small-scale microevolutionary cultural processes, as studied by psychologists and other behavioral scientists. We can see the emergence of a unified science of culture, one that transcends traditional social science disciplinary boundaries.

This view of a single, overarching science of culture, unified around a Darwinian evolutionary framework and incorporating anthropology, archaeology, economics, history, linguistics, psychology, and sociology, may seem naive. Anyone who has studied a social science subject at university level will probably be aware that there is little theoretical

common ground, or even communication, between many of the different branches of the social sciences. Yet the current state of the social sciences, composed as they are of theoretically incompatible and mutually incomprehensible disciplines, is hugely problematic. Valuable findings and theories are rarely transferred across disciplinary boundaries to stimulate work in other fields, and scholars waste time reinventing discoveries that have already been made in other disciplines. Consequently, while there are pockets of rigorous and high-quality research being carried out within specific social science disciplines, it is lamentable that so little progress has been made over the past few decades in understanding one of the most intriguing and astounding phenomena known to science—human culture—especially when so much progress has been made in the natural and physical sciences over the same period. My aim in this book is to nudge the social sciences along a little by showing that there is a growing interdisciplinary body of work that is making significant progress in explaining culture scientifically.

1

A Cultural Species

Humans are a cultural species. We acquire a multitude of beliefs, attitudes, preferences, knowledge, skills, customs, and norms from other members of our species culturally, through social learning processes such as imitation, teaching, and language. This culturally acquired information affects our behavior in quite fundamental ways. People who grow up in different societies exhibit measurably different ways of thinking and behaving because they acquire different cultural norms and beliefs from other members of their societies. Culturally transmitted technology, from stone tools to automobiles to the internet, and culturally transmitted political, economic, and social institutions have drastically changed our environments and our lives in a relatively short period of time. No other species on the planet exhibits such rapid and effective cultural change.

As a result, any explanation of human behavior that ignores culture, or treats it in an unsatisfactory manner, will almost certainly be incomplete. Yet a large number of social and behavioral scientists—many psychologists, economists, and political scientists, for example—either implicitly or explicitly downplay or ignore cultural influences on human behavior, instead focusing on the behavior and decisions of single individuals with little or no consideration of how that behavior and those deci-

sions are affected by culturally acquired norms and beliefs. Other social scientists—many cultural anthropologists, archaeologists, sociologists, and historians, for example—*do* acknowledge the importance of culture, yet their methods and approaches often lack the scientific rigor and precision needed to satisfactorily explain how and why culture is the way that it is and how it affects behavior in the way that it does. Consequently, while the natural and physical sciences have made huge progress in the last century or so in explaining the hidden mysteries of life, matter, and the universe, the social sciences have failed to provide a unifying and productive theory of cultural change. The different branches of the social sciences remain fractionated, each speaking their own, often mutually unintelligible, languages and holding assumptions and theories that are mutually incompatible. Indeed, a good example of this mutual incompatibility concerns the very definition of "culture" itself, which varies greatly from discipline to discipline. It is necessary, then, to clearly specify the definition of "culture" that will be used in the rest of this book, before going on to demonstrate the extent to which culture shapes our behavior.

What Is Culture?

"Culture" is one of those concepts, like "life" or "energy," that most people use in everyday speech without giving much thought to its precise meaning. In fact, people often use it in several different, but overlapping, senses. For example, it might be used to identify a specific group of people, usually within a single nation, such as "French culture" or "Japanese culture." Or it might be used in the sense of "high culture," such as literature, classical music, and fine art, as is the focus of many "culture" sections of Sunday newspapers. Or it might be used to describe a seemingly shared set of values or practices within a group or organization. For example, during the financial crisis that began in 2007, many commentators lamented the "culture of greed" that seemed to be prevalent within the banking industry, as it emerged that CEOs were still receiving huge bonuses even as their banks were being bailed out using public money.

When scientists use the term "culture," they usually mean something broader, something that encompasses all three of the definitions above. Although literally hundreds of definitions of culture have been proposed across the social sciences over the years, the definition that I will adopt in the rest of this book is that *culture is information that is acquired from other individuals via social transmission mechanisms*

such as imitation, teaching, or language.[1] "Information" here is intended as a broad term to refer to what social scientists and lay people might call knowledge, beliefs, attitudes, norms, preferences, and skills, all of which may be acquired from other individuals via social transmission and consequently shared across social groups. Whereas genetic information is stored in sequences of DNA base pairs, culturally transmitted information is stored in the brain as patterns of neural connections (albeit in a way that neuroscientists are only beginning to understand), as well as in extrasomatic codes such as written language, binary computer code, and musical notation. And whereas genetic information is expressed as proteins and ultimately physical structures such as limbs and eyes, culturally acquired information is expressed in the form of behavior, speech, artifacts, and institutions.

This definition of culture encompasses in one way or another all of the colloquial uses of culture noted above. Culture includes the Japanese grammar and vocabulary, Japanese norms, and Japanese customs that a Japanese child acquires that contribute to maintaining the specific "Japanese culture." The skill required to use chopsticks, for example, is stored in the brains of virtually all Japanese people, is acquired from other people via imitation or teaching, and is expressed behaviorally in the form of chopstick use. Cultural groups are not always the same as nation-states, though: there is substantial variation in the customs and values of people living in different regions of Japan, while Japanese customs such as chopstick use have diffused to many other nations. Culture also includes the literature, music, and art that make up "high culture," although it is by no means limited to this. Celebrity gossip about the latest relationship problems of Hollywood movie stars is just as much a part of human culture as are the works of William Shakespeare. And culture includes those norms and practices that may have been transmitted from banker to banker via imitation or direct instruction that create and maintain selfish behavior within an organization.

According to this definition, culture is defined as information rather than behavior (in anthropological jargon, it is an *ideational* definition of culture). Restricting our definition of culture to information does not mean to say that culturally acquired information does not *affect* behavior. Of course it does, otherwise it would be a useless concept for explaining human behavior. However, as anthropologist Lee Cronk makes clear, it is important to distinguish between culture and behavior for two reasons.[2] First, if behavior is the thing we are trying to explain, then including it in the definition of culture makes cultural

explanations for behavior circular. A thing cannot explain itself, at least not in any useful sense. And second, there are other causes of behavior besides culture. In fact, this is a useful way of defining culture: by what it is not. First, as noted above, culture can be distinguished from information that we acquire *genetically*, from our biological parents, which is stored as DNA base pair sequences and expressed as proteins and, ultimately, as entire organisms. Second, culture can be distinguished from information that we acquire through *individual learning*, which describes the process of learning on our own with no influence from other individuals. While individually learned information, like culturally acquired information, is stored in the brain, it is not acquired from other individuals via cultural transmission. This distinction between genetically, culturally, and individually acquired information is important, because even if we observe variation between people and groups in some behavioral practice, we cannot automatically assume that the explanation of this behavioral variation is culture. Take variation in alcohol drinking, for example. Some variation in alcohol drinking is most likely cultural in origin, for example, resulting from the culturally transmitted norms prohibiting the drinking of alcohol found in religions such as Islam, or the more informal prodrinking norms found in certain social groups such as university fraternities and sororities. But some variation might be the result of individual learning, where a person independently decides to drink (or not to drink) alcohol because they like (or dislike) its taste or its effects. Other variation in alcohol drinking might be genetic. Indeed, certain genetic alleles have recently been found to increase a person's risk of alcohol dependency such that people with these alleles have higher alcohol intake than people without these alleles. Many East Asians, on the other hand, lack a different genetic allele that would allow them to digest alcohol, potentially decreasing the frequency of alcohol drinking in that group.[3]

How Important Is Culture?

Given these alternative explanations for human behavioral variation, how can we be sure that culture really is important, compared to genes and individual learning? Here are three examples, one from political science, one from economics/cultural anthropology, and one from psychology, that illustrate the importance of culture in shaping our behavior.

Civic Duty: From Europe to America. It is often said that the United States is a nation of immigrants. Leaving aside the issue of the several million Native Americans who already lived on the continent, the early European settlers of North America did indeed come from various countries, including Britain, Germany, Italy, the Netherlands, and Scandinavia. As anyone who has traveled across Europe will be aware, while the inhabitants of each of these countries are broadly similar in their beliefs and attitudes (at least compared to, say, Japan or India), there are also significant differences between European countries. One such difference relates to values and attitudes concerning civic duty. These include various traits that can be considered beneficial to a liberal democratic society, such as the tendencies to donate to charity and conduct voluntary work, to vote in elections, to organize local pressure groups and labor unions, to regularly read newspapers (and thus be able to make informed democratic decisions), and to support social equality and representation for minorities. Some countries, such as Denmark, Norway, and Sweden, are high in average civic duty. Their inhabitants willingly donate to charity, vote, volunteer, and so on. Other countries, such as Italy and Spain, rank somewhat lower in average civic duty. Their inhabitants are less likely to, among other things, donate to charity, vote, and volunteer.

To political scientists Tom Rice and Jan Feldman, this cultural variation in civic duty presented a natural experiment that could test to what extent cultural differences persist over time.[4] Rice and Feldman reasoned that if values related to civic duty are faithfully passed via cultural transmission from parent to child and teacher to pupil, down the generations, then perhaps the civic duty of contemporary Americans could be predicted by the specific European country that their settler ancestors came from. So Rice and Feldman calculated the civic duty for Americans of various European ancestries. They did this using the answers to such questions as "Do you regularly read a newspaper?," "Did you vote in the last presidential election?," and "Generally speaking, would you say that most people can be trusted or that you can't be too careful in dealing with people?," and whether they agreed with such statements as "Most public officials are not really interested in the problems of the average person" and "Women should take care of running their homes and leave running the country up to men."

Rice and Feldman's results were just as they predicted. Americans who claim to be descended from settlers from European countries that have high civic duty, such as Denmark, Norway, and Sweden,

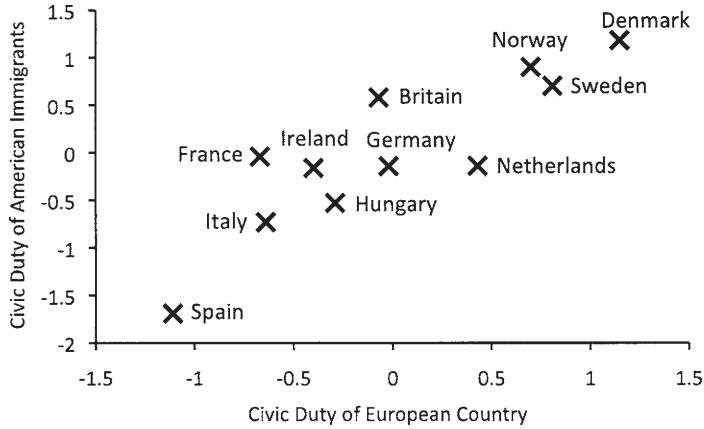

FIGURE 1.1 The correlation between civic duty of European populations and the civic duty of contemporary Americans who claim to be descended from those European populations. Values are composite z-scores from various measures of civic duty. Data from Rice and Feldman 1997.

themselves have relatively high civic duty. Americans who claim to be descended from European countries that have low civic duty, such as Italy and Spain, have relatively low civic duty. This can be seen in figure 1.1. Rice and Feldman's explanation for this match is that values related to civic duty, such as beliefs that voting or donating to charity are important and desirable things to do, have been culturally transmitted by imitation or teaching from parent to child or teacher to pupil over the several successive generations from original European settlers to present-day Americans. This would have occurred despite extensive interaction with other Americans of different descent, despite a declaration of independence and a civil war, and despite differences between Europe and the United States in geography and ecology. And a subsequent study by Tom Rice and Marshall Arnett showed that values related to civic duty can have important consequences.[5] They found that the average civic duty measured in different states at several points during US history significantly predict later socioeconomic development. For example, states that scored highly in civic duty in the 1930s were found to have relatively higher levels of personal income and education in the 1990s than states that scored low in civic duty in the 1930s. The reverse was not true: socioeconomic performance in the 1930s did not predict civic duty in the 1990s. So civic duty seems to be responsible for later socioeconomic development. The way in which it did this is not entirely clear, but we might imagine that states in which the residents more strongly value representative democracy elect more effective and honest public representatives, or perhaps rich residents of such states

give more to charity, thus reducing inequality and raising average income. In any case, Rice and colleagues' work illustrates how people's cultural values can persist over several generations and significantly shape people's behavior and the society in which they live.

Is Fairness Universal? Rice and colleagues' studies are intriguing, but limited somewhat because they rely on self-reported measures of civic duty. Someone who says that it is important to vote or donate to charity is not necessarily someone who actually votes or donates to charity. An alternative way of exploring cultural variation is by directly measuring people's behavior in a controlled experimental setup.

One aspect of civic duty is fairness, and its flipside, selfishness. People high in civic duty tend to value fairness in personal interactions (e.g., business dealings), with each party getting a fair deal, while people low in civic duty tend to eschew the ideal of fairness and attempt to selfishly maximize their own personal gain at the expense of the other person. One way that experimental economists have tested people's sense of fairness/selfishness is known as the ultimatum game. The ultimatum game is played by two players, a proposer and a responder. The proposer must divide up a sum of money, say $100, into two portions, one that the proposer can keep and the other that is given to the responder to keep. For example, the proposer might split the $100 equally into two $50 portions (a fair offer), they might offer $20 and keep $80 for themselves (a selfish offer), or they might offer $80 and keep $20 (a generous offer). The responder can then decide whether to accept this offer, in which case they both get the amounts specified by the proposer, or reject the offer, in which case neither the proposer nor the responder get anything. Typically, the game is played just once and both players are anonymous, in order to avoid complications like pacts, promises, and reputation. The amount of money to be divided is also fairly substantial in order to motivate the players to give serious responses.

In a typical sample of US college students, the most common offer made by proposers is 50 percent, a fair and equal split. And responders react in a way that suggests they also have a sense of fairness: any offer less than 20 percent is rejected half the time.[6] It seems that responders have a sense of fairness, rejecting offers that they perceive as being unfair. Proposers, knowing this, make fair offers. So these experimental findings show that US college students are not entirely selfish and, consistent with the existence of civic duty, exhibit some degree of charity to others and a sense of fairness.[7]

Just as civic duty varies across countries and states, so too fair-

ness responses in the ultimatum game vary across different societies. A team of cultural anthropologists led by Joseph Henrich of the University of British Columbia ran ultimatum game experiments in fifteen small-scale societies in twelve countries across the world.[8] These societies had diverse lifestyles, ranging from nomadic herders to hunter-gatherers to small-scale farmers. In each case, two randomly chosen members of the society played the ultimatum game anonymously and for a large potential reward, just as the US college students did. The results showed substantial variation between different societies in their offers. The Lamalera of Indonesia and the Aché of Paraguay, for example, both most commonly offered 50 percent of the sum to responders, just like US students. The Machiguenga of Peru and the Hadza of Tanzania, in contrast, most commonly offered just 20–25 percent. The acceptance thresholds also varied: the Quichua of Ecuador never rejected any offers, even those well below 50 percent, while the Au of Papua New Guinea rejected more than a quarter of all offers made, even those above 50 percent.

How can this variation between societies in fairness be explained? Individual-level variables, such as sex, age, wealth, and education, failed to predict behavior in the ultimatum game, both across societies and within each society. Instead, what predicted behavior best were the characteristics of the players' societies, primarily the degree to which economic life in that society depends on cooperation with people outside of one's family. Societies in which ultimatum game offers were lowest, such as the Machiguenga, had few economic dealings in their everyday life with people outside the family. Societies in which higher offers were made were much more integrated within market economies, frequently trading and cooperating with other people in their daily lives. The 50/50-splitting Lamalera, for example, hunt whales off the coast of Indonesia. Whale hunting is no easy task, and large crews of Lamalera in several boats are needed to stand a chance of making a successful kill. Because success depends on the cooperation of several people, the whale meat is divided into equal parts and shared among each crew member. In other words, the need for cooperation has resulted in the emergence of relatively strong fairness norms, which, Henrich et al. argue, are invoked in the ultimatum game and result in fair offers. So the bottom line: people in different societies exhibit different degrees of fairness because they have acquired different fairness norms from other members of their society, which in turn have emerged because of different requirements of life in those societies.

Eastern versus Western Thinking. One of the lessons of Henrich et al.'s study is that American college students are not necessarily representative of our species as a whole, a message that is slowly permeating the discipline of economics. Another discipline that is slowly beginning to recognize this is psychology. For much of its hundred-or-so-year history, experimental research in psychology has been carried out predominantly by Western (i.e., Western European and North American) psychologists on Western participants, who are typically well-educated, middle-class, financially well-off college students. Despite this patently narrow sample, major discoveries made by Western psychologists have often been heralded as major discoveries about universal, specieswide human psychological processes. In recent years, however, a growing number of cultural psychologists have begun to actually test this claim and have repeatedly found significant differences between the psychological processes of people from different societies.[9]

A good example relates to what Western psychologists have called the fundamental attribution error. This is the tendency, found in Western participants, to explain other people's actions in terms of stable, underlying dispositions. For example, if asked to explain why a student failed an exam, a Westerner might respond that the student was lazy and had not revised well enough, or that they were simply not smart enough. Westerners are much less likely to consider situational factors that are beyond the control of the student, such as that the student was badly taught, they were feeling unwell, or their questions didn't come up. This tendency is called an "error" because it persists even when it is obviously incorrect. The classic experimental demonstration of this in the 1960s had American participants read student essays that were either for or against Fidel Castro's communist regime in Cuba.[10] Half the students were told that the essay writers had been given a free choice as to whether to argue for or against the regime; the other half were told that the essay writers had been assigned the position at random. They were then asked to judge the extent to which the essay writers themselves supported Fidel Castro. As expected, the participants who were told that the essay writers had had a free choice said that those who chose to write a supportive essay really did support Castro more than those who wrote critical essays. Surprisingly, however, so did the participants who were told that the essay writers had had no choice: they also rated writers of supportive essays as having more positive attitudes toward Castro than writers of critical essays. In other words, the participants ignored the situational context—the fact that the essay

writers were assigned to a position at random—and erroneously attributed the essay content to the writer's attitudes.

Until the mid-1990s it was generally believed that the fundamental attribution error was a universal characteristic of human psychology (it was, after all, called "fundamental"). When cultural psychologists started to test non-Western participants using tasks similar to the Castro study, however, they found that the fundamental attribution error was much smaller, if not absent altogether. Michael Morris and Kaiping Peng, for example, asked American and Chinese participants to read a newspaper report of a real-life murder case in which a Chinese physics student named Gang Lu shot his PhD advisor, several bystanders, and then himself after he lost an award competition and failed to get an academic job.[11] American participants, more than Chinese participants, attributed the behavior of Lu to internal dispositions, agreeing more with statements such as "Lu had chronic personality problems," "Lu drove himself crazy by putting too much pressure on himself," and "If Lu couldn't win, he didn't care about anything else." Chinese participants were more likely to appeal to situational explanations, agreeing more with statements such as "The recession has hurt the job market, which places stress on people seeking a new job," "The advisor failed in his duties to help Gang Lu and respond to his increasing frustration," and "American movies and television glorify violent revenge tactics."

Similar cross-cultural studies comparing North American and East Asian participants have revealed many other differences in thinking styles. Numerous psychological phenomena once thought to be human universals have been found to be weaker or absent in non-Western, typically East Asian, populations, such as cognitive dissonance (the anxiety brought about by simultaneously holding contradictory beliefs). Other studies have revealed differences in basic processes of attention, memory, and perception. For example, East Asian participants show better memory for the position of an object relative to other objects, while Western participants show better memory for the features of single objects. Psychologist Richard Nisbett and colleagues have argued that these East-West differences can be described along a single dimension, with an East Asian thinking style characterized as "holistic," and a Western thinking style characterized as "analytic."[12] Eastern holistic thinking focuses on the relations between objects and people (recognizing, for example, the role of situational factors in the murder case), whereas Western analytic thinking focuses on the characteristics and dispositions of individual objects and people. In short,

the consensus from recent research in cultural psychology is that our thinking and behavior is deeply influenced by culture.

Culture, Environment, or Genes?

The examples given above all suggest that there are nontrivial differences between the members of different societies or different groups in various aspects of behavior and thinking. Can we be sure, however, that these differences really are cultural? Remember that there are two other ways in which people can acquire information: genetically and via individual learning. Perhaps the civic duty values that appear to have persisted over several generations have been inherited not culturally but genetically: perhaps Scandinavians are genetically predisposed to be more civic-minded than Italians, and this genetic variation has persisted in the modern-day United States. Or perhaps the variation in fairness revealed by the ultimatum game is the result of individual learning: each member of a relatively "fair" society lives in a (nonsocial) environment that has led them each to independently develop strong fairness norms, whereas members of less fair societies have each independently developed less fair norms.

These explanations need to be seriously considered, as many influential traditions within several social and behavioral science disciplines would favor genetic or individual learning explanations for human behavioral variation. The two dominant schools of thought of twentieth-century psychology, associative learning theory and cognitive psychology, both focus on individual learning while largely ignoring social learning and culture. Learning theorists such as J. B. Watson and B. F. Skinner sought to explain human behavior in terms of simple individual learning processes such as classical conditioning, where people learn associations between different stimuli in their environments (the original example of this being Pavlov's dogs learning to associate the sound of a bell with the appearance of food). Cognitive psychologists delve deeper into the underlying knowledge structures that shape people's behavior, such as the abstract categories that we use to classify objects (e.g., "furniture" or "animal") and use to infer the characteristics of novel objects without having to undergo trial-and-error associative learning. But like learning theorists before them, cognitive psychologists typically do not treat learning from the nonsocial environment and learning from other people any differently, if indeed they consider the latter at all. Similarly, economists of the "rational choice theory" school typically assume that people individually calculate costs

and benefits of different behaviors, with little cultural influence. And an approach known as "cultural ecology" or "cultural materialism" within cultural anthropology, often associated with anthropologists Julian Steward and Marvin Harris, assumes that behavioral practices and technology can be seen as adaptations to local conditions rather than as culturally acquired.[13]

Other disciplines stress the role of genes. Evolutionary psychologists, for example, typically explain human behavior in terms of genetically evolved adaptations and downplay or ignore the role of culture. While admitting in theory a role for "transmitted culture," that is, the definition of culture given earlier in the chapter, evolutionary psychologists such as John Tooby and Leda Cosmides typically focus instead on what they call "evoked culture."[14] According to the evoked culture argument, much behavioral variation between groups of people can be explained as different genetically encoded responses triggered by different ecological conditions, a sort of mix of genes and individual learning. Tooby and Cosmides use a jukebox analogy to explain this. Imagine two jukeboxes with an identical set of songs programmed into each. Despite being identical, one jukebox might be playing a Beatles song and another jukebox playing a Bob Dylan song in response to the selections of different people. In the same way, two people living in two different societies might exhibit different behaviors because different (nonsocial) environmental cues trigger those behaviors from the identical underlying behavioral repertoire. This is very different to the "social transmission" definition of culture given earlier. If evolutionary psychologists are correct, then transmitted culture plays little or no role in shaping human behavioral variation, and a theory of cultural evolution would be unnecessary. So it is important to demonstrate that individual learning and genes cannot fully explain human behavioral variation and that culture plays an important role.

Individual Learning Alone Cannot Explain Human Behavioral Variation. If individual learning were responsible for variation in human behavior, then we would expect to see a close match between a person's behavior and the nonsocial ecological conditions in which that person lives, such as climate, terrain, or local animal and plant species. Different ecological conditions would cause people to independently invent similar solutions to the problems posed by those ecological conditions.

Numerous examples collected by cultural anthropologists and sociologists show this not to be the case. Indeed, there seems to be a "double dissociation'" between behavior and ecology. Two societies living in

the same environment can have entirely different behavioral practices. For example, the Amish Mennonite religious groups live in the same ecological conditions in Pennsylvania as non-Amish Pennsylvanians, yet they retain quite distinct customs and practices, such as the use of horse and buggy rather than motor vehicles. Conversely, two societies with very similar behavioral practices can live in entirely different environments. For example, Britain and Australia have extremely different ecologies, yet British immigrants to Australia have maintained many British customs, laws, practices, and of course, the English language (albeit with many peculiar changes to proper English).

These anecdotal observations are confirmed by more systematic, statistical analyses. Anthropologist Barry Hewlett, along with biologists Annalisa De Silvestri and Rosalba Guglielmino, compared 109 different customs found in thirty-six ethnic groups across Africa.[15] Examples of the customs that they examined included type of marriage system (e.g., monogamous vs. polygamous), the presence or absence of intensive agriculture, and beliefs in interventionist versus noninterventionist gods. Just four of these 109 customs reliably varied according to ecological conditions (classified as desert, savannah, or forest), suggesting that local adaptation to ecological conditions through individual learning had little influence. The others correlated best either with family lineages, suggesting cultural transmission within families, or with geographical closeness, suggesting cultural transmission between neighboring groups.

Genes Alone Cannot Explain Human Behavioral Variation. The implication of Rice and Feldman's study is that values related to civic duty have been culturally transmitted down the generations. An alternative explanation, however, is genes. Perhaps the variation in civic duty in both European countries and their US descendents is genetic, rather than cultural. This is also a potential explanation for the findings of Hewlett, De Silvestri, and Guglielmino from Africa, which found that many practices correlate with family lineages. Such a pattern could also be explained by genetic inheritance, given that genes flow along family lineages as well as cultural information.

It is important first to be clear about exactly what genes are supposed to explain. There is no doubt that the psychological mechanisms that allow us to do things like imitate other people or learn languages are the product of genetic evolution. Such complex capacities did not spring from nowhere, unless one wishes to invoke creationism. However, we are not interested here in these underlying *capacities*, so much

as the *contents* of culture: the specific beliefs, attitudes, skills and values that are transmitted using these genetically evolved capacities. And in particular, whether variation in these beliefs, attitudes, skills, and values both within and between groups can be explained primarily in terms of genetic variation or cultural variation.

The vast majority of between-group behavioral variation in humans simply cannot be explained by genetic differences. Behavioral geneticists, by comparing identical twins (who are genetically identical) and fraternal twins or siblings (who share on average half their unique genetic variation), estimate that most behavioral and cognitive traits, such as IQ, personality, and psychopathology, have a heritability of around 40–50 percent. That is, around half the variation in behavior between people living in the same society can be attributed to genes.[16] That leaves around 50–60 percent for culture. But the crucial point is that these differences are *within* societies, not *between* societies: for the kind of between-society differences discussed above, genetic influence will be substantially lower. Recent worldwide analyses estimate that the vast majority of human genetic variation (93–95 percent) is found within populations and just a tiny proportion (5–7 percent) between populations, and that this between-population genetic variation is far too small to explain documented behavioral variation in customs, practices, and languages.[17]

Immigration also counts against purely genetic explanations of human behavioral variation. Recall the aforementioned differences between the holistic thinking style of East Asians and the analytic thinking style of Westerners. What happens when people who grew up in East Asia emigrate to North America, or vice versa? Do the immigrants' children inherit the psychological characteristics of their parents, suggesting a genetic basis for these differences? Or do the immigrants' children adopt the psychological characteristics of the local society, suggesting a cultural basis? The evidence clearly favors the latter cultural explanation. When East Asians migrate to North America, this first generation tends to retain the psychological traits of their society of origin. However, their children, who grew up in the United States or Canada, show psychological characteristics that are much closer to their local Western society than to those of their parents. By the third generation, the psychological traits of people of East Asian descent are indistinguishable from their peers of European descent.[18] Substantial genetic change does not occur in just two generations: it must be the result of acculturation to local norms.

Other aspects of human behavior can change even more rapidly and

offer further evidence against purely genetic explanations. Technology, for example, has changed incredibly quickly over the last few hundred years[19]: a gap of just sixty-six years separated the first powered flight by the Wright brothers and Neil Armstrong stepping foot on the moon. Social customs show similarly monumental change in relatively short periods of time: just forty-five years separate the Civil Rights Act of 1964, which ended racial segregation in the United States, with the election of Barack Obama in 2008 as the first African American president. These time periods are roughly equivalent to one or, at most, two biological generations. Given that genetic evolution operates gradually over many generations, genes simply cannot account for change this rapid. And these are just the big changes: think of the even more rapidly changing fashions and fads in clothing and popular music that change on the order of weeks and months.[20]

More Evidence for Culture: Children Are Cultural Sponges. These examples suggest that much behavioral variation between societies can be explained in terms of cultural transmission: people acquire knowledge, customs, attitudes, values, and so on from other members of their society. More proximate research on the learning habits of children supports this conclusion. Children seem to be predisposed to rapidly and automatically acquire huge amounts of information from other people. They are, in a sense, "cultural sponges," soaking up knowledge from those around them. A well-studied example is language. By the time they reach adulthood, children have a vocabulary of 60,000 words. This means that they must be learning, on average, 8–10 words every day.[21] As anyone who has tried to learn a second language as an adult can attest, this is no mean feat. Yet young children do this with little direct instruction. This general finding extends beyond words to all kinds of actions and beliefs. In one recent study conducted by developmental psychologists Derek Lyons, Andrew Young, and Frank Keil, for example, three- to five-year-old children were shown by an adult how to open an unusual box to retrieve a toy inside.[22] Some of the actions performed by the adult were functional, such as unscrewing a lid, while others were nonfunctional, such as tapping the side of the box with a feather. Yet despite their obvious irrelevance, the latter nonfunctional actions were faithfully copied by the children. This was found even when the nonfunctional actions were identified by the adult as being "silly and unnecessary," when the children were alone and unobserved, and when the children were rewarded for opening the box as quickly as possible. In sum, children can't help copying.

Evolutionary anthropologist Michael Tomasello has argued that it is our capacity to rapidly and accurately acquire huge amounts of information culturally that sets humans apart from other species. One study conducted by Esther Herrmann, Tomasello, and others illustrates this.[23] Herrmann et al. gave a battery of intelligence tests to two-year-old human children, adult chimpanzees, and adult orangutans. Some of these tests tapped physical intelligence, such as the ability to keep track of the number of objects in a display or the ability to use a tool to retrieve some food. Other tests tapped what Herrmann et al. called cultural intelligence, such as imitating the solution to a problem, communicating with the experimenter to retrieve a reward, or following the experimenter's gaze. There were no significant differences between the children, chimps, and orangutans on any of the tests of physical intelligence. On the tests of cultural intelligence, however, the children greatly outperformed both other species. Even at this early age, the minds of human children seem to be designed to acquire knowledge from other individuals, a finding that has been found in study after study.[24]

Culture Is Genetically Adaptive. A more theoretical line of support for the claim that humans are a cultural species comes from a set of theoretical models that show that it is often genetically adaptive for individuals to acquire information culturally.[25] In other words, it often in our genes' interests (metaphorically speaking) to forego direct control over behavior and let culture take over. While this might seem counterintuitive, the theoretical models show exactly why, in evolutionary terms, culture is adaptive. These models typically specify a population of hypothetical individuals tasked with discovering the correct "behavior" to carry out in their particular environment, such as what kind of food to eat or what stimuli in their environments constitute threats to be avoided. Each individual is assumed to possess one of three genotypes, each of which specifies a different way of discovering the best behavior to carry out: an "innate" genotype that directly specifies its bearers' behavior genetically, with that behavior fixed at birth and unable to be changed via learning; an "individual learning" genotype that causes its bearers to randomly try out different behaviors and stick with the one that gives the highest payoff; and a "cultural" genotype that causes its bearers to copy the behavior of another individual in the population. The modeler then allows the different types of individuals to compete with one another over several generations to see which genotype does best.

According to these models, learning, either individual or cultural, is

favored over innateness when environments change relatively rapidly, because genes cannot respond to rapid change that occurs within a single biological generation. Once we receive our genes from our parents we are stuck with them, and novel changes in the world that occur within one's lifetime cannot be anticipated directly by those genes. Individual learning is a way for genes to indirectly respond to rapid, within-generational change: if a new potential food item or predator suddenly appears in the environment, then individual learners can discover whether the item is edible or whether the potential predator really is dangerous. However, individual learning is also often costly: trying out various novel food items one finds in one's environment is a risky way of identifying what is edible and what is poisonous. Culture allows individuals to forego these costs: eating whatever other individuals are eating is a much safer way of identifying edible food items, given that you can observe whether the other individuals are getting sick or not.[26] Culture also allows us to acquire and use things like cars and computers that could never have been invented by a single individual in their lifetime from scratch purely via individual learning. These theoretical findings that culture can be genetically adaptive fit well with the evidence reviewed so far that much of human behavior is shaped by culture rather than directly by genes or via individual learning.

Problems with How Culture Is Studied

Culture is thus clearly important in shaping various aspects of human behavior. So why are so many social and behavioral scientists reluctant to acknowledge this? To some extent it is quite understandable. For many economists, cognitive psychologists, and evolutionary psychologists, explanations of human behavior in terms of "culture" are simply meaningless. As economists Luigi Guiso, Paola Sapienza, and Luigi Zingales write:

> Until recently, economists have been reluctant to rely on culture as a possible determinant of economic phenomena. Much of this reluctance stems from the very notion of culture: it is so broad and the channels through which it can enter economic discourse so ubiquitous (and vague) that it is difficult to design testable, refutable hypotheses.[27]

The evolutionary psychologists John Tooby and Leda Cosmides are similarly disparaging about typical cultural explanations of human be-

havior in the social sciences. They describe the "Standard Social Science Model," in which every aspect of human behavior is explained in terms of some mysterious force called "culture," and mock its use in the social sciences during the mid- to late twentieth century to simultaneously explain everything and nothing:

> The invocation of culture became the universal glue and explanatory variable that held social science explanations together: Why do parents take care of their children? It is part of the social role their culture assigns to them. Why are Syrian husbands jealous? Their culture tied their status to their wife's honor. Why are people sometimes aggressive? They learn to be because their culture socializes them to be violent. Why are there more murders in America than in Switzerland? Americans have a more individualistic culture. Why do women want to look younger? Youthful appearance is valued in our culture. And so on.[28]

These complaints are somewhat justified. Historically, social scientists studying cultural phenomena have been reluctant, and even unable, to specify in precise terms exactly how culture operates beyond some vague and informal notion of "socialization" or "social influence." As Guiso, Sapienza, and Zingales note, when a concept is imprecise, then one cannot generate specific predictions, often via formal models, which can then be tested quantitatively through systematic experimentation or real-world measurement. This gives noncultural disciplines that *do* employ formal models and quantitative methods, such as evolutionary psychology or economics, an intrinsic advantage in explaining human behavior. In the chapters that follow I will argue that the theory of cultural evolution offers a fully scientific, quantitative, and rigorous way of understanding and explaining cultural change. But first, it is useful to examine in more detail the problems with how culture is typically studied in the social sciences.

The Perils of Hermeneutics, Reflexivity, and Social Constructionism. In the past few decades cultural anthropology has undergone something of a crisis. The principle methodology of cultural anthropology is ethnography, in which an anthropologist lives in a particular society for an extended period of time and observes and interviews the members of that society. The ethnographer's aim is to describe the studied people's lives, typically through the production of written descriptions. In the

early years of cultural anthropology, attempts were then made to quantify the information contained in these ethnographies and to assemble these data into large cross-cultural databases. This allowed systematic cross-cultural comparisons to be made and gave early anthropologists a way to test hypotheses concerning how and why different cultural practices spread from society to society.[29]

In the latter part of the twentieth century, however, the ethnographic method, and the systematic cross-cultural comparisons that resulted from it, came under attack from various directions. Scholars working within what is called the "hermeneutic" or "textualist" school of thought, such as Clifford Geertz and James Clifford, attacked the validity of the ethnographic method. They argued that any example of written text, including an ethnography, will necessarily reflect the many implicit and subjective assumptions of its writer, assumptions that the writer acquires from members of his or her own society. Because ethnographers' assumptions will be different to those of the people being studied, who acquired different assumptions from their own society, these critics argue that an ethnographer can never accurately capture the true experiences of those people. A similar criticism arose in the guise of "reflexivity," the idea that the very act of observing another person's actions changes those actions, making observational methods intrinsically flawed. And another line of attack came from social constructionists, led by sociologists such as Bruno Latour, who conducted ethnographic studies of practicing scientists. Having observed numerous examples of how social factors—the ideological beliefs of scientists, for example—can shape scientific findings, Latour concluded that science is largely a social construction rather than an objective means of acquiring accurate knowledge.[30]

As a result of these challenges to the validity of ethnographic fieldwork and to the objectivity of the scientific method in general, most contemporary cultural anthropologists have largely abandoned any attempt to quantify the behavior of people living in different societies and to scientifically test hypotheses concerning behavioral variation. Seemingly accepting the criticisms fully, many ethnographers do not now claim to be conducting scientific research and make no claims of even trying to achieve objective findings, instead producing subjective and qualitative descriptions ("thick descriptions") of people's lives in particular social contexts.

The social constructionists and others have valid points: of course the assumptions of the ethnographer will affect their conclusions, the act of observing may well affect those being observed, and nobody

who has had firsthand experience of working in a university science department will deny that social factors play some role in the scientific process. But this does not mean that ethnography cannot ever be scientifically useful, that insights cannot be gained from quantitative studies of human behavior, that cross-cultural comparisons are meaningless, and that science is entirely subjective. There are many ways of reducing the likelihood of subjectivity and bias in observational studies. Field biologists, for example, who have produced thoroughly scientific observational field studies of nonhuman animal behavior, get around the problem of observer bias by using multiple observers, some of whom are blind to the hypothesis under study, then quantifying the interobserver reliability (the extent to which different observers' observations agree). And if observer bias *is* detected, then statistical techniques can be used to correct that bias.[31] Regarding the social constructionists' criticism that social factors influence the scientific process, while this may be the case, ultimately the objective tools of the scientific method—hypothesis testing, falsification, replication, quantitative statistical analyses, and so on—result in a much more accurate understanding of the world than the nonscientific alternative of compiling subjective and superficial descriptions of people's lives.

Culture Is Not Static. Other branches of the social sciences that are fully scientific and methodologically rigorous, including economics, social/cultural psychology, and much of sociology, suffer from a different problem. These disciplines often treat culture as a static background variable that influences certain aspects of human behavior, rather than as something that itself changes and is itself a product of human behavior. Take cultural psychology, for example. As noted above, much recent research has demonstrated that what were once thought to be psychological universals are actually characteristics that are specific to Western countries. Many of these differences relate to quite fundamental psychological processes, such as the way that people view objects and attribute causes to behavior. Whereas Westerners tend to focus on individual objects in a scene and explain behavior in terms of stable dispositions, people who grew up in East Asian countries pay more attention to the relations between objects and explain behavior more in terms of social relationships. As argued above, patterns of immigration show that such differences cannot be attributed to genes or individual learning: they are cultural differences. Yet this still leaves much to explain: how exactly does "culture" give rise to these differences?

Many explanations of cultural variation given by cultural psycholo-

gists tend toward the descriptive. For example, the thinking of Westerners is labeled as "analytic," while that of East Asians as "holistic." Western selves are described as "independent" while East Asian selves are described as "interdependent."[32] While these labels are useful for connecting related findings under umbrella categories, they do not really explain the origin of these differences. Occasionally, historical scenarios are proposed as explanations of current cross-cultural variation. It has been argued, for example, that Eastern thinking is holistic because East Asian societies are more collectivist, which in turn is because the ancient Chinese agricultural system of rice farming necessitated the cooperation of large numbers of people. The analytic thinking that developed in the West can be attributed to a more individualistic Western European society, which originated in the ancient Greek farming methods of herding and fishing, which were more solitary activities.[33] However, these historical scenarios are still quite descriptive and speculative, and they fail to specify exactly how agricultural practices translate into psychological traits, or the transmission mechanisms by which these traits have persisted over successive generations.

Economists Richard Nelson and Sidney Winter have long made a parallel argument concerning economics.[34] Mainstream economics, they argue, is unrealistically focused on static equilibria. A typical economic model specifies a set of decisions that a firm can carry out in response to a set of external conditions, such as supply and demand in the market, and internal conditions, such as stock levels, assuming that firms are attempting to maximize profits. Rigorous mathematical modeling techniques can be used to determine the static equilibrium, or stable state, of the economic system at which all economic forces balance out, such as when supply matches demand. While such equilibria describe real economic conditions reasonably well at a single point in time, Nelson and Winter argue they are not so good at explaining changes in economic systems over time. Economic growth that is driven by technological change is particularly poorly described by static equilibria, given that technology such as telecommunications and computing exhibit continual growth and change. The inability of economists to foresee the 2007 global recession is a forceful reminder of this limitation. Again, a way is needed of combining the rigor of economic models with a proper treatment of change over time.

Disciplinary Fragmentation. An adequate understanding of culture is also hindered by the fragmentary structure of the social sciences. There is little exchange of theories and findings between economists, sociolo-

gists, linguists, historians, psychologists, anthropologists, and archaeologists. In many cases these disciplines hold mutually incompatible assumptions. In other cases, different disciplines end up reinventing concepts from scratch that other disciplines have known about for years, because of the lack of communication. This should not be the case, if every social science discipline is supposed to be studying the same phenomenon—culture—and it is certainly not conducive to scientific understanding.

Compare this situation to that of the biological sciences, which for decades have been unified under a single theoretical framework: Darwinian evolutionary theory. Each branch of biology, from field studies to laboratory experiments to mathematical models to the study of the fossil record, is united by a unifying theory with a shared set of common assumptions. As a result, there is frequently the mutually productive exchange of ideas, theories, and methods across these branches: an experimentalist might, for example, try to recreate in the lab the pattern of "punctuated equilibria" observed in the fossil record (i.e., long periods of stasis interspersed by brief periods of rapid biological change) in order to better understand the underlying processes that drive it. A field biologist might measure the strength of natural selection in a wild population in order to check the validity of mathematical models of selection, after which the modelers revise and improve their models.[35] This back and forth both within and across subdisciplines has resulted in huge progress in biologists' understanding of biological change and diversity, which would not have been possible in the absence of a common, unifying theoretical framework.

Conclusion: Culture Is important, But Inadequately Studied

So despite the importance of culture in shaping various aspects of human behavior, there are several problems with the way in which culture is studied and conceptualized across the social sciences, such as the lack of quantitative, formal methods and scientific hypothesis testing, the treatment of culture as static rather than dynamic, and a general lack of communication of findings and methods across different branches of the social sciences. In the chapters that follow, I argue that the theory of cultural evolution, based on the premise that culture evolves according to similar Darwinian principles as do biological species, provides solutions to all of the problems just outlined: it fully recognizes the role of culture in explanations of human behavior; it provides formal, quantitative methods that can be used to explain

cultural phenomena in a way that explicitly incorporates change over time; and it provides a common theoretical framework around which the different branches of the social sciences can be synthesized. The next chapter introduces the basic theory of cultural evolution and the evidence supporting this theory.